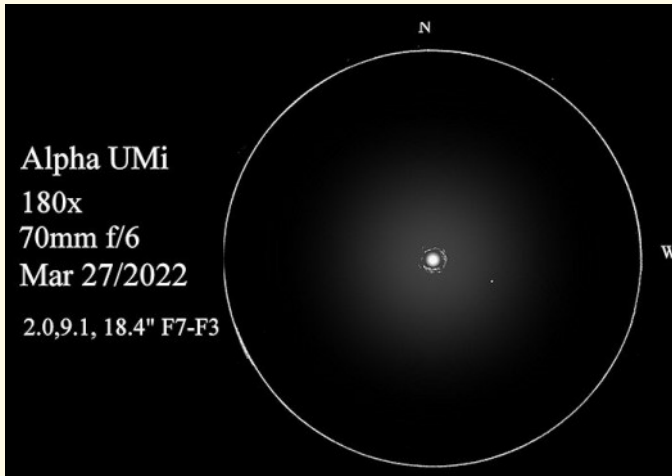


Vol. 27 Issue 1

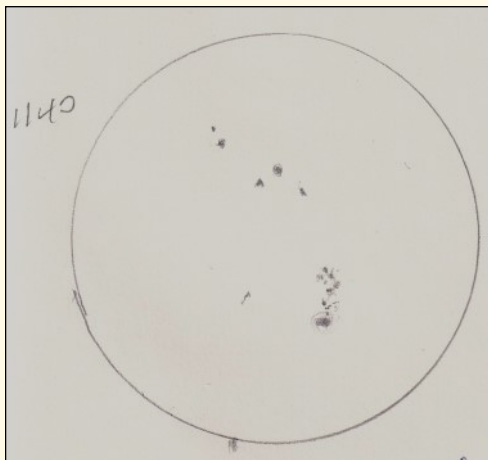
Winter 2026

H O R I Z O N

LA SOCIÉTÉ ROYALE D'ASTRONOMIE DU CANADA
New Brunswick Centre du Nouveau-Brunswick
THE ROYAL ASTRONOMICAL SOCIETY OF CANADA



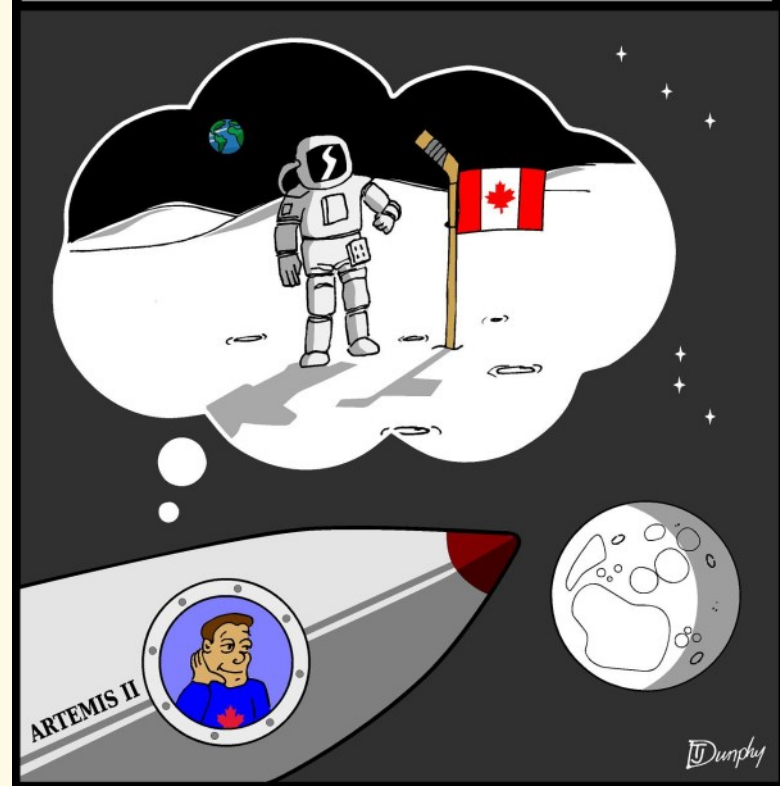
*Above: Polaris A & B sketch by Len Larkin
Below: Questionable sunspots Feb. 4 by C Nason*



Ted's Toon

Ted Dunphy

COL. JEREMY HANSEN PONDERES IF
THERE'S ENOUGH FUEL FOR A QUICK STOP!



