

POLARIS



Royal Astronomical Society of Canada London Centre Newsletter February 2017

Binary and Double Stars

Information from Wikipedia, Edited By Norman McCall

Binary Stars

A **binary star** is a star system consisting of two stars orbiting around their common barycenter (centre of mass). Systems of two or more stars are called multiple star systems. These systems, especially when more distant, often appear to the unaided eye as a single point of light, and are then revealed as multiple by other means. Research over the last two centuries suggests that half or more of visible stars are part of multiple star systems.

The term **double star** is often used synonymously with binary star; however, double star can also mean optical double star. Optical doubles are so called because the two stars appear close together in the sky as seen from the Earth; they are almost on the same line of sight. Nevertheless, their "doubleness" depends only on this optical effect; the stars themselves are distant from one another and share no physical connection. A double star can be revealed as optical by means of differences in their parallax measurements, proper motions, or radial velocities. Most known double stars have not been studied sufficiently closely to determine whether they are optical doubles or they are doubles physically bound through gravitation into a multiple star system.

Binary star systems are very important in astrophysics because calculations of their orbits allow the masses of their component stars to be directly determined, which in turn allows other stellar parameters, such as radius and density, to be indirectly estimated. This also determines an empirical mass-luminosity relationship (MLR) from which the masses of single stars can be estimated.

Binary stars are often detected optically, in which case they are called **visual binaries**. Many visual binaries have long orbital periods of several centuries or millennia and therefore have orbits which are uncertain or poorly known. They may also be detected by indirect techniques, such as spectroscopy (spectroscopic binaries) or astrometry (astrometric binaries). If a binary star happens to orbit in a plane along our line of sight, its components will eclipse and transit each other; these pairs are called **eclipsing binaries**, or, as they are detected by their changes in brightness during eclipses and transits, photometric binaries.

If components in binary star systems are close enough they can gravitationally distort their mutual outer stellar atmospheres. In some cases, these close binary systems can exchange mass, which may bring their evo-

lution to stages that single stars cannot attain. Examples of binaries are Sirius, and Cygnus X-1 (Cygnus X-1 being a well-known black hole). Binary stars are also common as the nuclei of many planetary nebulae, and are the progenitors of both novae and type Ia supernovae.

Double Stars

In observational astronomy, a **double star** or visual double is a pair of stars that appear close to each other in the sky as seen from Earth when viewed through an optical telescope.

This can happen either because the pair forms a binary star, i.e. a binary system of stars in mutual orbit, gravitationally bound to each other, or because it is an optical double, a chance alignment of two stars in the sky that lie at different distances. Binary stars are important to stellar astronomers as knowledge of their motions allows direct calculation of stellar mass and other stellar parameters.

Since the beginning of the 1780s, both professional and amateur double star observers have telescopically measured the distances and angles between double stars to determine the relative motions of the pairs. If the relative motion of a pair determines a curved arc of an orbit, or if the relative motion is small compared to the common proper motion of both stars, it may be concluded that the pair is in mutual orbit as a binary star. Otherwise, the pair is optical. Multiple stars are also studied in this way, although the dynamics of multiple stellar systems are more complex than those of binary stars.

Types of Paired Stars

There are three types of paired stars:

- **Optical Doubles** are unrelated stars that appear close together through chance alignment with Earth.
- **Visual Binaries** are gravitationally-bound stars that are separately visible with a telescope.
- **Non-Visual Binaries** are stars whose binary status was deduced through more esoteric means, such as occultation (eclipsing binaries), spectroscopy (spectroscopic binaries), or anomalies in proper motion. (astrometric binaries)

Improvements in telescopes can shift previously non-visual binaries into visual binaries, as happened with Polaris A in 2006. It is only the inability to telescopically observe two separate stars that distinguish non-visual and visual binaries.

History

Mizar, in Ursa Major, was observed to be double by Benedetto Castelli and Galileo. The identification of other double stars soon followed: Robert Hooke discovered one of the first double-star systems, Gamma Arietis, in 1664, while the bright southern star Acrux, in the Southern Cross, was discovered to be double by Fontenay in 1685. Since that time, the search has been carried out thoroughly and the entire sky has been examined for double stars down to a limiting apparent magnitude of about 9.0. At least 1 in 18 stars brighter than 9.0 magnitude in the northern half of the sky are known to be double stars visible with a 36-inch (910 mm) telescope.

