

POLARIS



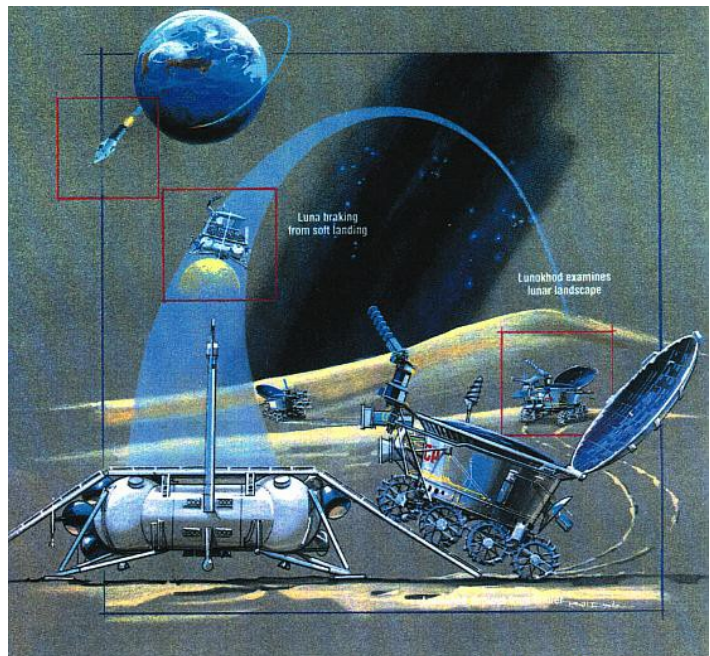
Newsletter of the London Centre, RASC

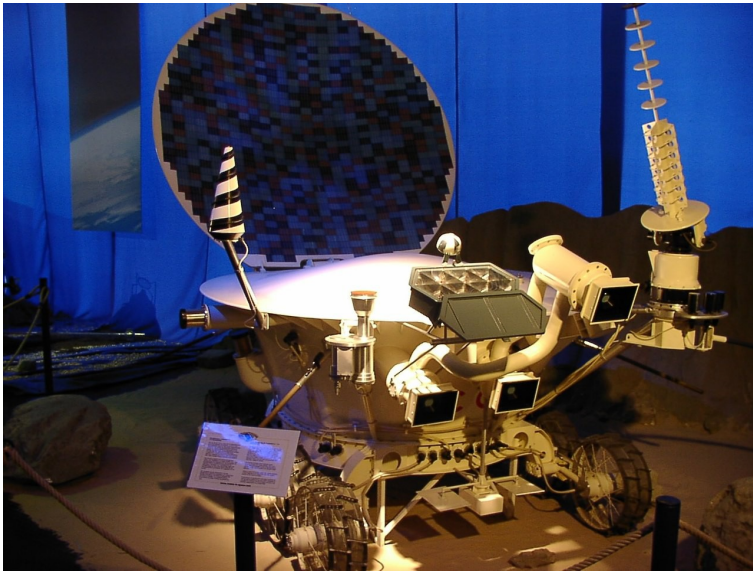
February 2020

The First Lunar Rovers

On November 17, 1970 at 0347UTC a Soviet spacecraft soft landed in the Sea of Rains on the Moon. On this spacecraft sat a large, pressure-cooker looking device with eight wheels. After a while, the lid of the pressure cooker opened and the whole affair rolled down a ramp onto the lunar surface. Man's first remote rover on another planet, Lunokhod 1, had started its mission.

The Lunokhod project began to support Soviet manned Moon missions but after the US successfully landed Apollo 11 it switched over to a program of lunar exploration. Development testing for the project was done at a man-made patch of lunar surface that the Soviets created using thousands of cubic metres of soil where the lander's suspension and wheels could be tested using a realistic surface. Of course this patch being on earth would have 1G pressing on the lander. This was taken into account.





The first launch of a lander on Feb 19, 1969 failed when, just after launch, the booster exploded. Typical of the Soviet space program it was many years before the rest of the world heard anything about this failure. The lander's radioactive heat source (more later) ended up covering a large area of Russia.

After the failure of the first lander the Soviets put together Lunokhod 1. This would end up being the first of two spacecraft that would eventually make successful trips to the Moon. The final configuration of these craft retained the eight-wheels and the pressure cooker. The

lander contained several scientific devices that would be mounted internally. These were:

- Two television cameras,
- Four panoramic telephotometers,
- An X-Ray spectrometer,
- An X-Ray telescope,
- A soil penetrometer,
- A Cosmic Ray Detector, and
- a Laser Retroreflector.