**SRAC/RASC Centre du NB Centre
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Social Media: Gerry Allain

Equipment: Chris Weadick

Library: Ted Dunphy

Newsletter Editor: Curt Nason

Centre News

Business Meetings

Third Saturday in some months

Centre Presentation Meetings

Third-week evening of most months

Star Parties 2026

Kouchibouguac May 15-16

Mactaquac July 17-18

Mount Carleton August 14-15

Fundy September 4-5

Kouchibouguac September 18-19

Our membership has increased to 84, thanks and a big welcome to new members since our previous newsletter: Diane Cohen, Peter Jordison, Charline Bourgeois, and Mark Laflamme (welcome back).

We have had two lively and informative presentation meetings over Zoom this year. In January, Stéphane Picard recounted personal highlights of his attendance at the Jasper Dark Sky Festival, and Alan Hindle described his efforts to resolve Sirius and the Pup, with 17 viewers. In February 21 we were treated to an inspiring talk on solargraphy by Maria DiCaprio, Len Larkin's sleuthing to find ten stars that are in a constellation other than indicated by their designation, and an insightful presentation on the details of a solar analemma. Join us for the next meeting on March 17 if you aren't in a pub.



*Ted Dunphy presents David Kerr with the RASC
Explore the Universe certificate (see Page 6)*

Photo by Chris Weadick



*RASC NB 25th Anniversary swag coat
See <https://www.maydaygroup.ca/>*

Photo submitted by Emma MacPhee

Black Holes, Tom Bolton and Little Red Dots

David Hunter

Astronomy and Black Holes

Observing and understanding the skies (astronomy) has played a key role in the development of a rational understanding of the world we live in. This might seem somewhat odd since the skies have often been interpreted as whimsical portents of good or bad will from 'above'. Even today some people consult their horoscopes on a regular basis. Well, who can blame them given the current political climate we are being subjected to?

That the world is rational and highly mathematical is not at all obvious. But the regularity and lawful movement of the heavenly objects was gradually sussed out by patient observers of the heavens. These regularities eventually led Isaac Newton to formulate the universal laws of both gravitation and physical mechanics with the publication of his *Principia* (1686). Although in modern times it is often brushed under the rug by some as an embarrassment, Newton was a committed theist who attributed the rationality of the Universe to a lawgiver.

Newton viewed light as consisting of particles, what we today would call photons. The scientific philosopher and reverend John Michell (1724-1793) was one of the first persons to propose that black holes, or dark stars, could exist. Michell reasoned that if light were made of particles and obeyed

Newton's laws of gravitation, then should a star be massive enough, light particles could not escape from its surface and the star would be dark. A century later, Einstein published his magnum opus theory of gravitation in 1915. Within months of its publication Karl Schwarzschild produced a solution to Einstein's theory of a non-rotating black hole. Einstein would have none of it and even the eminent astronomer Eddington dismissed the idea. But in 1939 Oppenheimer and Snyder, using the Schwarzschild metric, showed how a black hole could form. However, their solution was special in that the initial object had to have perfect spherical symmetry, be non-rotating, and form from a cloud of pressureless dust.

Critics argued that such conditions would not be encountered in nature and that asymmetries would prevent collapse. However, in 1964 Roger Penrose developed the mathematical tools that showed the formation of black holes would be an inevitable consequence of Einstein's theory of gravity. No special initial conditions were necessary. For this Penrose received the Nobel Prize in 2020. His delayed receipt of the prize was because observational astronomy had finally shown incontrovertible evidence for black holes.

Tom Bolton and the first Empirical Evidence for a Black Hole

So how did the first evidence for black holes surface? During the 1960s John Wheeler was leading a renaissance of interest in gravitation physics and black holes, in fact he coined the term 'black hole' in 1968. Note

that at that time one of Wheeler's illustrious former graduate students, Richard Feynman, scoffed at gravitation physics as a backwater, as most physicists were researching particle physics. But astronomers were hot on the trail of black holes. As we shall see, in the end, it is always observation which must confirm or deny theories. As today, the United States was in political turmoil in the 1960s and 1970s. Possibly because of this political climate, either directly or indirectly, or not at all, (I have no evidence of this one way or another), the University of Toronto offered a position for the freshly-minted American astronomer Tom Bolton.