The unrelated categories of optical doubles and true binaries are lumped together for historical and practical reasons. When Mizar was found to be a binary, it was quite difficult to determine whether a double star was a binary system or only an optical double. Improved telescopes, spectroscopy, and photography are the basic tools used to make the distinction. After it was determined to be a visual binary, Mizar's components were found to be spectroscopic binaries themselves.

Observation of Double Stars

Observation of visual double stars by visual measurement will yield the separation, or angular distance, between the two component stars in the sky and the position angle. The position angle specifies the direction in which the stars are separated and is defined as the bearing from the brighter component to the fainter, where north is 0°.

These measurements are called measures. In the measures of a visual binary, the position angle will change progressively and the separation between the two stars will oscillate between maximum and minimum values. Plotting the measures in the plane will produce an ellipse. This is the apparent orbit, the projection of the orbit of the two stars onto the celestial sphere; the true orbit can be computed from it. Although it is expected that the majority of catalogued visual doubles are visual binaries, orbits have been computed for only a few thousand of the over 100,000 known visual double stars.

Distinction between binary and other double stars

Visual double stars may be distinguished from binary stars by observing their relative motion. If the motion is part of an orbit, or if the stars have similar radial velocities or the difference in their proper motions is small compared to their common proper motion, the pair is probably physical. When observed over a short period of time, the components of both optical doubles and long-period visual binaries will appear to be moving in straight lines; for this reason, it can be difficult to distinguish between these two possibilities.

Sir William Herschel – Double Starr Observer

One of the regrets of Herschel's life was that he was never able to devote sufficient time to the study of double stars. His observing was spread out in so many directions that inevitably one branch of his work suffered.

It was in 1767 that the Rev. John Nichell presented a paper to the Royal Society in which he suggested that there was a strong possibility that some stars lying near one another formed part of the same system. Herschel was intrigued by the idea and set out to find as many double stars as he could in his first review of the heavens between 1776 and 1781. The first catalogue containing 269 pairs was published in 1792. This was not the first collection as an earlier list of 69 pairs had been prepared by May-

er in 1781 and Herschel was concerned that some of the pairs had been seen previously.

The 269 pairs seen were divided into 6 classes according to separation with Class I being 0" – 4" and Class VI over 60". A second and larger catalogue of double stars was begun on at once and published in 1784. Here the measures were more complete and Herschel was very much more pleased with the results of his work.

Then followed a gap in his observation of double stars and the next we here was when Herschel presented a paper to the Royal Society on June 9th 1803. This paper discussed the changes that had occurred in the relative situations of double stars during the previous 25 years. Without reservation, he declared that "some stars must be allowed to be real binary combinations of two stars intimately held together by the bond of mutual attraction."

It must be remembered that the original idea for observing double stars was to determine parallax. Herschel had hoped to find stellar distances by means of measurements on double stars. In this he had failed. But he had discovered and proved instead the existence of binary systems and this was the supreme contribution that Herschel made in the field of double star astronomy.

Examples to Observe

Maybe the next time you are outside doing some astronomical observing you can take the time to take a look at some of the following examples.

Visual Binaries

- Acrux
- Alpha Centauri
- Capella
- ρ Eridani
- Polaris
- Procyon
- Sirius

Optical Doubles

- Alpha1 and Alpha2 Capricorni
- Theta Muscae and Theta Muscae B
- Eta1 and Eta2 Coronae Australis
- Kappa1 and Kappa2 Coronae Australis
- Winnecke 4 (Messier 40)

Uncertain

- Alpha Centauri system (AB) and Proxima Centauri (thus α Cen C): association is generally considered a physically connected system
- Castor system (Aa/Ab/Ba/Bb) and YY Geminorum (thus Castor Ca/Cb) is generally considered a physical system
- Mizar system (Aa/Ab/Ba/Bb) and Alcor (itself a binary, thus Mizar Ca/Cb, though generally not considered physical until 2009)