These were powered by a battery bank which was charged as needed by solar cells on the underside of the lid of the pressure cooker, which was only open when the sun was in the sky. When the sun was on the other side of the moon the lid closed and a Polonium 210 heater was turned on to keep the instruments warm until the next time the sun rose.

The television cameras were of the slow-scan type. One was mounted high for use in navigation.

Lunokhod 1 was launched on Nov 10, 1970 and after stabilizing in orbit was sent towards the moon which it reached on Nov 15, 1970. After rolling out it worked on the lunar surface for 322 earth days and travelled 10.5km returning television and high-rez panoramas. It took 500 penetrometer tests along the way.

Lunokhod 2 was of a similar form factor as the first lander but held a different bank of sensors and experiments. These were:

- Three television and four panoramic cameras,
- The same X-Ray sensing equipment as Lunokhod 1,
- The same soil Penetrometer and laser retroreflector,
- A Visible light/UV astrophotometer,
- A Magnetometer, and
- A photodetector.

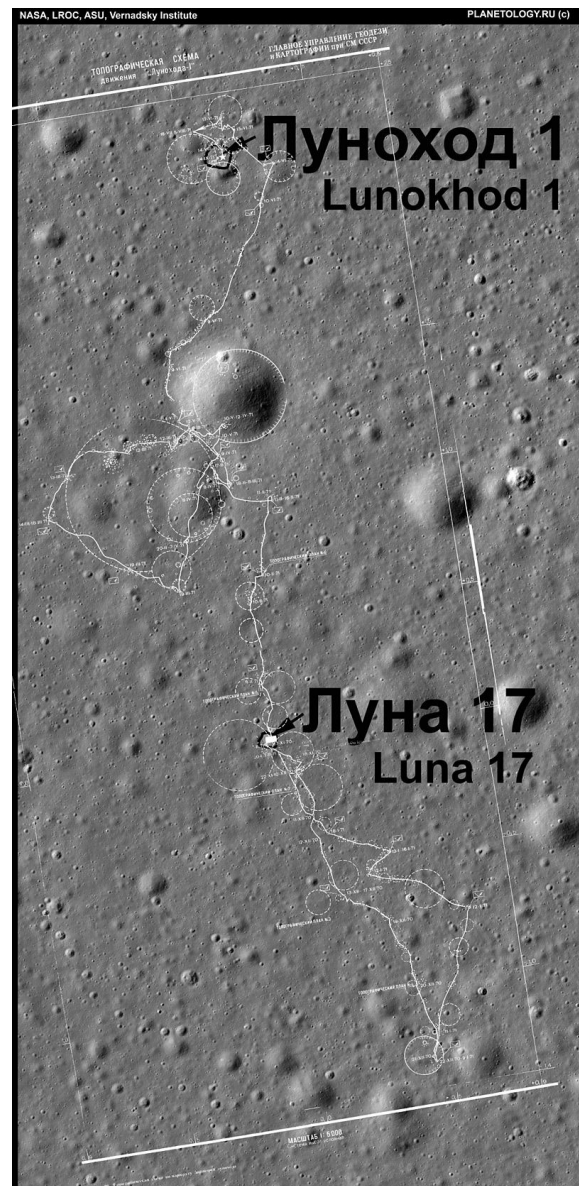
Lunokhod 2 covered 42km over 4 months and drove into more varied terrain than the first lander and returned 86 panoramas and over 80,000 television images.

Lunokhod 1 was lost due to the failure of the retroreflector but in March 2010 the lander and the rover were found on LRO images. In April of that year Apache Point Observatory detected the retroreflector using its pulsed laser rangefinder.

Lunokhod 2's retroreflector always worked and its position is known to a metre or so.

After Chernobyl the Lunokhod engineers were called back into service and put their electronics and other bits to good use and in 1986 allowed designers to put together two rovers which were sent into the accident zone to move debris.

In 1993 at a Sotheby's auction Richard Garriot purchased the Lunokhod 2 lander and rover for \$68000USD.



RASC London Centre Library
Books of the Month
February 2020
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 2020 are as follows:

An Astronaut’s Guide to Life on Earth, [by] Chris Hadfield. – Toronto: Random House Canada, c2013.