Dr. Bolton was born in Tennessee and had a charming southern accent. I attended one of his courses and a student acquaintance of mine also knew of his character and methods. Dr. Bolton was a man of charm, hard work, and conviction. He did much of his observational work at the David Dunlap Observatory in Richmond Hill, north of Toronto. Towards the end of his career he passionately defended the observatory and worked for the preservation of dark skies and the observatory's continued research function.

In *Nature*, Vol. 235, February 4, 1972 (received January 3, 1972), Dr. Bolton published an article titled *Identification of Cygnus X-1 with HDE 226868*. Cygnus X-1 had been discovered as a strong X-ray source from rocket observations starting in 1964. Incidentally, X-rays are strongly absorbed by the atmosphere, which is why balloon and rocket observations were the first

means to detect astronomical X-ray sources. The first sentence in Bolton's article is "The ninth magnitude BO1b star HDE 226868 is closely coincident with the position of Cygnus X-1 and its associated variable radio source." The radio emissions emitted by Cygnus X-1, as detected by the National Radio Observatory in Green Bank, West Virginia, allowed accurate positioning of the X-ray source.

Bolton conducted spectroscopic radial velocity observations of HDE226868 which indicated an orbital period of 5.6 days. This period matched the periodicity of the X-ray strengths from Cygnus X-1. Much of the research data (but not all) for Bolton's Nature article was obtained at the Dunlap Observatory. Using orbital dynamics, the range of possible masses of the two objects were estimated. The results indicated the compact 'unseen' object had to have a mass greater than three solar masses which, based on theoretical estimates, ruled out a neutron star. Additionally, Bolton argued that the lack of a supernova remnant ruled out a white dwarf or neutron star.



Fig. 1: Artist's impression of the HDE 226858-Cygnus X-1 binary system (Public Domain)

Current estimates of the mass of the Cygnus X-1 black hole is about 20 solar masses and of HDE 226868 20-30 solar masses. Bolton hypothesised that the compact black hole was in orbit around HDE 226868 and was drawing material from the star. This accretion of matter to the black hole would result in violent acceleration of the gas, hence producing X-rays. Shown in Fig. 1 is an artist's interpretation of the Cygnus Black Hole and companion blue star. It is a little bit remarkable that Dr. Bolton passed away on February 4, 2021, 49 years to the day that his groundbreaking black hole paper in *Nature* was published. If one searches for the first discovery of a black hole one may find the names of Louise Webster and Paul Mardin at the Royal Greenwich Observatory. They also published an article supporting this idea in *Nature* in January 1972. They normally get most of the credit, but Tom Bolton, the American-Canadian, was in close sync. For more details visit the Wikipedia article:

https://en.wikipedia.org/wiki/Cygnus_X-1

For an obituary of Dr. Bolton see:

<https://baas.aas.org/pub/2021i0316/release/1>

Little Red Dots

On Christmas Day morning 2021, the James Webb Space Telescope (JWST) was successfully launched. Over a period of several months the JWST was deployed and became operational at the Lagrange 2 location of the Sun-Earth-Moon system. Prior to its launch I calculated its orbital position at L2 as shown in Fig. 2. The JWST is one of the most advanced objects (alien technology) ever created by man, and it operates at a distance of 1.5 million kilometres from Earth.

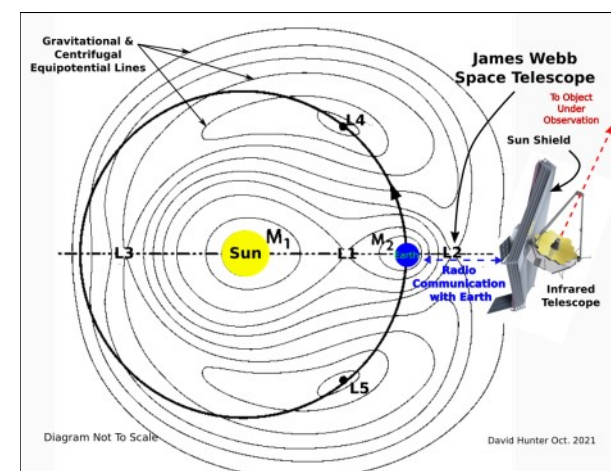


Fig. 2 (David Hunter): Orbit of the James Webb Space Telescope I calculated using the python computer language. Note that L2 is beyond the orbit of the Moon. The Moon is not shown.