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Moon Phases



Last Quarter: February 18, 2017



New Moon: February 26, 2017

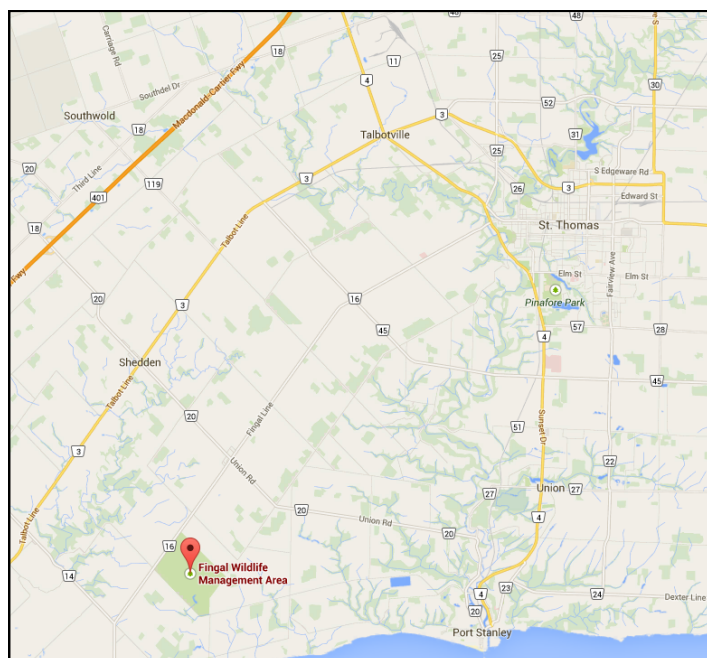


First Quarter: March 5, 2016



Full Moon: March 11, 2017

Fingal Dark Sky Observing Site



Sky Events for Late February and March

Monday, February 20 – Saturn 4° S of Moon
 Monday, February 27 – Mars 0.6° N of Uranus
 Wednesday, March 1 – Mars 4° N of Moon
 Thursday, March 2 – Ceres 0.8° N of Moon, occultation
 Sunday, March 5 – Aldebaran 0.2° S of Moon, occultation
 Friday, March 10 – Regulus 0.8° N of Moon, occultation
 Tuesday, March 14 – Jupiter 2° S of Moon
 Tuesday, March 14 – Venus at greatest heliocentric latitude



Mercury lost in Sun's glare as it passes behind the Sun and emerges mid-month
 Venus having achieved greatest latitude on the 14th, brilliant planet will be viewable in morning and evening twilight for a few days.
 Jupiter in retrograde motion throughout the month.
 Saturn low in the dawn sky in western Sagittarius.
 Uranus vanishes into the evening twilight late in the month.
 Neptune in conjunction with the Sun is too close to be seen all month. .



R.A.S.C. London Centre Library Books of the Month, February 2017 By Robert Duff

As always, these "Books of the Month" are available for loan to members, to be returned at the following monthly meeting. The books for February 2017 are as follows:

In Search of Time: Journeys Along a Curious Dimension, by Dan Falk. c2008.

The Science of Shakespeare: A New Look at the Playwright's Universe, by Dan Falk. C2014

365 Starry Nights: an Introduction to Astronomy for Every Night of the Year, text and illustrations by Chet Raymo. c1982.

For a complete listing of our library collection please go to the *Main Menu* on the left side of the *RASC London Centre* Web site main page and click on *Club Library*: <http://www.rasclondon.ca/library-and-rentals>

If there is a particular book or video you wish to borrow, please feel free to contact me by telephone at (519) 439-7504 or by e-mail at rduff@sympatico.ca

Donation to RASC London Centre

We wish to express our deepest thanks and appreciation for the donation from Matt Neima of his home-built 12-inch (30.5cm, f/5) Dobsonian telescope to the RASC London Centre, for use at Western University's Cronyn Observatory.

Patrick Whelan delivered it to the Cronyn Observatory on the evening of Thursday, February 9th, 2017, during and Exploring the Stars event and it was received by Everett Clark and Paul Kerans who placed it in the dome storage room where the London Centre's 25.4cm Dobsonian is also kept.

We are deeply appreciative of this donation from Matt Neima of his telescope to the RASC London Centre for use at the Cronyn Observatory.

Cronyn Observatory Public Night & Exploring the Stars Event, January 17th & February 9th 2017 By Robert Duff

Exploring the Stars, 1st Kerwood Scouts, Jan. 17th, 2017

Cloudy skies with rainy weather greeted 8 visitors (4 children and 4 adults / leaders) from the 1st Kerwood Scouts for Exploring the Stars at Western University's Cronyn Observatory, Tuesday, January 17th, 2017, 6:00 p.m. They were welcomed by graduate students Kendra Kellogg and Viraja Khatu. Kendra presented the digital slide presentation "*Life in the Universe*" and fielded questions. Kendra and Viraja followed this with the activity "*Telescope Kits*" with the Scouts assembling and testing simple telescopes from small reusable kits.

