January 2017

Winnicentrics

The Newsletter of the Winnipeg Centre of the Royal Astronomical Society of Canada

Regular meetings of the Winnipeg Centre are held in the Robert B. Schultz lecture theatre in St. John's College at the University of Manitoba. The theatre is on the lower (basement) floor of the College. Meetings are usually held on the second Friday of each month from 7 p.m. to 10 p.m. After the meetings, members who wish to do so usually retire for pizza and more conversation about astronomical subjects. The June meeting is not held at St. John's College but is instead a barbeque at either a member's house or at Glenlea.

Meeting dates and meeting places may be adjusted during exam times and during Bomber home games or stadium events.

Upcoming Events

Next meeting
January 13, 2017

Venus at Greatest Elongation
(47 degrees) East
January 12

Members' Observing Night
January 14

Mercury at Greatest Elongation
(24 degrees) West
January 19

January 21
Potluck dinner:
Jay & Judy Anderson
189 Kingsway Avenue

January 25
U of M Open House
6:30 pm
394 University College

January 28
New Moon

January Meeting Schedule

7:00 pm: Beginner's Session:
"The Moon and Tides" - Mick Rice

7:30 pm: Regular session
Announcements - Jay Anderson
What's Up? - Bryan Stach
Printing Astro Images - Kevin Black
Centre Elections

8:30 pm: Break for coffee and refreshments
(donations gratefully accepted)

9:00 pm: Guest Speaker, Dr. Ed Cloutis: "The OSIRIS-REx asteroid sample return mission and Canada's role"
Outline:
The OSIRIS-REx asteroid mission is a joint NASA-Canadian Space Agency endeavor that will bring a piece of a primitive near-Earth asteroid to Earth for analysis. Canada is contributing a laser altimeter to the mission as well as providing a Canadian science team that will be involved in all aspects of the mission and subsequent sample analysis. This talk will describe the mission, its timeline and Canada's role.

10:00 pm: Pizza at Boston Pizza

Midwinter Potluck Dinner

The annual midwinter potluck dinner will be held on January 21 at Jay and Judy Andersons' place. Bring along something to eat and drink, instruments to play, and Christmas toys to show off. A bag for your boots will be useful, too. This event is for Centre members and guests. Children are welcome.

Place: 189 Kingsway Avenue (near Kelvin High School)
Time: 6:30 and onward

WHO, WHERE, WHEN?

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Winnicentrics is published 10 times each year by the Winnipeg Centre, RASC. Winnicentrics is produced by and for the members of the Winnipeg Centre. Any opinions expressed are those of the author. If you have comments, questions, or concerns about Winnicentrics, you can contact any of the councilors above, or write to:

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Editor's Message

Welcome to the first issue of 2017!

It is my pleasure to be your new editor and I wish to thank the Council for this opportunity. I'm also very fortunate that Abdul Al Manni has volunteered to help me compile the content of Winnicentrics. A special thanks also goes out to Tami Reynolds for her assistance in helping proofread and also providing a must read book review in this issue.

I consider myself to be extremely fortunate to have found the Winnipeg RASC almost 20 years ago. From the very first meeting, I felt welcomed. In fact, I still remember the presentation that night—it was Jay Anderson discussing how to observe Jupiter. Wow, I was home!! Since then, I am proud to say that many of my closest friends are also RASC members. Yes, our Centre is a special place indeed.

2017 will prove to be an exciting year for amateur astronomy. How could it not, thanks to the total solar eclipse in August? We are anticipating that this event will generate a lot of interest in both solar observing and photography, and I'm sure our Centre will be called upon to help educate the public on how to observe this event safely.

We also are in the process of establishing two dark sky preserves—something that has never happened before in our province. Work is well underway with both of them, and we will keep you up to date on their progress in future issues.

In this issue, I have created a new column entitled "Classical Glass," which is dedicated to classic telescopes and eyepieces of yesteryear. The only prerequisite is that these instruments are no longer in production. If you happen to be among the fortunate few to still have one of these beauties, consider submitting an article as we would love to read about them!

We are very fortunate to have many talented members in our Centre who are willing to share their knowledge. One of which is Kevin Galka - an accomplished astrophotographer who has contributed an article in the issue on remote imaging and telescope use. Thanks very much Kevin!