Clyde Tombaugh: Discoverer of Planet Pluto, by David H. Levy. – Cambridge, Mass.: Sky Publishing Corp., c2006.

The Planet Factory: Exoplanets and the Search for a Second Earth, [by] Elizabeth Tasker. – London, England: Bloomsbury Sigma, 2019, c2017.

For a complete listing of our RASC London Centre Library collection please click on the **Library** menu at the top of the RASC London Centre main Web page: <http://rasclondon.ca/>

If there is anything you wish to borrow from the Library, please feel free to contact me by telephone at (519) 439-7504 or by e-mail at rduff@sympatico.ca

**Cronyn Observatory Exploring the Stars Events, January 13th—
February 13th, 2019**

By Robert Duff

Cronyn Observatory Public Night, Monday, January 13th, 2020

Cloudy, damp weather greeted 44 visitors (including 4 youth) to Western University’s Cronyn Observatory Weekday Public Night, Monday, January 13th, 2020, 7:00—9:00 p.m. They were welcomed by graduate students Heather MacIsaac and Kaylie Green. Heather gave tours of the big 25.4cm refractor in the dome. Kaylie spent some time directing visitors upstairs into the dome and downstairs for tours of the historic “*Period Rooms*” before joining Heather in the dome to spend most of the evening learning about the telescopes.

RASC London Centre was represented by Mark Tovey and Bob Duff, who arrived at 7:30 p.m. Since damp weather ruled out opening the dome, Heather, who was also a RASC London member, set up the RASC London Centre’s home-built 30.5cm Dobsonian inside the dome for demonstration. She also placed the observatory’s Meade 8-inch (20.3cm) Schmidt-Cassegrain (12.5mm Ortho eyepiece, 160X)—without the tripod—on the table near the east wall of the dome. Heather spent the evening giving tours of the big 25.4cm refractor and the 2 amateur telescopes set up in the dome, and explaining the difference between a reflector and refractor telescope. She also explained the 2 clocks mounted on the

east wall of the dome and the difference between Standard and Sidereal Time.

Downstairs in the basement, Mark Tovey showed visitors the historic “1940s Period Room,” a recreation of Dr. H. R. Kingston’s 1940 office, with his brass refractor and the *Sotellunium*—a mechanical eclipse demonstration model built by W. G. Colgrove—on display; and the “1967 Period Room,” recreating the early control room of the Elginfield Observatory to celebrate the 150th anniversary of Confederation—Canada 150. The “*W. G. Colgrove Workshop Period Room*” remained closed. The 3 “*Period Rooms*” were designed by RASC London Centre member Mark Tovey.

Towards the end of the evening, Bob Duff showed the “*Spectroscopy Demonstration*,” to one visitor, using the *diffraction grating* glasses to view the spectra of 4 gas discharge lamps, including hydrogen, helium, neon and mercury. Most of the visitors were gone by around 9:00 p.m., after expressing their appreciation for the very interesting tours of the dome and downstairs history rooms. Mark remained in the history rooms until 9:30 p.m., talking to one very interested visitor.

Exploring the Stars, 3rd London Brownies, January 16th, 2020

Cloudy skies with snow flurries greeted 17 visitors from the 3rd London Brownies, including 11 children and 6 adult leaders, for Exploring the Stars at Western University’s Cronyn Observatory, Thursday, January 16th, 2020, 7:00—8:30 p.m. They were greeted by graduate students Viraja Khatu and Kaylie Green. Viraja gave the digital slide presentation “*Constellations*” and fielded questions. This was presented on the large TV screen newly installed in the lecture room. This was followed with the “*Constellations*” activity, with Viraja and Kaylie distributing some 17 “*Star Finder*” planispheres. Rolls of adhesive tape were circulated and the Brownies were shown how to assemble and use the planispheres.

RASC London member Bob Duff arrived around 7:15 p.m. and set up the London Centre’s 30.5cm Dobsonian (17mm Nagler eyepiece, 88X) inside the dome. When everybody arrived upstairs in the dome, Bob gave a talk on the history of the observatory and some of the technical aspects of the big 25.4cm refractor, using the 32mm Erfle eyepiece (137X) for demonstration. He explained the Schmidt camera and Cassegrain reflector piggy-backed on the main telescope, opening and closing the shutter on the Schmidt camera to demonstrate how it worked. Bob also showed them the 30.5cm Dobsonian and explained the difference between a reflector and refractor telescope. He called their attention to the 2 clocks on the east wall of the observatory and explained the difference between Standard and Sidereal Time. Bob rotated the dome to demonstrate how it worked.