RASC London Centre was represented by Everett Clark, Paul Kerans and Bob Duff. Cloudy rainy weather ruled out opening the dome. When everybody arrived upstairs in the dome, Bob gave a talk on the history of the Cronyn Observatory and some of the technical aspects of the big refractor, using the 32mm Erfle eyepiece for demonstration. Bob pointed out the Schmidt camera and Cassegrain reflector telescope piggybacked on the big 25.4cm refractor and explained the difference between and refractor and reflector telescope, as Paul showed them the mirror in the London Centre's 25.4cm Dobsonian. Bob also explained the Standard and Sidereal Time clocks on the east wall.

Everett and Paul had set up the observatory's 8-inch (20.3cm) Meade Schmidt-Cassegrain (26mm Plossl eyepiece, 77X) and the London Centre's 25.4cm Dob-

sonian (17mm Nagler eyepiece, 66X) inside the dome door so as to view the gauges on compressed gas canisters visible in an Engineering building window and the red light on a construction crane, respectively.

Despite the cloudy rainy weather, the visitors were delighted with the opportunity to view through amateur telescopes. Paul showed them his chondrite (stony) and iron meteorites. The visitors were gone by around 7:23 p.m. after an enjoyable evening learning about astronomy and telescopes.

Exploring the Stars, 77th Masonville Beavers, January 18th, 2017

Cloudy skies with a light drizzle greeted 27 visitors (15 children and 12 adults / leaders) from the 77th Masonville Beavers for Exploring the Stars at Western University's Cronyn Observatory, Wednesday, January 18th, 2017, 5:30 p.m. Graduate student Robin Arnason presented the digital slide presentation "*Our Solar System*" around 5:45 p.m. to accommodate late arrivals and fielded questions afterwards. Robin followed this with the activity "*Galaxy Sorting*."

Graduate student Jeff Vankerkhove was in the dome, which remained closed due to the cloudy sky and drizzle. RASC London Centre was represented by Everett Clark and Paul Kerans. When everybody arrived upstairs in the dome, Paul Kerans gave a talk on the history of the Cronyn Observatory and some of the technical aspects of the big 25.4cm refractor. Jeff Vankerkhove talked with the visitors and fielded questions.

Everett Clark had set up the observatory's 8-inch (20.3cm) Meade Schmidt-Cassegrain (26mm Plossl eyepiece, 77X) and the London Centre's 25.4cm Dobsonian (17mm Nagler eyepiece, 66X) inside the dome so as to view out the door to the roof patio. The Beavers were invited to view children the TV screen through the windows of the Western Sports & Recreation Center through the 20.3cm Schmidt-Cassegrain and the wind turbine on the Engineering building through the 25.4cm Dobsonian.

The visitors were delighted with the opportunity to view through amateur telescopes, despite the cloudy drizzly weather. Paul showed them his chondrite (stony) and iron meteorites. The visitors were gone by around 7:10 p.m. after an enjoyable evening learning about astronomy and looking through the telescopes.

Exploring the Stars, 2nd Lambeth Sparks, January 19th, 2017

Cloudy skies with damp, hazy weather greeted 23 visitors (15 children and 8 adults / leaders) from the 2nd Lambeth Sparks for Exploring the Stars at Western University's Cronyn Observatory, Thursday, January 19th, 2017, 6:30 p.m. Graduate student Viraja Khatu presented the digital slide presentation "*Constellations*" and fielded questions. Viraja followed this with the constellations activity "*Make Your Own Constellation / Constellation Detective*" which involved the children drawing their own constellations from a given pattern of stars on transparency sheets

with magic markers. This activity also included the children matching 4 constellation sketches displayed in a PowerPoint slide with the 4 night sky images provided to them on a laminated sheet.

RASC London Centre was represented by Everett Clark, Paul Kerans and Bob Duff. When everybody arrived upstairs in the dome, Bob gave a brief talk on the history of the Cronyn Observatory and some of the technical aspects of the big 25.4cm refractor. Bob also explained the Standard and Sidereal Time clocks on the east wall and the difference between a refractor and reflector telescope, showing them the mirror in the London Centre's 25.4cm Dobsonian.