Of course, the strength of our newsletter is dependent upon its content. If you've read a good book (astronomy related of course!), built an observatory or purchased a piece of equipment that you'd like to write about, please contact either Abdul or myself. We would be interested in including it in a future issue.

Happy New Year and Clear Skies,

Mike Karakas

Telescopic Observations of Venus

Mike Karakas

No one can miss seeing the bright "star" in the early evening sky these days. Venus is unmistakable as the brightest object visible. If you happen to be at a dark sky site, it will even cast shadows on the ground.

Venus also happens to be at its highest elongation this month, making it a good time to conduct visual observations of this planet. However, be forewarned that because of its brilliance, it might be more of a challenge than you first thought!

Experienced planetary observers have commented that when Venus is at its current magnitude, it's actually *harder* to observe it than at other times. Daytime observations typically provide much better results. Why? In a word - contrast. Venus is so bright against a black sky that even the most perfect optical system may experience some false colours and flare - not only because of its brightness but also because it's still relatively low to the horizon, and subject to more atmospheric turbulence than objects at a higher elevation. Adding these factors together makes visual observation more difficult.

The stark contrast between the bright planet and surrounding sky is too strong for any subtle cloud features to be detected with our eyes alone. What we need is a way to "dim" the planet and reduce this contrast. Fortunately, there is a way to do so, and you might have that tool in your eyepiece case already.

Variable density polarizers (which you would typically use on the Moon) can be a very effective way to control the contrast and perhaps glimpse those subtle features. In fact, our own Gerry Smerchanski has used this filter to effectively "dial in" the right balance of contrast to observe faint, dusty markings of the planet's atmosphere when the seeing conditions allowed. These markings are very elusive and it is a real accomplishment to actually see them.

In addition to a variable polarizer, other useful eyepiece filters are #47 violet and #38A dark blue. These filter colours are best suited for upper atmospheric study and can be used on Jupiter as well. Because they are deeply coloured, the general rule of thumb is that they are more suitable for apertures greater than 6". Don't despair if you have a smaller scope though - I still have used them successfully on 4" scopes as well, but just expect a darker image. Fortunately, colour eyepiece filters are quite inexpensive and are a worthwhile investment for planetary observation.

If you'd like to try to image Venus, those same filters could be used as well. Many successful planetary imagers have used both UV and IR filters with excellent results. These specific filters do cost more than the colour ones for visual use, but the results seem to be worth the expense.

Another useful accessory that I have been playing with recently is an Atmospheric Dispersion Corrector (ADC). When viewing objects lower on the horizon, we are looking through more atmosphere. Wavelength of light are being more dispersed through this thicker layer of air, with blue light dispersed differently than red. This results in a objects having a blue tint one side and red tint on the other (this false colour was mentioned earlier). The brighter the object, the more pronounced the effect, and the larger the telescope the worse this chromatic condition becomes. I have found that Venus is particularly prone to this problem, but when I use this corrector with my 8" maksutov, the problem vanishes. I won't go to an exhaustive review of my ADC here, but it has proven to be very useful accessory and I won't observe Venus without it now. Perhaps I'll do a review of my particular ADC in a future issue.

Now having armed yourself with the right tools, be patient with your observations. Venus is a tough target and takes time to study, so don't give up if your early attempts are unsuccessful. Try observing Venus just after sunset and see how compares to observing it against a darker sky.

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Telescopic Observations of Venus (continued)

Remember, elusive features do not reveal themselves easily and excellent seeing conditions are required. If you store your telescope indoors, don't forget to allow it time to cool down to the outdoor air temperature before attempting any serious observing. Otherwise heat dissipating from the telescope tube will introduce unacceptable heat currents, making accurate observations virtually impossible. Plan ahead because this can take anywhere from 30-45 minutes for a refractor and as long as 2 hours for a Newtonian or SCT. A better idea would be to store your scope in a unheated garage or gazebo so that it's ready to go.

Aside from seeing faint markings, another interesting subject of study is the famed "Schröter Effect", named after Johann Schröter who first documented this anomaly in 1793. Simply put, it's the discrepancy between when the predicted date of dichotomy (the date when Venus would have a straight terminator or "half moon" phase) differs from when it is actually observed.