Viraja finished the evening downstairs in the “*Black Room*,” doing the “*Spectroscopy Demonstration*,” with the Brownies put on *diffraction grating* glasses to view the spectra of 4 gas discharge lamps, including hydrogen, helium, neon and mercury. The event was over by around 8:30 p.m., with the visitors expressing their appreciation for an informative and enjoyable evening learning about the constellations, telescopes and spectroscopy.

Cronyn Observatory Public Night, Saturday, January 25th, 2020

Cloudy skies greeted some 44 visitors (including 12 youth) to Western University's Cronyn Observatory Public Night, Saturday, January 25th, 2020, 7:00—9:00 p.m. Graduate student Viraja Khatu presented her digital slide presentation "*Journey into the Milky Way: a sneak peek at our home galaxy*" and fielded questions. Downstairs in the "*Black Room*" graduate student Kaylie Green showed visitors the "*Spectroscopy Demonstration*," with the visitors putting on *diffraction grating* glasses to view the spectra of 4 gas discharge lamps, including hydrogen, helium, neon and mercury. She also showed them the "*Transit Demonstration*," with the "*Transit Demo*" model—showing how the transit detection method worked for finding extra-solar planets.

RASC London member Bob Duff arrived around 7:15 p.m. After counting the visitors in the lecture room, Bob set up the observatory's Meade 8-inch (20.3cm) Schmidt-Cassegrain (20mm Plossl eyepiece, 100X) inside the dome so as to view out the door to the observation deck towards the TV screen visible in the Western Student Recreation Centre windows and later towards the flashing white lights on the communications tower in south London. When the visitors arrived upstairs in the dome, Bob gave a talk on the history of the observatory and some of the technical aspects of the big 25.4cm refractor, using the 32mm Erfle eyepiece (137X) for demonstration. He explained the Schmidt camera and the Cassegrain reflector telescope piggy-backed on the 25.4cm refractor. He called their attention to the 2 clocks on the east wall of the observatory and explained the difference between Standard and Sidereal Time. Bob rotated (but did not open) the dome to demonstrate how it worked. Bob supervised as visitors viewed the flashing white lights on the communications tower in south London through the 20.3cm Schmidt-Cassegrain. Bob also hauled out the RASC London Centre's home-built 30.5cm Dobsonian from the storage room to show some visitors and explained the difference between a reflector and refractor telescope.

The visitors were gone by around 9:00 p.m. and the observatory was closed down after an enjoyable evening with the slide presentation on the Milky Way Galaxy, demonstrations of spectroscopy and the transit method for finding extra-solar planets, and the tour of the dome learning about telescopes.

Exploring the Stars, 91st London Brownies, January 27th, 2020

Cloudy skies greeted 17 visitors from the 91st London Brownies, including 14 children and 3 adult leaders, for Exploring the Stars at Western University's Cronyn Observatory, Monday, January 27th 2020, 6:30—8:00 p.m. Graduate student Heather MacIsaac gave the digital slide presentation "*The Scout / Guide Astronomy Badge*," with the title slide "*The Basics*," and fielded questions. This was presented on the large TV screen newly installed in the lecture room. Heather followed this with the "*Crater Experiment*" activity, placing a pan filled with flour and chocolate powder on the floor into which various size balls and rocks were then dropped to demonstrate impact cratering.

RASC London member Bob Duff arrived around 6:54 p.m. and, after counting the visitors in the lecture room, set up the RASC London Centre's home-built 30.5cm Dobsonian (17mm Nagler eyepiece, 88X) inside the dome. Bob also set up the observatory's Meade 8-inch (20.3cm) Schmidt-

Cassegrain (26mm Plossl eyepiece, 77X) so as to view out the door to the observation deck, towards the flashing white lights on the communications tower in south London.

Heather, who was also a RASC London member, gave the telescope talk after bringing everybody upstairs into the dome. She showed them the lens of the big 25.4cm refractor and explained how an eyepiece was used to view through the telescope. Bob showed them the 32mm Erfle eyepiece (137X). Heather explained the 2 finderscopes and Schmidt camera piggy-backed on the big 25.4cm refractor, opening and closing the shutter on the Schmidt camera for demonstration. Heather showed them the 30.5cm Dobsonian and explained how a reflector telescope worked. She also showed them the 20.3cm Schmidt-Cassegrain and explained that mirrors and lenses could be combined to make a very short compact telescope.