Everett set up the London Centre's 25.4cm Dobsonian (17mm Nagler eyepiece, 66X) inside the dome door and Bob supervised as the Sparks viewed the red light on a construction crane behind the Engineering building.

Paul showed the visitors his chondrite (stony) and iron meteorites as well as his Moon meteorite sample in a small plastic display case. Paul had placed his lunar meteorite sample display case in a wooden block with a transparent Lexan polycarbonate sheet cover and he invited visitors to "*walk on the Moon*." The visitors were gone by around 7:30 p.m. after an enjoyable evening learning about the constellations and looking through the telescope.

Exploring the Stars, 1st Lambeth Sparks, January 24th, 2017

Cloudy skies with damp, hazy weather greeted 22 visitors (11 children and 11 adults / leaders) from the 1st Lambeth Sparks for Exploring the Stars at Western University's Cronyn Observatory, Tuesday, January 24th, 2017, 6:30 p.m. Graduate student Kendra Kellogg presented the digital slide presentation "*Constellations*" and fielded questions. Kendra followed this with the constellations activity "*Make Your Own Constellation / Constellation Detective*" which involved the children in matching 4 constellation sketches displayed in a PowerPoint slide with the 4 night sky images provided to them on a laminated sheet. This was followed by the children drawing their own constellations from a given pattern of stars on transparency sheets with magic markers.

RASC London Centre was represented by Everett Clark and Bob Duff. When everybody arrived upstairs in the dome, Kendra gave them a brief tour of the big 25.4 cm refractor in the dome, using the 52mm Erfle eyepiece (84X) for demonstration. The dome remained closed due to the cloudy damp weather. Kendra also explained and showed them the mirror in the London Centre's 25.4cm Dobsonian reflector telescope. Everett Clark had set up the 25.4cm Dobsonian (17mm Nagler eyepiece, 66X) inside so as to view out the dome door and Kendra supervised as the Sparks viewed the red light on a construction crane behind the Engineering building. Kendra also briefly explained the Standard and Sidereal Time clocks on the east wall of the dome. The visitors were gone from the dome by around 7:35 p.m., after an enjoyable evening learning about the constellations and looking through the telescope.

Exploring the Stars, 1st Watford Cubs, January 25th, 2017

Cloudy skies with a light drizzle greeted 19 visitors (9 children and 10 adults / leaders) from the 1st Watford Cubs for Exploring the Stars at Western University's Cronyn Observatory, Wednesday, January 25th, 2017, 7:00 p.m. Graduate student Jeff Vankerkhove presented the digital slide presentation "*Constellations*" and fielded questions. Jeff followed this with the "*Constellation*" activity, distributing 15 "*Star Finder*" planispheres and helping the Cubs assemble them with adhesive tape. He showed the slide "*Reading a Star Finder*" followed by 2 slides of constellations for them to practice using the planispheres.

RASC London Centre was represented by Everett Clark and Bob Duff. The dome remained closed due to the cloudy damp weather. When everybody arrived upstairs in the dome, Bob gave them a brief tour of the big 25.4 cm refractor in the dome. Everett had set up the observatory's 8-inch (20.3cm) Meade Schmidt-Cassegrain (26mm Plossl eyepiece, 77X) inside the dome door to the roof patio and Bob supervised as the Cubs viewed the TV screen visible in the windows of the Western Sports & Recreation Center. The visitors were gone by around 8:20 p.m., after an enjoyable evening learning about the constellations and looking through the telescope.

Exploring the Stars, 1st Lambeth Brownies, January 26th, 2017

Mostly cloudy skies greeted 21 visitors (14 children and 7 adults / leaders) from the 1st Lambeth Brownies for Exploring the Stars at Western University's Cronyn Observatory, Thursday, January 26th, 2017, 6:30 p.m. Graduate student Kendra Kellogg presented the digital slide presentation "*Constellations*" and fielded questions. Kendra followed this with the "*Constellation*" activity, distributing 21 "*Star Finder*" planispheres and helping the Brownies assemble them with adhesive tape. She then showed them how to use the planispheres.