For reference, here are some dates to remember for Venus this month:

- 12 Jan 2017 09:52 CST – Venus at greatest elongation east
- 14 Jan 2017 07:13 CST – Venus at dichotomy (predicted date of "half moon" phase)
- 17 Feb 2017 01:29 CST – Venus at greatest brightness

As you can see, the date of dichotomy and greatest elongation does not occur exactly on the same date. But what is even more interesting is how much the date seen of the Schröter Effect and the predicted date of dichotomy varies - by as much as 7 or 8 days for Venus (and 5 days for Mercury). For evening elongations (eastern), it usually arrives early so start your observations a week before January 14th if possible.

What would cause this curious effect? Unfortunately, no one knows for certain. It was once believed that this condition may be due to sunlight being diffused through the planet's dense atmosphere, but this dichotomy anomaly has also been documented on Mercury, which we know does not have an atmosphere. Other theories have suggested that it may be a combination of optics, sky conditions present at the time of observation, filters used or the actual experience of the observer. It's still a mystery that exists from the time it was first observed over 200 years ago.

Amateur astronomers have estimated the time of dichotomy for decades using just a telescope and eyepiece, making it an ideal project as no special equipment is required.

Observing planets can be done right from your backyard without worry of light pollution, so take your time and enjoy the experience. Your warm house is nearby and you don't have to endure that long car ride home during the wee hours of the morning to get back to your bed!

Classical Glass

A Baby Blue Refractor

Mike Karakas

Classic telescopes… ahh, you gotta love them. There is just something special about how they look, how they feel. Many amateur astronomers are like car collectors – some of us just love the classics.

A number of names come to mind when I think of classic telescopes – Unitron, Cave, Criterion, Clark and Meade Research Grade but there are many others.

Haven't heard of them before? Well you're not alone - especially if you are new to the hobby. This column is really meant for you then, so that you can enjoy a trip back to the past and gain an appreciation for these forgotten beauties.

To further add to their attraction, many have optics superior to what we see now with commercially made telescopes, making them a wonderful purchase when they do pop up for sale on the used market.

I have seen many lovely classic scopes owned by members since joining the Winnipeg RASC. However, I have never seen a Winnicentrics column dedicated to these instruments of yesteryear … until now.

It is my hope that this first entry in the column will inspire others to do the same for their own classic scopes. So c'mon – tell us what you've got!

<u>94mm Brandon Apochromatic (APO) Refractor</u>

My classic telescope was manufactured by a company called VERNONscope & Co. in Candor, New York. Although it began manufacturing several smaller refractors and eyepieces in its early years, the production of their 94mm Brandon APO refractor did not begin until 1997. And in case you were wondering, its name came from 20th century optical designer, Chester Brandon.

For the next 3 years, VERNONscope sold only 100 tube assemblies with polished white enamel and another 400 sky blue or "robin egg" versions. This blue colour is truly unique in the telescope community and easily distinguishes itself from others in the crowd.

The first 50 telescopes off the production line were erroneously marked with 92mm instead of the correct designation. Unfortunately, VERNONscope never placed serial numbers on any of their Brandon scopes, so it's difficult at best to know what year a given telescope was produced. However, there are some subtle clues to help determine their vintage. For example, the early models came with a collimatible lens cell. The later ones came with a fixed lens cell. Based on this information, it's reasonable to conclude that my particular scope must have been produced in either 1989 or 1990.

VERNONscope used components from the Tokyo based optical firm of Nihon Seiko Kenkyuso Ltd., the same company that supplied Unitron with its telescopes. But this telescope's true claim to fame came from its cemented, triplet objective lens cell – engineered and manufactured by the infamous Roland Christen of Astro-Physics. And it was this lens which garnered so much attention from the amateur astronomer community. Because of this high optical quality, the Brandon rivaled the best apochromatic telescopes produced in its day.

With the resounding success of the 94mm APO refractor, VERNONscope decided to introduce a slightly larger 130mm (5.1-inch) F/8 version. Virtually identical in construction to its smaller companion scope, the 130mm used a modified optical system with a Starfire triplet objective lens.

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A Baby Blue Refractor (continued)

Following the color scheme of the 94mm, about 80 sky blue and 20 white optical tube assemblies were sold. Quality craftsmanship came at a price; the basic "bare-bones" 94mm Brandon APO cost the amateur astronomer $1,295 US in the late 1980s. On today's secondary market, the 94mm Brandon has held its value remarkably well, often exceeding the owner's original cost for units in excellent condition.