Heather opened and rotated the dome to demonstrate how it worked. She also explained the 2 clocks mounted on the east wall of the dome and the difference between Standard and Sidereal Time. Heather then invited the Brownies to line up and view the flashing white lights on the communications tower through the 20.3cm Schmidt-Cassegrain (26mm Plossl eyepiece, 77X) telescope. The evening ended with the Brownies posing beside the 20.3cm Schmidt-Cassegrain for a picture taken by one of the leaders with her Smartphone. Everybody was gone by around 8:00 p.m. after expressing their thanks for an enjoyable evening learning about astronomy and telescopes.

Exploring the Stars, 84th London Brownies, February 3rd, 2020

A clear sky with later hazy clouds greeted 19 visitors from the 84th London Brownies, including 15 children and 4 adult leaders, for Exploring the Stars at Western University's Cronyn Observatory, Monday, February 3rd, 2020, 6:30—8:00 p.m. Graduate student Heather MacIsaac gave the digital slide presentation "*The Scout / Guide Astronomy Badge*," with the title slide "*The Basics*," and fielded questions. This was presented on the large TV screen newly installed in the lecture room. Heather followed this with the "*Crater Experiment*" activity, placing a pan filled with flour and chocolate powder on the floor into which various size balls and rocks were then dropped to demonstrate impact cratering.

RASC London member Bob Duff arrived around 7:09 p.m. and, after counting the visitors in the lecture room, went upstairs into the dome and made ready the big 25.4cm refractor (32mm Erfle eyepiece, 137X), directing it towards the 2-day-past-first-quarter Moon. Heather, who was also a RASC London member, gave the telescope talk after bringing everybody upstairs into the dome. She explained the 2 finderscopes and Schmidt camera piggy-backed on the 25.4cm refractor, opening and closing the shutter on the Schmidt camera for demonstration. She also explained the 2 clocks mounted on the east wall of the dome and the difference between Standard and Sidereal Time. Heather then invited the Brownies to line up and view the Moon through the 25.4cm refractor. The Moon was occasionally dimmed by drifting, hazy clouds. The Brownies and their leaders were impressed by the view of the Moon and its craters through the telescope. Everybody was gone by around 8:00 p.m. after expressing their thanks for an enjoyable evening of astronomy.

Cronyn Observatory Public Night, Monday, February 10th, 2020

Mostly cloudy skies greeted 18 visitors (including 2 youth) to Western University's Cronyn Observatory Weekday Public Night, Monday, February 10th, 2020, 7:00—9:00 p.m. There was no slide presentation. Graduate student Hadi Papei directed the big 25.4cm refractor (17mm Nagler eyepiece, 258X) to show visitors Venus in the western sky. Venus appeared as a gibbous disk, periodically obscured by hazy clouds, in the telescope's field of view.

RASC London member Bob Duff arrived around 7:15 p.m. and set up the observatory's Meade 8-inch (20.3cm) Schmidt-Cassegrain telescope on the observation deck. Sirius was briefly visible in the southeastern sky early in the evening but obscured by clouds before it could be observed through the telescope. Bob directed the 20.3cm Schmidt-Cassegrain to show visitors 2 flashing white lights on the communications tower in south London, using the 26mm (77X) and 20mm (100X) Plossl eyepieces. There were 2 more visitors who later viewed the tower through the 12.5cm Ortho (160X) eyepiece, before Bob put away the 20.3cm Schmidt-Cassegrain.

When Venus became mostly obscured by clouds, Hadi went downstairs into the "*Black Room*" where he did 3 demonstration of the "*Transit Demonstration*," with the "*Transit Demo*" model, showing how the transit detection method worked for finding extra-solar planets, and the "*Spectroscopy Demonstration*," with the visitors putting on *diffraction grating* glasses to view the spectra of 4 gas discharge lamps, including hydrogen, helium, neon and mercury.

Bob remained in the dome and gave 2 talks on the history of the observatory and some of the technical aspects of the big 25.4cm refractor. He explained the Schmidt camera and the Cassegrain reflector telescope piggy-backed on the 25.4cm refractor, and the difference between a reflector and refractor telescope. He also explained how the 20.3cm Schmidt-Cassegrain was similar to the Cassegrain reflector, except for the Schmidt corrector lens. He called their attention to the 2 clocks on the east wall of the observatory and explained the difference between Standard and Sidereal Time.