The JWST is an infrared space telescope. We know that the Universe started about 13.7 billion years ago in the Big Bang creation event and it has been undergoing expansion ever since that time. The further we look out in space (back in time), the expansion of the Universe causes the objects to be cosmologically red shifted. Objects near the beginning of time will be very red shifted (large cosmological z values) into the infrared. The JWST is an infrared telescope because its primary objective is to understand events closer to time zero. The Hubble telescope works in the optical regime and is not well suited for observing early red shifted cosmological objects.

As early as the 1970s the British Astronomer Royal (1995-2025) Sir Martin Rees and colleagues were researching the formation of

black holes, and in particular what we now call supermassive black holes. Most garden variety black holes have several tens of solar masses and are due to the end state collapse of massive stars. These are the type which LIGO (Laser Interferometer Gravitational-Wave Observatory) has detected when two such objects merge and produce a gravitational wave disturbance. But other types of observations, such as stellar orbital dynamics near the centre of the Milky Way Galaxy point to supermassive black holes with masses of millions or billions of solar masses.

As stated earlier it was generally thought that black holes were the end state in the lives of massive or supermassive stars. But Rees and others were concluding that most galaxies had a supermassive black hole in their centre. Furthermore, it appeared these central supermassive black holes (SMBH) influenced the evolution of their host galaxy even though the SMBH contributed only a very small fraction of the galaxy's overall mass. That is, the character and future of a galaxy was partially or strongly determined by the initial mass of its central black hole. But how could such SMBHs arise through the 'gradual' merger of regular stellar collapse black holes soon enough after the Big Bang and be at centre stage of galaxies?

Images from the JWST started revealing objects, now called Little Red Dots (LRD), that have large red shifts of ~ 5 , were tiny (80-300 parsecs), and clearly appeared very early (0.6 - 1.6 billion years) after the Big Bang (Fig. 3). Their very broad Balmer emission lines indicate, to some, that they are likely SMBHs with a super-active accretion disc

wherein hydrogen gas is rapidly inflowing and being ingested. However, some astronomers (Fabio Pacucci and Abraham Loeb, see: *The Astrophysical Journal Letters*, Volume 989, Number 2) have suggested that LRDs are powered in part by the ingestion of low-spin dark matter and just represent a small portion of a spectrum of compact nascent galactic object types.

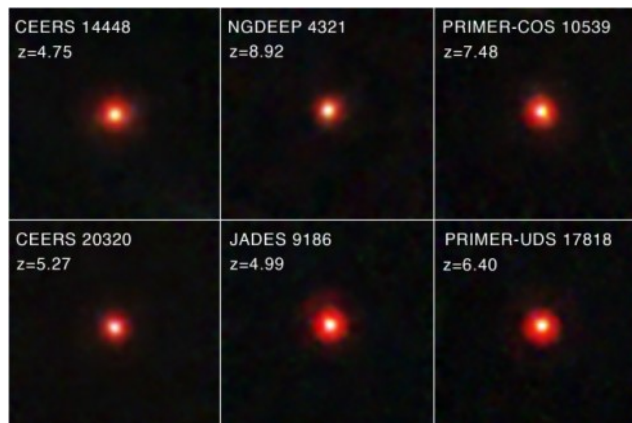


Fig. 3: Images of the Little Red Dots

Credit: NASA, ESA, CSA, STSci, Dale Kocevski (Colby College)-Little Red Dots (NIRCam image), Public Domain

<https://commons.wikimedia.org/w/index.php?curid=157977835>

Concluding, astronomers are at the forefront of delineating the history of the Universe and how it works. As is probably well known, our current physics is incomplete and cannot answer what happens in the heart of a black hole. It is possible that by observing black hole objects a new quantum theory of gravity might be formulated and tested. Hopefully some Canadians might contribute to this ad-

What's Up for Spring

by Curt Nason

The highlight for the months of March to May will be a damn-near total lunar eclipse in New Brunswick around sunrise on March 3.

The **Sun** reaches the vernal equinox at 11:46 on March 20. It is past peak activity but we have seen large and plentiful sunspots this year

New **Moon** dates are March 18, April 17 and May 16. A total lunar eclipse occurs on the morning of March 3, with totality beginning shortly after moonset for all but the north-western edge of the province. In late evening on April 25 it passes $\sim 10'$ below Regulus.

Mercury is dimming near the end of its best evening apparition, reaching inferior conjunction March 7. It is at greatest western elongation April 3 but finding it will be easier later as it brightens. It has a triple conjunction with Saturn and Mars on April 20 and reaches superior conjunction in mid-May.