Holding the Brandon – its design is unmistakable. They are built like a tank with a hefty feel. The focal ratio is a reasonable fast F6.8 yielding a focal length of 680mm, making it an ideal instrument for wide field, Milky Way cruising.

As an added bonus, the dewshield and focuser can be unscrewed. This transforms the scope into a very transportable package – ideal for airline travel.

If I were to name a mechanical downside of this telescope, it would have to be the focuser. Perhaps they worked fine when first produced, but my particular model has too much play in it for any serious focusing work. After tweaking it for years, I was delighted to discover that Starlight Instruments makes a Feathertouch focuser which can replace that old focuser. The tough part is waiting for it to be delivered!

94mm Brandon APO Refractor
(with original focuser)
On Vixen GPDX mount

On the optical downside, despite being excellent in its day, the Brandon's color correction can't match that of today's modern apochromats. Minor colour fringing is apparent when viewing very bright objects like Vega or the lunar limb, while top apochromats yield a perfect image without a hint of any chromatic aberration.

That aside, I have found that the Brandon excels in both widefield viewing and imaging. I could not see any vignetting at the corners of the frame when using either a 35mm single reflex film camera or a cropped sensor DSLR.

Visually, seeing the entire North American / Pelican Nebula in a low power eyepiece is no problem. The entire Veil Nebula, again no problem. Stars are perfect pin points of light that just sparkle when viewed. Open clusters are a real treat. One of my favorite objects to see in this scope has to be M27 (the Dumbbell Nebula). It's in a particular rich swath of the Milky Way so to see the nebula swimming in a sea of sparkling stars … oh yeah, that's one lovely sight!

But low power viewing isn't the Brandon's only use; it's no slouch at high magnifications either. During the 2003 Mars opposition on a night of exceptionally steady skies, it provided crisp, clean planetary views at magnifications exceeding 60x per inch of aperture – a very respectable feat by any optical standard.

So, there you go folks. Hope you enjoyed this first installment. I look forward to reading about your classic scope very soon!

Online Telescopes

Kevin Galka

As we all know life doesn't always go according to plan, and it was one such unexpected situation that led me to unloading most of my telescope gear. That was many months ago, and for the most part I didn't have the opportunity to miss it… but things are beginning to right themselves and as of late I have found my mind wandering to astronomy once again. There can be many reasons we can't get out into the field and this was mine, but who am I kidding, there's also no chance I'm going out when it's minus -27C before wind-chill regardless if I have the gear or not!!!!

This led me to thinking of other ways to get my astronomy fix. Sure, there are plenty of magazines and online articles to read, you can even contribute to research sometimes by combing through data, but I was looking for something else. For me personally, while I love the science of astronomy, it's the aesthetics that keeps me so entranced. There's something magical about grabbing your own data, sitting down to process it and seeing the final image… but how to do that without having my own telescope? Through the internet, that's how!!!

There are several online telescope sites if you do a google search. Some are as simple as just watching live feeds through telescopes while others offer more options such as pointing to objects and taking pictures. Several of these sites are free but most of them require a membership of some type, where introductory memberships give you access to see what the scopes are currently pointed at and more premium memberships allow you to book time on a telescope. I'm going to be discussing one such site now, the pros and cons and my overall conclusions.

Slooh.com:

Years ago, during one long cold winter I did a search for online telescopes. At that time the choices were far less than now, and I ended up joining a site called Slooh.com. I was happy with them at that time and I decided I'd join again.

Costs:

There are currently two levels of membership available on Slooh, a "Community Membership" for $4.95US/month and an "Astronomer Membership" for $24.95US/month. The two main differences between them are the Community Membership allows you to make 5 reservations with the telescopes per month, while with the Astronomer Membership you have unlimited reservation amounts (though you can only have 5 booked at one time). The other main difference is that the Astronomer level allows you to save .fits files of your images while the Community level can only save .png images. Both memberships allow you to watch live shows and special events, and live views of the current telescope object, plus any images you did take are stored online for you to look at and download. For myself, I went with the Astronomer Membership as I really enjoy working with the fits data and I'm able to take a fair number of images.