The visitors were gone by around 9:00 p.m. after an enjoyable evening observing Venus through the big 25.4cm refractor in the dome, demonstrations of spectroscopy and the transit method for finding extra-solar planets, and tours of the dome learning about the telescopes.

Girls & Women in Space Night at the Cronyn Observatory, February 11th, 2020

Cloudy skies greeted some 150 visitors (including some 75 children) to Western University's Cronyn Observatory for the "Girls and Women in Space Night," Tuesday, February 11th, 2020, scheduled for 5:00—9:00 p.m. The event ended around 8:30 p.m. due to weather. This was a special event in recognition of the "International Day of Women and Girls in Science" and a celebration of the women and non-binary professors, students and alumni at Western University. This event was jointly hosted by the Department of Physics and Astronomy and the Institute for Earth and Space Exploration at Western University (Western Space), and the Royal Astronomical Society of Canada London Centre. Physics

and Astronomy graduate student Viraja Khatu and Dr. Parshati Patel, Outreach Program Coordinator for Institute for Earth and Space Exploration, organized the event. This event also celebrated the Canadian Space Agency's Junior Astronauts campaign, offering inspiration to the next generation of Canadian astronauts and how they can play a role in Canada's mission to the Moon.

There were an estimated 150 visitors (with about 75 children) by 7:15 p.m., including 3 Girl Guide groups of 20—25 each, for an estimated total of 60 Guides. There were 15 children with their parents among the visitors. RASC London Centre member Bob Duff greeted one lady with 2 children shortly after he arrived at 7:15 p.m., so the count may be more than 150 visitors—perhaps some 153 visitors (including about 77 children).

Activities included (1) Hands-on Junior Astronauts Activities (5:00—8:00 p.m.); (2) Women in Space Trivia (5:00—5:30 p.m.); (3) Ask a Woman Space Scientist Panel (5:30—6:00 p.m.), with 6 Panelists: Avery Mainprize, Athithya Aravinthan, Carolina Rodriguez Sanchez-Vahamonde, Catheryn Ryan, Dr. Shauna Burke and Hira Nadeem; (4) Special Junior Astronauts Talk (6:00—6:30 p.m.), with Speaker: Miriam Micael, Project Management Engineer, Canadian Space Agency; (5) Junior Astronauts Activities showcase and Raffle Draw (6:30—7:00 p.m.); and (6) Stargazing through the Cronyn Observatory's 25.4 cm refractor and other telescopes (7:00—9:00 p.m.)

The Hands-on Junior Astronauts Activities were done in the downstairs “*Black Room*” and led by Tabetha Sheppard, Racel Sopoco and Siena McLachlan from the Institute for Earth and Space Exploration (Western Space). The Women in Space Trivia was run by Viraja Khatu and Xiaochen Zhang (Western Space); the Ask a Woman Space Scientist Panel was coordinated by Jahnavi Shah (Western Space) and Viraja; and both activities were done in the main floor lecture room. Viraja introduced the Special Junior Astronauts Talk guest speaker, CSA Project Management Engineer Miriam Micael, who appeared on the large TV screen in the lecture room. Viraja fielded questions after Miriam Micael's talk. Parshati Patel, Outreach Program Coordinator for the Institute for Earth and Space Exploration, posted updates on social media throughout the event.

RASC London Centre was represented by Mohammed Mubeen, Mark Tovey and Bob Duff. Graduate student and RASC London member Heather MacIsaac set up the observatory's Meade 8-inch (20.3cm) Schmidt-Cassegrain (Tele Vue 26mm Plossl eyepiece, 77X) so as to view out the door to the observation deck, towards 2 flashing white lights on the communications tower in south London. She also set up RASC London's home-built 30.5cm Dobsonian in the northwest corner of the dome, with the 18 mm Radian eyepiece (83X) installed. The dust cap was placed on the 18 mm Radian eyepiece to protect it from fingerprints.

Heather talked to visitors, explaining the big 25.4cm refractor and the 2 amateur telescopes set up in the dome, and the difference between a reflector and refractor telescope. She also explained the 2 clocks mounted on the east wall of the dome and the difference between Standard and Sidereal Time. Mohammed was there from 5:30—8:00 p.m., took pictures of the event with his camera and supervised visitors as they viewed the lights on the communications tower through the 20.3cm Schmidt-Cassegrain.