Venus is 1° right of Saturn after sunset on March 7. It climbs between the Hyades and the Pleiades in late April, and passes within 1° of M35 on May 20. At month's end it sits in the middle of Gemini $\sim 7^\circ$ from Jupiter.

Mars is a challenging morning binocular object through April, and on May 15 it rises an hour before sunrise and sits 10° right of the crescent Moon.

Jupiter resumes prograde motion in mid-March. Around sunset on May 8 Europa's shadow begins a transit that will chase Ganymede's shadow off at 22:26. See the What's Up calendar posted to our website and social media for most of Jupiter's moon action and Red Spot transits between evening twilight and 01:00.

Saturn is in conjunction on March 25 and by May 1 it rises an hour before sunrise.

Uranus slips sunward south of the Pleiades and reaches conjunction on May 22.

Neptune is in conjunction on March 22.,

Comets C/2024 E1 Wierzchos appears low in the southwest in Eridanus and appears west of the Hyades in the first week of April. It is fading but predicted to be brighter than tenth magnitude until about March 10.

C/2026 A1 MAPS is a sun-diving Kreutz comet, a supposed remnant of a huge shattered comet, pieces of which have generated some great comets. It reaches perihelion on April 4, less than a million kilometres from the Sun, and could be spectacular or a dud, depending on whether it survives. Predictions show it reaching an apparent total magnitude of 10 in the first week of March.

Meteor Showers The Lyrids peak on April 22, a day before the first quarter moon. The Eta Aquariids peak May 6 with a waning gibbous moon.

RASC Observing Programs with Certificates and Pins

Emma MacPhee, Observing Chair

The RASC offers eight (nine if you count Explore the Moon twice) observing programs to promote active observing, some of which are based on object lists published in the RASC Observer's Handbook. Observing programs are a great way to learn more about the night sky, challenge yourself, and get the most out of our rewarding hobby. By successfully completing a program, a RASC member may apply for an official certificate for that program (non-members may apply for the Explore the Universe certificate). Several certificates come with lapel pins.

Explore the Universe
Explore the Moon
Messier Catalogue
Finest NGC Objects
Isabel Williamson Lunar Observing
Deep-Sky Gems
Deep-Sky Challenge
Double Stars

I would like to see more members of RASC NB on the national list. Past recipients are:

Explore the Universe
Ivan Robichaud 2003
Emma MacPhee 2003
Charles Doucet 2003
Paul Gray 2006

Don Kelly 2007
Camille LeBlanc 2007
Colette Fortier 2007
Tim Doucette 2010
Detlef Rudolph 2010
Marc Arsenault 2012
Emile Cormier 2015
Jean Marc Drapeau 2019
Yolanda Kippers 2021
Jeff Leger 2021
Marco Landry 2025
David Kerr 2025

Messier Catalogue

Ted Dunphy 2004
Emma MacPhee 2004
Daniel LeBlanc 2004
Charles Doucet 2004
Bob Crossman 2004
Derek Lapointe 2005
Don Kelly 2007
Emile Cormier 2016

Finest NGC Objects

Ted Dunphy 2005
Charles Doucet 2005
Emma MacPhee 2007
Daniel LeBlanc 2007

Isabel Williamson Lunar Observing

Ted Dunphy 2012
Marco Landry 2025

Deep Sky Gems

Emile Cormier 2021

Double Stars

Len Larkin 2022

Light Pollution Abatement and Dark-Sky Development Report

Stéphane Picard

1. Introduction

Since accepting the role of Light Pollution Abatement (LPA) Representative for the Royal Astronomical Society of Canada (RASC) New Brunswick Centre, my work has focused on strengthening dark-sky stewardship across the province while supporting outreach, accreditation initiatives, and collaborative partnerships aligned with both national RASC priorities and provincial tourism strategies.

New Brunswick possesses a unique competitive advantage for astronomy and astrotourism: more than 85% of the province is forested, resulting in extensive regions with naturally low light pollution and exceptional night-sky quality. These conditions position the province to become a premier North American dark-sky destination while supporting rural economic development and expanding tourism during the shoulder and off-season months (October–May).

This report summarizes star party activities, accreditation progress, light pollution monitoring concerns, provincial partnerships, and upcoming national collaboration efforts.

2. Outreach & Star Party Activities (2025)

Public observing events remain one of the most effective tools for light pollution education and community engagement. During

summer and fall the NB Centre supported or participated in five major star parties across existing and prospective dark-sky locations.