Observatories:

Slooh current has two main observatories. The main one is on Mt. Teide in the Canary Islands, located around 28 degrees north. The other is in La Dehesa, Chile, located around 33 degrees south.

Canary Islands consists of two domes:

Dome 1: 20" f6.8 Dall-Kirkham scope with an FOV of 37x37 arc minutes. I'm unsure of the camera type but the resolution is 3056x3056 pixels.

Dome 2: 17" f6.8 Planwave scope with an FOV of 43x43 arc minutes. The camera used is a FLI Proline PL16803 with a resolution of 4096x4096 pixels. They also have an 85mm f5.6 apochromatic refractor with an FOV of 1.78 x 1.2 degrees. The camera used on it is an SBIG ST10XME with a resolution of 2184x2184 pixels.

Chile consists of one dome:

Dome 1: 14" F11 Celestron C14 with an FOV of 32x22 arc minutes. The camera is an STL 11000M with a resolution of 4008x2672 pixels.

The website states that there are two scopes in the Chile dome but I haven't yet seen images from the second scope… it's supposed to be a wide field scope. Besides the two main observatories, they partner with a number of other observatories around the globe to cover special events, such as asteroid occultations or eclipses, which you can watch live.

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Online Telescopes (continued)

How does it work?
I was planning on doing an in-depth coverage of the site, but there is going to be an entire overhaul that's supposed to happen on February 1st. In its current state, this is how it's setup:

The main area of the website is called the LaunchPad. Overall, it's a very straightforward, clean interface that's easy to use and pretty much everything can be done from here.

The website is broken into 5 areas. The main area is where you select the dome/scope that you want. Here you can see the current observatory time, see a live feed of the scope and check the current weather conditions.

The "Reservations" section shows the up and coming targets that you've scheduled, which scope it will be with and the date. You can schedule new targets from here.

The "Upcoming Missions" section shows the next 4 targets/missions of dome you have selected, what time they will be taken and who scheduled them.

The "Pictures" section shows your 5 most recent images and has a link to the "My Pictures" area which is where all your images are stored and from where you can download them.

At the bottom is "Live Updates", which is a news feed for anything important and a current status indicator for the domes.

As an Astronomer level member, I can schedule up to 5 targets from any of the 3 scopes. I click Reservations for either Chile or Canary Islands. From there I'm taken to a schedule of available time slots and I simply choose the time I want. I then select a target… I can choose from a drop down list of targets, enter my own target such as an NCG or Messier object or I can enter the RA/DEC coordinates. From this section you can also choose how you'd like the image to be processed if you don't wish to process the fits files yourself, or if you don't have access to the fits files. During special events you can watch the live feed from the LaunchPad which is usually accompanied with audio from Bob Berman (from Astronomy magazine).

Pros and Cons:
There are both pros and cons to this site and this technology in general. One of the pros can also be considered a con… and I speak of being able to sit inside your home while imaging. Sure it's great but you also don't get out under the stars to enjoy just looking up. Even those with personal observatories will still get outside, start up the scope and either sit down at the eyepiece or the computer and begin their night. With Slooh I just schedule my targets during the day and see what I have the next day.
Pro: Most us don't own equipment like this! Having access to a 20" or 17" scope with a high end ccd is fantastic.
Con: You're limited to the length of exposure you want. With the 17" and under scopes the length is 50 seconds on the luminosity frame and 20 seconds in each of the RBG frames. You can take multiple images of the same target and stack them but this can take a long time. I haven't captured an image with the 20" yet so I don't know the break down of time on each of the frames.
Pro: Location! 33 degrees south with the Chile observatory gives you access to all those southern objects we can only dream about from up here in the great white north.
Con: Sometimes the image that you take doesn't show up in your "My Pictures" section even though you received an email about it being successful… I do want to mention that I've talked to support about this and they said that the new rollout is supposed to fix this issue.
Pro: All your flats and darks are applied
Con: Sometimes the flats aren't applied correctly
Pro: You get to work with the fits data

Overall Impressions:
There's a lot I like about this site and online telescopes in general, but the magic of heading out with my own equipment is missing. In the middle of a winter deepfreeze it's fantastic to sit in a warm house and image, but once it gets a little milder out I will definitely miss those nights under the stars. One last PRO before I go: if life in general gets in the way of you being able to get out all night long under the stars, this is a great way to keep in touch with the universe.