Downstairs in the basement, Mark Tovey (5:00—8:30 p.m.) showed visitors the historic “*1940s Period*

Room,” a recreation of Dr. H. R. Kingston’s 1940 office, with his brass refractor and the *Sotellunium*—a mechanical eclipse demonstration model built by W. G. Colgrove—on display; and the “1967 *Period Room*,” recreating the early control room of the Elginfield Observatory to celebrate the 150th anniversary of Confederation—Canada 150. The “*W. G. Colgrove Workshop Period Room*” remained closed. The 3 “*Period Rooms*” were designed by RASC London Centre member Mark Tovey.

“Girls and Women in Space Night” was intended to continue until 9:00 p.m. but ended early, around 8:30 p.m., due to weather. It was a very enjoyable evening for the visitors, with the Hands-on Junior Astronauts Activities, Ask a Woman Space Scientist Panel, the Special Junior Astronauts Talk with the CSA guest speaker, visits to the dome and tours of the historic “*Period Rooms*” rooms.

Exploring the Stars, 1st Strathroy Scout Troop, February 13th, 2020

Cloudy skies with some light snow flurries greeted 24 visitors (16 children and 8 adults) from the 1st Strathroy Scout Troop for Exploring the Stars at Western University’s Cronyn Observatory, Thursday, February 13th, 2020, 7:00—9:00 p.m. They were greeted by graduate students Viraja Khatu and Kaylie Green. Viraja gave the digital slide presentation “*The History of Space Exploration*” and fielded questions. This was presented on the large TV screen newly installed in the lecture room. She then did the “*Kitchen Comet*” activity on a table set up at the front of the lecture room, making a comet with dry ice and other materials. The Scouts were invited to come up to the table to put on a glove and handle the dry ice comet. The Scouts were then split into 2 groups with one going upstairs for a tour of the dome and the other to go downstairs for demonstrations in the “*Black Room*.”

RASC London member Bob Duff arrived at 7:20 p.m., counted the visitors in the lecture room and then went upstairs into the dome. He set up the observatory’s Meade 8-inch (20.3cm) Schmidt-Cassegrain (20mm Plossl eyepiece, 100X) so as to view out the door to the observation deck, towards the TV screen visible in the windows of the Western Student Recreation Centre. He also set up the RASC London Centre’s home-built 30.5cm Dobsonian (17mm Nagler eyepiece, 88X) inside the dome for demonstration. Bob gave 2 tours of the dome, one to each group of Scouts, telling them about the history and technical aspects of the big 25.4cm refractor in the dome, using the 17mm Nagler eyepiece (258X) for demonstration. He explained the 2 finderscopes and called their attention to the Schmidt camera and Cassegrain reflector piggy-backed on the main telescope, opening and closing the shutter on the Schmidt camera to demonstrate how it worked. Bob showed them the 30.5cm Dobsonian reflector, explaining the difference between a reflector and refractor telescope, and the 20.3cm Schmidt-Cassegrain, explaining how mirrors and lenses could be combined to make a very short compact telescope. He rotated (but did not open) the dome to demonstrate how it worked and explained the 2 clocks on the east wall and the difference between Standard and Sidereal Time.

Bob invited the first group of Scouts to view the TV screen visible in the windows of the Western Student Recreation Centre through the 20.3cm Schmidt-Cassegrain. When the second Scout group came upstairs, Bob made the same presentation, although there was not enough time for them to view through the 20.3cm Schmidt-Cassegrain.

Downstairs in the “*Black Room*” Kaylie gave 2 demonstrations, one to each group of Scouts, of the “*Transit Demonstration*,” with the “*Transit Demo*” model, showing how the transit detection method worked for finding extra-solar planets; and Viraja did 2 demonstrations of the “*Spectroscopy Demonstration*,” with the visitors putting on *diffraction grating* glasses to view the spectra of 4 gas discharge lamps, including hydrogen, helium, neon and mercury.

The Scouts were gone by around 9:00 p.m. after an enjoyable evening with the slide presentation on the history of space exploration, making comet with dry ice and other materials, tours of the big 25.4cm refractor and other telescopes in the dome, and demonstrations of spectroscopy and the transit method for finding extra-solar planets.