RASC London Centre was represented by Everett Clark, Paul Kerans and Bob Duff. When everybody arrived upstairs in the dome, Kendra gave them a brief tour of the big 25.4 cm refractor in the dome. Since clouds obscured Venus, Everett directed the 25.4cm refractor (28mm Meade Super Wide Angle eyepiece, 157X) so as to show the visitors the red lights on the communications tower in south London. Everett had set up the observatory's 8-inch (20.3cm) Meade Schmidt-Cassegrain (26mm Plossl eyepiece, 77X) inside the dome door to the roof patio so as to view the TV screen visible in the windows of the Western Sports & Recreation Center. Paul set up the London Centre's 25.4cm Dobsonian (17mm Nagler eyepiece, 66X) on the roof patio outside the dome so as to view the wind turbine on the Engineering building. Bob supervised as the Brownies viewed through both these amateur telescopes.

Paul showed the visitors his chondrite (stony) and iron meteorites as well as his Moon and Mars meteorite samples in small plastic display cases. Paul had placed his

lunar meteorite sample display case in a wooden block with a transparent *Lexan* polycarbonate sheet cover so he could invite visitors to "*walk on the Moon*." Paul also brought his *Meteorite and Impactite* collection in a small black case. The visitors were gone by around 7:50 p.m. after an enjoyable evening learning about the constellations, examining meteorites and looking through the telescope.

Cronyn Observatory Public Night, Saturday, January 28th, 2017

Cloudy skies with some light snow greeted 34 visitors (including 4 children) to Western University's Cronyn Observatory Public Night, Saturday, January 28th, 2017, 7:00 p.m. Graduate student Kendra Kellogg presented her digital slide presentation "*Our Connection to the Cosmos*" before an audience of 8 visitors and fielded questions.

Graduate student Robin Arnason was telescope operator for the big 25.4cm refractor in the dome, which remained closed because of the snowy weather. RASC London Centre was represented by Everett Clark, Paul Kerans, Bob Duff, Peter Jedicke, Dale Armstrong, Tricia Colvin and Mark Tovey.

There were 4 amateur telescopes set up inside the dome. The observatory's 8-inch (20.3cm) Meade Schmidt-Cassegrain (12.5mm eyepiece, 160X) was set up on display in the dome along with the Orion 6-inch (15cm) Newtonian reflector (26mm Plossl eyepiece, 29X), which was set up on the Sky-Watcher EQ5 computerized mount. The observatory's second 20.3cm Meade Schmidt-Cassegrain was set up without its tripod on the table near the window so as to show visitors the red light above the north campus buildings. The London Centre's 25cm Dobsonian (17mm Nagler eyepiece, 66X) was also set up inside the dome door so that visitors could view the wind turbine on the Engineering building.

Paul showed the visitors his chondrite (stony) and iron meteorites as well as his Moon and Mars meteorite samples in small plastic display cases. Paul had placed his lunar meteorite sample display case in a wooden block with a transparent *Lexan* polycarbonate sheet cover so he could invite visitors to "*walk on the Moon*." Paul also brought his *Meteorite and Impactite* collection in a small black case. There were 4 "*Star Finder*" planispheres distributed including 3 given out by Everett and one by Paul.

The last visitors were gone by around 8:45 p.m. and Dale Armstrong set up his camera and tripod and took pictures, with an off-camera flash and some coloured gels, of the big refractor in the dome, including an excellent picture with Robin, Everett, Mark, Peter and Bob standing in front of the big telescope. The observatory was closed down a little after 9:00 p.m. after an enjoyable evening for the visitors learning about astronomy, meteorites and telescopes.

Exploring the Stars, Space Society of London, January 30th, 2017

Partly cloudy, later clearing, skies greeted 10 visitors from the Space Society of London (Western University) for Exploring the Stars at Western University's Cronyn Observatory, Monday, January 30th, 2017, 7:00 p.m. Graduate student Kendra Kellogg presented the digital slide presentation "*Life in the Universe*" and fielded questions. Kendra followed this with the activity "*Kitchen Comet*," making a comet from dry ice and other materials.

RASC London Centre was represented by Everett Clark, Paul Kerans and Rob McNeil. The skies cleared out around 7:30 p.m. When everybody arrived upstairs in the dome Everett showed them the planets Venus and Mars through the big 25.4cm refractor, using the 28mm Meade Super Wide Angle eyepiece (157X). Venus appeared in its crescent phase. Paul showed the visitors the Orion Nebula (M42) through his 80mm Sky-Watcher refractor set up on his Vixen SXD2 equatorial mount, using the 26mm Tele Vue Plossl eyepiece (23X) from one of the observatory's 8-inch (20.3cm) Meade Schmidt-Cassegrain telescopes. Rob McNeil brought his *Utopia 360 Virtual Reality* headset and showed visitors the "*Stellar Sky*" VR app with an all-sky view of the night sky. The sky clouded over again around 9:00 p.m. and the visitors were gone after an enjoyable evening of astronomy.