Book Review

Rise of The Rocket Girls: The Women Propelled Us, from Missiles to the Moon to Mars

Author: Nathalia Holt

When we think of rockets or space exploration, we often picture the excitement and tension of the "control room" and I am betting you visualized a room filled with men and can easily name key men associated with the missions. Although not well known until the release of this book, *Rise of the Rocket Girls* and now the book and movie, *Hidden Figures*, women also have played a pivotal role in U.S. rocketry and space exploration. The women recruited in the 1940s and 1950s were initially known as "the human computers" who analysed complex mathematical equations using only a pencil and paper at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. They were responsible for all the critical mathematical calculations that powered early missiles, rocketed heavy bombers over the Pacific, launched America's first satellite, guided lunar missions and planetary explorations, and even navigate Mars rovers today. As an example, the first woman working at JPL as a human computer, Barby Canright, filled more than 20 notebooks in a month with raw data from the rocket tests as well as equations and calculations including thrust-to weight ratios to assist in developing the first rocket plane – a jet-assisted take-off by a Douglas A-20A bomber.

As the demand grew, more women were hired. In the 1950s, they worked with engineers on hypergolic propellant (a combination of fuel and oxidant that ignite on contact) for guided-missile systems which two decades later, would fill the tanks of the Project Apollo launch vehicles. They undertook pioneering analysis on how the barrier of Earth's atmosphere might impact a fast-moving projectile when calculating the trajectory of a two-stage rocket, useful years later in calculating the heat caused by re-entry for space missions. The tools of the trade were a pencil, paper, a slide rule, a Friden calculator and the Mathematical Tables Project series (filled with logarithms, exponential functions and trigonometry). The pencil and paper lines of commands were the forerunners of the code for the later computer programs.

This book is a recommend read if you would like to understand how the mathematical "code" written by these women continues to work its way into current spacecraft, navigation and climate study systems. It is worth your time if you are interested in an inside look at their personal world while getting a sense of the political realities, such as the effect of paranoia about Communist scientists. The challenges of gender and race constraints are also highlighted as being a computer was like a secret back door into engineering for women of all races. The first African-American woman, Janez Lawson, was hired in March 1952. The contributions of many of the women are highlighted based on interviews with JPL staff, the ladies themselves and appropriately referenced.

The last of the initial rocket women, Sue Finley - the longest serving woman of the American space program, recently retired after seeing the Juno spacecraft orbiting Jupiter last July as her final mission. Their legacy truly has been written in the stars as their work has enabled Voyager spacecrafts to travel further than any ~~man~~ human - made object to date. Today, women fulfil roles as engineers, mission control managers and scientists thanks to the on-going efforts of these amazing women.

Tami Reynolds

Member's Gallery

Omega Centauri, imaged remotely from Chile with a C14 SCT telescope and an SBIG STL-11000M ccd camera.

Photo by Kevin Galka

Horsehead Nebula, imaged remotely from the Canary Islands with a PlaneWave CDK17 telescope and a FLI ProLine PL16803 ccd camera.