Four star parties were successfully hosted at established RASC-certified Dark Sky Preserves (DSP):

Kouchibouguac National Park

- June Star Party and September Star Party Both events attracted strong public participation and demonstrated continued interest in dark-sky programming within protected national park environments. Sky quality remained excellent, reinforcing the park's value as a flagship observing location in Eastern Canada.

Mont Carleton Provincial Park

- August Star Party This event showcased some of the darkest accessible skies in Atlantic Canada. Attendance included both experienced observers and first-time participants, highlighting the educational role of DSPs.

Fundy National Park

- August Star Party The event supported ongoing collaboration with Parks Canada and reinforced Fundy National Park's importance as a cornerstone site for future regional dark-sky development initiatives.

Prospective Dark Sky Location

Mactaquac Provincial Park

- Summer Star Party This event served as an exploratory outreach activity at a provincial park identified as a strong candidate for future certification. Public response and observing conditions confirmed the site's strong potential for accredi-

tation pending future provincial investment.

3. Development of the Fundy Dark Sky Corridor

Significant progress is underway toward establishing the Fundy Dark Sky Corridor, a regional initiative designed to create a connected network of certified dark-sky destinations along the Bay of Fundy coastline. Once completed, the corridor is expected to include six certified dark-sky locations.

Currently accredited sites

- Fundy National Park DSP
- Irving Nature Park — Urban Star Park

Proposed Accreditation Sites

- Municipality of Fundy–St. Martins: Pursuing Dark Sky Community designation (Dark Sky International)
- Hopewell Rocks Provincial Park
- Fundy Trail Provincial Park
- New River Beach Provincial Park

New Brunswick Tourism, Heritage & Culture leadership — including Parks NB — has approved these three provincial parks to move forward with accreditation planning during 2026–2027, contingent upon funding allocation. While most locations are expected to pursue RASC certification, some may also seek Dark Sky International accreditation to align with tourism and economic development strategies. The corridor concept represents a transformational opportunity, linking conservation, astronomy outreach, and tourism development into a unified regional identity.

4. Provincial Accreditation Expansion

Beyond the Fundy region, several additional communities and sites have been identified for future accreditation projects awaiting provincial funding:

- Miramichi
- Neguac
- Pokeshaw and Black Rock (between Bathurst and Caraquet)
- Negotkuk (Tobique First Nation in North-west New Brunswick)

These initiatives demonstrate growing provincial recognition of dark skies as both cultural and economic assets.

Phase Two Provincial Parks (2027–2028)

Discussions with provincial partners include future accreditation planning for Mactaquac Provincial and North Lake Provincial Parks.

If current timelines proceed as anticipated, New Brunswick could emerge as one of North America's most concentrated networks of certified dark-sky destinations within the next several years.

5. Light Pollution Monitoring & Concerns

New Brunswick currently hosts four RASC-certified dark-sky sites. Two of these locations are experiencing measurable pressure from increasing artificial light.

Irving Nature Park

Recent measurements indicate rising sky brightness associated with expanding commercial and industrial development within the City of Saint John. Continued monitoring and municipal engagement will be necessary to preserve observing quality.

Fundy National Park

A noticeable increase in sky glow has been observed following the refurbishment of the fishing wharf in the Village of Alma. The lighting impact is visible approximately 5–10 km into the park's southeast region, demonstrating how localized lighting infrastructure can affect protected dark-sky environments.

These cases reinforce the importance of proactive lighting education, municipal collaboration, and improved lighting design standards.

6. National Collaboration/RASC Initiatives

Upon accepting the LPA role, I met with Bernie Hasselman (RASC Ottawa) and Curt Nason to discuss national priorities involving light pollution abatement and accreditation efforts. These discussions connected ongoing work at the Centre level with broader RASC National initiatives led through the Light Pollution Abatement Committee and accreditation programs.

Additionally, earlier conversations with Roland Dechesne (RASC Calgary) contributed to discussions surrounding new dark-sky designation categories currently under development at the national level. These new designations are expected to begin rollout within the coming year and may significantly expand participation opportunities for communities and protected areas.

7. National LP Conference Participation

I am registered to attend the National Light Pollution Conference (virtual) scheduled for March 28.