Exploring the Stars, 81st London Cubs, February 2, 2017

Mostly clear skies greeted 20 visitors (12 children and 8 adults / leaders) from the 81st London Cubs for Exploring the Stars at Western University's Cronyn Observatory, Thursday, February 2nd, 2017, 7:00 p.m. Graduate student Jeff Vankerhove presented the digital slide presentation "*The Cub Scout Astronomy Badge*" and fielded questions. Jeff followed this with the activity "*Kitchen Comet*," making a comet from dry ice and other materials on a table set up at the front of the lecture room.

RASC London Centre was represented by Paul Kerans. Before everybody went upstairs into the dome, Paul took the Cubs outside the front door of the observatory and showed them how to find the North Star, Polaris, using the Big Dipper. When everybody arrived upstairs in the dome, Paul gave a brief talk on the history of the Cronyn Observatory and the big 25.4cm refractor in the dome. He pointed out that there were 5 telescopes, including the Schmidt camera and the Cassegrain reflector, as well as the 2 finderscopes, all piggybacked on the big 25.4cm refractor.

Jeff operated the big 25.4cm refractor and showed the Cubs the 6-day-past-new crescent Moon, just one day prior to first quarter. Jeff also showed them the planets Venus, using the Meade 28mm Super Wide Angle eyepiece (157X), and Mars, using the 17mm Nagler eyepiece (258X), through the big 25.4cm refractor. On the roof patio outside the dome, Paul set up the London Centre's 25.4cm Dobsonian and showed the Cubs the Orion Nebula (M42), Betelgeuse, the Pleiades (M45) and the Moon. Paul showed

the visitors his chondrite (stony) and iron meteorites as well as his Mars meteorite sample in its small plastic display case. The visitors were gone by around 9:00 p.m., after an enjoyable evening of astronomy.

Exploring the Stars, 3rd Lambeth Brownies, February 6th, 2017

Mostly cloudy skies greeted 37 visitors (21 children and 16 adults / leaders) from the 3rd Lambeth Brownies for Exploring the Stars at Western University's Cronyn Observatory, Monday, February 6th, 2017, 6:30 p.m. Graduate student Kendra Kellogg presented the digital slide presentation "*Constellations*" and fielded questions. Kendra followed this with the "*Constellation*" activity, distributing 37 "*Star Finder*" planispheres and helping the Brownies assemble them with adhesive tape. She then showed them how to use the planispheres.

RASC London Centre was represented by Everett Clark and Paul Kerans. When everybody arrived upstairs in the dome, Paul gave a brief talk on the history of the Cronyn Observatory and the big 25.4cm refractor in the dome, which remained closed due to the cloudy weather. He pointed out that there were 5 telescopes, including the Schmidt camera and the Cassegrain reflector, as well as the 2 finderscopes, all piggybacked on the big 25.4cm refractor. Everett set up the London Centre's 25.4cm Dobsonian (17mm Nagler eyepiece) on the roof patio outside the dome and showed the Brownies the red light on top of the construction crane behind the Engineering building. The 3-day-past-first quarter gibbous Moon was obscured by clouds and glimpsed only a few times, and was not viewed by the visitors through the 25.4cm Dobsonian.

Paul had set up the observatory's 8-inch (20.3cm) Meade Schmidt-Cassegrain (20mm Plossl eyepiece, 100X) inside the dome so as to view out the door to the roof patio and he supervised as the Brownies viewed the TV screen visible in the windows of the Western Sports & Recreation Center. Paul then showed the visitors his chondrite (stony) and iron meteorites as well as his Moon and Mars meteorite sample in their small plastic display cases. The visitors were gone by around 7:45 p.m., after an enjoyable evening of astronomy.

Exploring the Stars, MEC London, February 7th, 2017

Cloudy skies with rain showers greeted 28 visitors from MEC London (Mount Equipment Co-op) for Exploring the Stars at Western University's Cronyn Observatory, Tuesday, February 7th, 2017, 8:30 p.m. Graduate student Robin Arnason presented the digital slide presentation "*Life in the Universe*" and fielded questions. Robin followed this with the "*Transit Demonstration*" activity. The visitors divided into 2 groups with one group going upstairs into the dome and the other downstairs to see the "*Transit Demo*" in the "*Black Room*."