Photo by Kevin Galka

Member's Gallery

NGC 2024, The Flame Nebula with the Horsehead

Photo by Alan Macklem

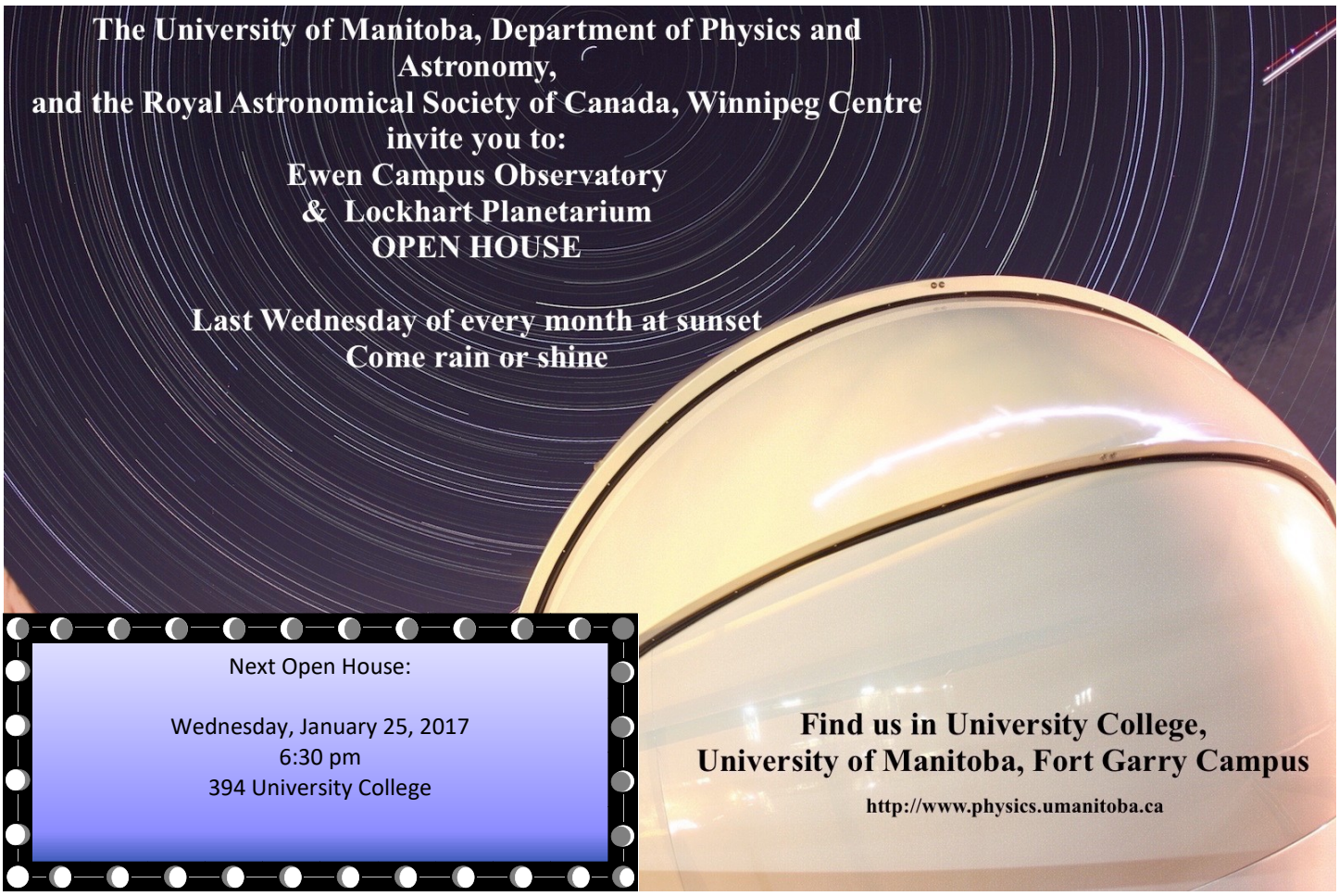
M42,The Great Orion Nebula with the Running Man Nebula (upper left)