Purpose

To bring together RASC Centre LPA representatives and the National Light Pollution Abatement Committee to:

- Build shared understanding of light pollution challenges
- Align efforts across Canada
- Advance practical tools and initiatives

Goals

- Clarify roles of RASC and LPAC
- Strengthen coordination around Dark Sky Sites
- Improve outreach collaboration nationwide

Expected Outcomes

- Shared national understanding of RASC leadership in light pollution abatement
- Increased awareness of Dark Sky Community and Site initiatives
- Development of practical tools such as municipal by-law templates
- Coordinated outreach and shared astro-tourism resources
- Identification of next steps for national collaboration and resource development

Participation will help ensure New Brunswick remains aligned with national standards and positioned to benefit from emerging resources.

8. Strategic Outlook

The expansion of dark-sky initiatives directly supports the Province of New Brunswick's evolving tourism strategy, which emphasizes:

- Nature-based tourism growth
- Rural economic diversification
- Increased visitation outside peak summer months

- Sustainable experiences rooted in environmental stewardship

Dark skies represent a powerful, low-impact tourism asset uniquely suited to these objectives. If current accreditation projects advance as scheduled, New Brunswick will possess one of the most comprehensive and accessible dark-sky networks in North America, positioning the province as a global leader in astro-tourism and night-sky conservation.

9. Conclusion

The 2025 season marked meaningful progress in outreach, partnerships, and long-term planning. Continued collaboration between RASC, provincial leadership, municipalities, Indigenous communities, and national committees will be essential to maintaining momentum. The NB Centre is well-positioned to play a leadership role in protecting night skies while advancing astronomy education and sustainable tourism across the Province.



RASC NB Outreach Events and Handouts									
Year	# of Events	People At Events	Live Feed	Youth	Star Finders English	Star Finders French	Moon Guides English	Moon Guides French	Volunteer Hours
2016	219	9498			1984	115	2290	87	988
2017	248	9951	8441		2276	162	2262	131	1937
2018	187	7289	37,922	>1300	1788	170	1635	79	1355
2019	240	7036	46,675	2997	1320	216	1520	213	1950
2020	171	1859	161,688	954	817	22	636	125	1079
2021	131	731	60,240	565	108	0	46	0	1160
2022	173	12,952	63,122	10,192	586	60	472	106	1809
2023	168	23,419	9787	20,612	556	223	452	110	1789
2024	186	12,362	12,304	6805	352	92	506	87	2331
2025	167	4907	61,810	2506	607	167	808	90	2237

Types of Outreach Events							
Year	Presentation	Night Observing	Day Observing	Youth Group	School Talks	Exhibition	Observ./Planet'm
2016	31	55	39	19	54	11	10
2017	61	89	22	19	50	6	1
2018	50	80	13	18	20	5	1
2019	73	94	10	22	36	5	0
2020	86	43	5	8	29	0	0
2021	65	48	6	1	11	0	0
2022	72	52	6	4	34	4	0
2023	60	13	8	14	69	4	0
2024	101	23	8	15	33	6	0
2025	76	36	7	21	26	1	0

The Long Road to Other Galaxies

Last issue I described how astronomers used the parallax method to determine the distance to the stars, but that method is limited to most of those we see within our Milky Way galaxy. A century ago, thanks to the work of a woman and two men, the Milky Way was found to be just one of innumerable galaxies in the night sky.

In the late 1800s astronomers were mounting spectroscopes on telescopes to spread the wavelengths of starlight, much as a rainbow is the spreading of the visible wavelengths of sunlight. Dark lines seen within a star's spectrum are due to elements such as hydrogen and calcium absorbing the light at specific wavelengths, which are characteristic for each element. If a star is moving toward or away from us, the wavelengths shorten or lengthen proportional to the star's velocity. This is known as the Doppler shift, and since red light has longer wavelengths than blue the light from a receding star is said to be red shifted.

During the second decade of the twentieth century, Vesto Slipher at Lowell Observatory in Arizona was measuring the Doppler shifts of spiral nebulae, cloud-like star clusters that were thought to be part of our galaxy. He was surprised to find that most were receding, and those thought to be farther were receding proportionately faster. A decade earlier

er Henrietta Leavitt, one of the hard-working human computers at Harvard College Observatory, was tasked with looking for variable stars in the Magellanic Clouds, the two brightest and closest of those mysterious nebulae.

Cepheid variables are unstable giant stars that expand and contract on a regular cycle, brightening quickly and dimming slowly. Painstakingly analyzing glass photographs shipped from the Harvard Observatory in Peru, Leavitt identified and calculated the periods of many Cepheids in the Small Magellanic Cloud (SMC). She published a paper in 1912 showing that the brighter the Cepheid, the longer its period. This is now called Leavitt's Law.