Downstairs in the "*Black Room*" Robin gave 2 demonstrations of the "*Transit Demo*" model, one to each of the 2 groups of visitors, and explained how the transit detection

method worked for finding extra-solar planets. A photodiode was clamped to a laboratory stand and linked to a laptop computer, which displayed the dipping light curve as model planets of various sizes revolved around and in front of the lighted model “*sun*” representing the distant star. It was a very impressive demonstration of the transit detection method for finding extra-solar planets.

RASC London Centre was represented by Everett Clark, Paul Kerans and Bob Duff. Since cloudy skies and rain showers ruled out opening the dome, Bob gave 2 talks, one to each of the 2 groups of visitors, on the history of the Cronyn Observatory and the technical aspects of the big 25.4cm refractor. Bob also pointed out the Schmidt camera and the Cassegrain reflector and the 2 finderscopes all piggybacked on the big 25.4cm refractor. He also showed them the observatory’s 8-inch (20.3cm) Meade Schmidt-Cassegrain (26mm Plossl eyepiece, 77X) and Orion 6-inch (15cm) Newtonian reflector (20mm Plossl eyepiece, 37.5X) with the Sky-Watcher EQ5 mount, set up inside the dome by Everett and Paul, respectively. Bob also explained the Standard and Sidereal Time clocks on the east wall.

Heavy dewing of the eyepieces of the telescopes and the Schmidt-Cassegrain corrector plate made it impossible, until later in the evening, to view the TV screen visible in the windows of the Western Sports & Recreation Center—from out the dome door to the roof patio. Bob set up the London Centre’s 25.4cm Dobsonian (17mm Nagler eyepiece, 66X) inside the dome door to view the red light on the construction crane, although eyepiece dewing made seeing virtually impossible.

Paul showed the visitors his chondrite (stony) and iron meteorites as well as his Moon and Mars meteorite samples in small plastic display cases. Paul had placed his lunar meteorite sample display case in a wooden block with a transparent *Lexan* polycarbonate sheet cover and he invited visitors to “*walk on the Moon*.” Paul also brought his *Meteorite and Impactite* collection in a small black case. The visitors were gone by around 10:36 p.m., after an enjoyable evening learning about astronomy, despite the unfavourable weather.

Exploring the Stars, London 31st B Cub Scouts, February 9, 2017

Cloudy skies greeted 28 visitors (19 children and 9 adults / leaders) from the London 31st B Cub Scouts for Exploring the Stars at Western University’s Cronyn Observatory, Thursday, February 9th, 2017, 7:00 p.m. Graduate student Robin Arnason presented the digital slide presentation “*The Small Bodies in Our Solar System*” and fielded questions. Jeff followed this with the activity “*Kitchen Comet*,” making a comet from dry ice and other materials on a table set up at the front of the lecture room.

RASC London Centre was represented by Everett Clark and Paul Kerans. When everybody arrived upstairs, Robin gave a brief talk about the big refractor in the dome, which remained closed due to the cloudy weather. The Cub Scouts were able to view the wind turbine on the Engineering building and later the red light on the construction crane

through the London Centre’s 25.4cm Dobsonian (17mm Nagler eyepiece, 66X), which Everett had set up just inside the dome door to the roof patio.

Paul showed the visitors his chondrite (stony) and iron meteorites as well as his Moon and Mars meteorite samples in small plastic display cases. Paul had placed his lunar meteorite sample display case in a wooden block with a transparent *Lexan* polycarbonate sheet cover and he invited the Cub Scouts to “*walk on the Moon*.” The visitors were gone by around 8:30 p.m., after an enjoyable evening learning about astronomy, despite the cloudy sky.

There were 2 very useful additions to the equipment available at the Cronyn Observatory during the course of the evening. Paul installed a “*Rigel Systems QuikFinder*”—ordered by Professor Jan Cami—on the large white finderscope of the big 25.4cm refractor. RASC London Centre member Patrick Whelan arrived during the evening and was assisted by Everett in bringing in Matt Neima’s 12-inch (30.5cm) home-built Dobsonian—a donation to the London Centre for use at the Cronyn Observatory.