Photo by Alan Macklem

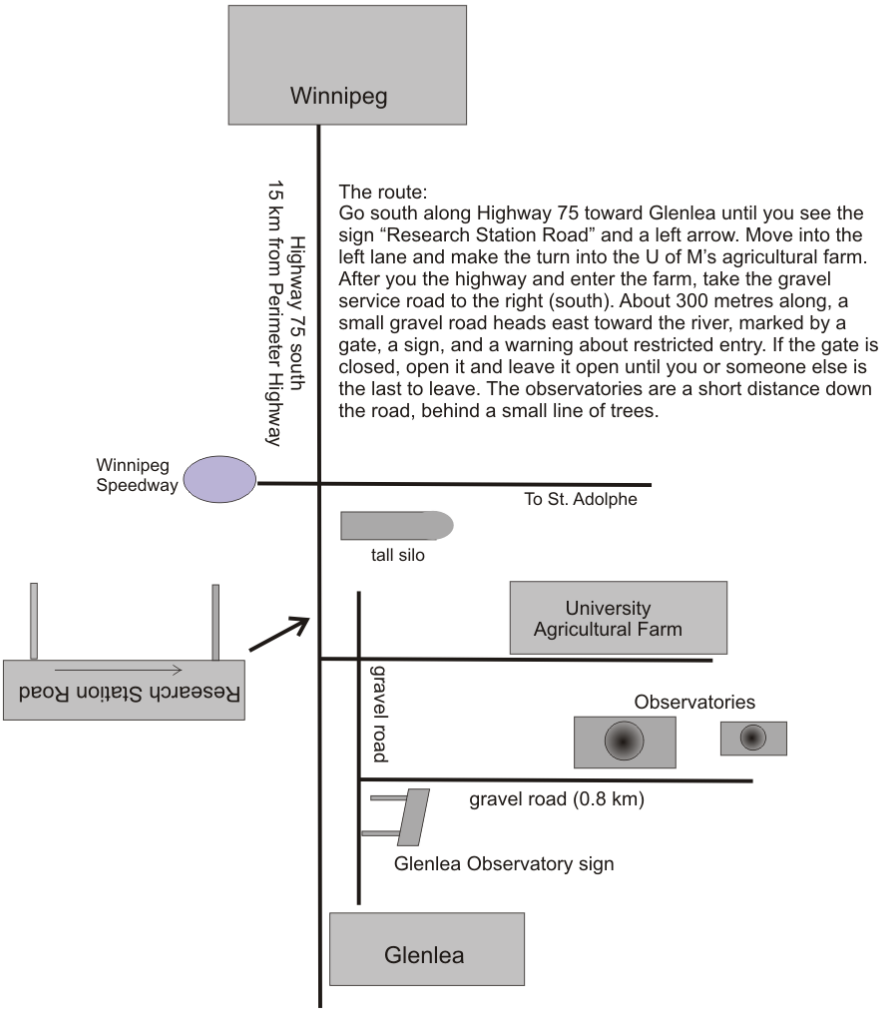
Member's Gallery

M31, the Andromeda Galaxy

Photo by Richard Konrad



Finding the Observatory

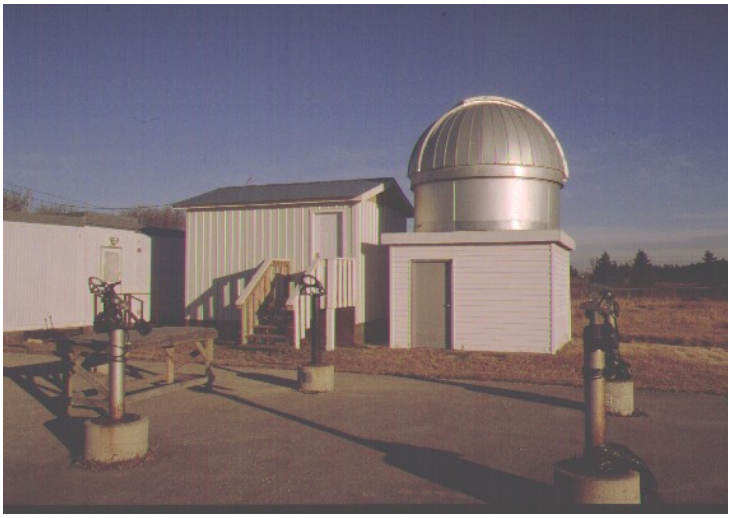


The Winnipeg Centre maintains a working observatory and warm room at the University of Manitoba's Research Farm. The observatory contains a 30 cm Meade telescope on a fork mounting. Members of the Centre may sign out the use of this telescope provided they have first taken a short instruction course on its use.

The Meade provides outstanding views of the night sky. Its large aperture collects more than 1800 times as much light as the human eye. It is capable of magnifying more than 500 times under favourable conditions.

The warm room provides a convenient place for members to take refuge from winter temperatures and summer mosquitoes, or to wait out a passing cloud. The building also provides desk space and lighting for planning a night's observing session. A cement pad in front of the warm room and observatory provides a convenient space to place members' telescopes while conducting personal observing programs.

Etiquette requires that you approach the observing site with your headlights off if that's possible on your model of car. Headlights should remain off, but you can still use your parking lights to drive. Proceed slowly, and be careful about parked cars along the road, or people walking. If you cannot turn off your headlights, make a cardboard or garbage bag mask to dim the lights. You might wish to turn around at the end of the road so that you are facing the direction back toward the highway at the end of the evening.



Remember to close the gate if you are the last one to leave.

Please contact Bryan Stach for observatory bookings.