Henrietta Swan Leavitt (1868 - 1921)

(Public Domain)

A star's visual brightness depends upon its intensity and distance from us. Leavitt assumed correctly that the SMC is far enough from us for all of its stars to be at relatively

equal distance, and any difference in brightness among them would be due their intensity only. Therefore, if a nearby Cepheid had its distance calculated by parallax, then the distance to one in the SMC with the same period could be determined by comparing their visual brightness and applying the inverse square law. For example, if one were one hundred times dimmer it would be ten times farther. Using the known parallax distance to the prototype Cepheid in the constellation Cepheus, Leavitt calculated the SMC was about one hundred times farther, still within what some astronomers considered to be the Milky Way.

A century ago, Edwin Hubble was examining photos of the Andromeda Nebula he had taken using what was then the largest telescope in the world. He discovered a Cepheid variable and used the Leavitt Law to show it was definitely beyond the Milky Way, proving that those mysterious spiral nebulae are separate galaxies, including the Magellanic Clouds. He continued to find Cepheids in other galaxies, some of which had their red shift measured by Vesto Slipher and thereby calibrating red shift to Leavitt's Law and parallax. The distance to galaxies too far to image individual stars could now be determined by its red shift.

Astronomers refer to these methods of distance measurement as cosmic yardsticks, each building on a previous one and depending on the accuracy of parallax. There are other methods based on the brightness of supernovas and star clusters, but this is enough physics for one day.

Try a Triad of Eclipses in 2026

For many New Brunswickers the thrill of viewing the total solar eclipse two years ago is still fresh in our minds and shared eagerly when the topic arises. This month sees the beginning of the first of two eclipse seasons for 2026 and, although they won't be tourist attractions, we will be treated to three highlights in the daytime and night skies.

Eclipse seasons, periods when the Moon and Earth line up with the Sun so that one casts its shadow on the other, last approximately five weeks and occur about 19 days earlier each year. Lunar eclipses occur at full moon and solar eclipses at the new moon phase. The eclipses can be total or partial, and whether we can see them from home depends upon location and weather.

If you happen to be in Antarctica on February 19 you will have lots of sunshine to catch an annular eclipse, which occurs when the Moon's angular diameter is not great enough to cover the Sun completely. A partial solar eclipse will be seen over the southern tip of South America and southern Africa. Southern New Brunswick experienced an annular eclipse in May 1994 but we see nothing of this one.

Since eclipses happen two weeks apart a total lunar eclipse comes for breakfast on

March 3, but with an asterisk. The partial phase begins at 5:50 and the Moon is totally within Earth's umbral shadow at 7:04. Essentially we get to see totality but the Moon sets just prior to 7:04 for all but those near the western border of the province. The Moon will have assumed its reddish-orange eclipse coat well before then so don't expect an influx of nitpicking lunar eclipse chasers to visit McAdam or Edmundston.



Total Lunar Eclipse in September 2015

Paul Owen photo

August 12 is a day awaited by stargazers annually as that is around the peak of the Perseid meteor shower. This year the day hosts an even more anticipated event, a partial solar eclipse. The Moon will take a bite out of the Sun before 2 p.m. and cover less than half of it an hour later, after which it retreats from the Sun for an hour. If you have stored eclipse glasses from the 2024 event so that they are undamaged they can be re-used safely on this day. A bonus will be a moonless night giving darker skies for the Perse-

ids. Meteorologists, please be as kind to us as you were on April 8, 2024.

A total eclipse can be seen on August 12 by travelling to eastern Greenland, western Iceland or northern Spain. There might still be vacancies on eclipse tours if you have some travel money saved up. Although the average weather prospects for Iceland are less positive, Reykjavik will have two minutes, 29 seconds of totality, about 40 seconds longer than the maximum in Spain. Recall that the prospect for early April sunshine in New Brunswick was much less positive than for Texas, but I read that Texas licence plates were seen here in April 2024.

Beginning around 11:33 p.m. on August 27 we are treated to all stages of a deep lunar eclipse, with up to 93 percent of the Moon's diameter entering Earth's dark shadow by 1:42 a.m. The Moon is restored to fullness at 2:52.

Shadow play between the Earth and Moon are big events for amateur astronomers and major draws for public outreach when the time is convenient. The partial solar eclipse on August 12 occurs at an opportune time. Hopefully the weather will cooperate and those who witnessed the spectacular 2024 event don't shrug this one off with a "meh."