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Journal

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PROMOTING ASTRONOMY IN CANADA

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Jellyfish Nebula

Great Images

By Shelley Jackson

This image of Bode's Galaxy (Messier 81) was taken by Shelley Jackson. "There is so much going on in what we think is just empty space. There are several galaxies in this image and the Integrated Flux Nebula (IFN) is so interesting. All that interstellar dust being illuminated by the combined star light of the Milky Way is amazing." She used a Samyang 135-mm lens @ f/4 with a ZWO ASI2600 MC cooled to –10 °C, a ZWO filter wheel EFW, an Optolong UVIR cut filter, on a Sky-Watcher GTI mount. 327 × 120 sec = 10h 48m of total integration time.

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Société Royale d'Astronomie du Canada

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Great Images / Superbes images

Katelyn Beecroft imaged the Jellyfish Nebula (IC 443) from her home in London, Ontario. She said, "When processing the image, I decided to go a more creative route and started with a HOS style palette which led to an interesting purple-and-pink-hued overall image. I usually keep my images fairly traditional but narrowband is already falsely coloured when processing so I thought I would keep the fun colours that this turned out to be. Hope you enjoy it as well!" She used an Askar FRA400 telescope with a 72-mm aperture, f/5.6 with a ZWO ASI2600mm Pro, gain 100, 26 MP. 66 × 300s Antlia 4.5 nm Hα filter; 61 × 300s Antlia 4.5 nm SII filter; 64 × 300s Antlia 3 nm OIII filter. 15 × 60s for each Antlia V-Pro RGB filter. Total time of integration: 16h 40min.

Journal

The *Journal* is a bi-monthly publication of The Royal Astronomical Society of Canada and is devoted to the advancement of astronomy and allied sciences. It contains articles on Canadian astronomers and current activities of the RASC and its Centres, research and review papers by professional and amateur astronomers, and articles of a historical, biographical, or educational nature of general interest to the astronomical community. All contributions are welcome, but the editors reserve the right to edit material prior to publication. Research papers are reviewed prior to publication, and professional astronomers with institutional affiliations are asked to pay publication charges of $100 per page. Such charges are waived for RASC members who do not have access to professional funds as well as for solicited articles. Manuscripts and other submitted material may be in English or French, and should be sent to the Editor-in-Chief.

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President's Corner

Connecting in an Unconnected World

Brendon Roy (Thunder Bay), President
novationheart@hotmail.com

I consider myself something of a news enthusiast. By that, I mean I try to stay informed about current events happening around the world and rarely miss a full news cycle. I also make a conscious effort to seek out information from a variety of sources, across the political spectrum, in order to better understand what is happening. Even then, I remain mindful that not everything is reported accurately or without bias.

More recently, I have found myself wondering how much of what we see and hear may be influenced by AI-generated content or misinformation—designed not to inform, but to distract or mislead. If we are not careful, it is easy to be drawn into narratives that may not fully reflect reality.

As I write this, conflict has once again flared in the Middle East, with the potential for broader global impact. It raises an important question: what can any of us do in the face of such uncertainty?

For me, the answer lies in connection. It means stepping away from the constant stream of news and engaging more directly with our communities—through local groups, shared activities, and even time with family and friends. Spaces like the RASC provide a welcoming environment where people can come together around a shared passion for astronomy and the open exchange of ideas.

It can sometimes feel as though these contributions are small in the face of larger global challenges, but every effort matters. Positive community engagement—no matter how modest—helps build understanding, resilience, and connection.

As we move into the summer months, many Centres will be entering star party season. This is a wonderful opportunity to get out under dark skies, share your passion for astronomy, and connect with others who share your interests. These moments help foster friendships, strengthen communities, and remind us of the value of coming together.

Later this month, we will also hold the Annual General Meeting of The Royal Astronomical Society of Canada. This is an important opportunity for members to reflect on the past year and to help shape the future of the Society. Positions on the Board of Directors and various committees will be open, and I encourage anyone with an interest in contributing to step forward or to nominate someone who would be a good fit. This is our opportunity to guide the direction of the Society together.

On a personal note, it is hard to believe that it has already been a full year since I stepped into this role. I would like to thank everyone I have had the opportunity to work with over the past year—those who have brought forward new ideas and contributed to the continued growth of the Society.

I look forward to seeing many of you at the Annual Meeting, where we can continue to build on our shared goals and set a course for the year ahead.

Brendon Roy, President ✶

News Notes / En manchette

Compiled by Jay Anderson

Big brother for WISPIT 2b

Astronomers have observed two planets forming in the disc around a pre-main-sequence star in Aquila named WISPIT 2. The star is named after the astronomical survey Wide Separation Planets In Time (WISPIT). Having previously detected one planet (WISPIT 2b), the team has now employed European Southern Observatory (ESO) telescopes to confirm the presence of another (WISPIT 2c). These observations, and the unique structure of the disc around the star, indicate that the WISPIT 2 system could resemble a young Solar System at an estimated age of around 5 million years.

"WISPIT 2 is the best look into our own past that we have to date," says Chloe Lawlor, PhD student at the University of Galway, Ireland, and lead author of the study published in *The Astrophysical Journal Letters*.

The system is only the second known, after PDS 70, where two planets have been directly observed in the process of forming around their host star. Unlike PDS 70, however, WISPIT 2 has a very extended planet-forming disc (~380 AU) with distinctive gaps and rings. "These structures suggest that more planets are currently forming, which we will eventually detect," Lawlor says.

"WISPIT 2 gives us a critical laboratory not just to observe the formation of a single planet but an entire planetary system," says Christian Ginski, study co-author and researcher at the University of Galway. With such observations, astronomers aim to better understand how baby planetary systems develop into mature ones, like our own.

The first newborn planet found in the system—WISPIT 2b—was detected last year, with a mass estimated to be ~4.9 times that of Jupiter and orbiting the central star at 57 au. "This detection of a new world in formation really showed the amazing potential of our current instrumentation," said Richelle van Capelleveen, PhD student at Leiden Observatory, the Netherlands, and leader of the previous study.

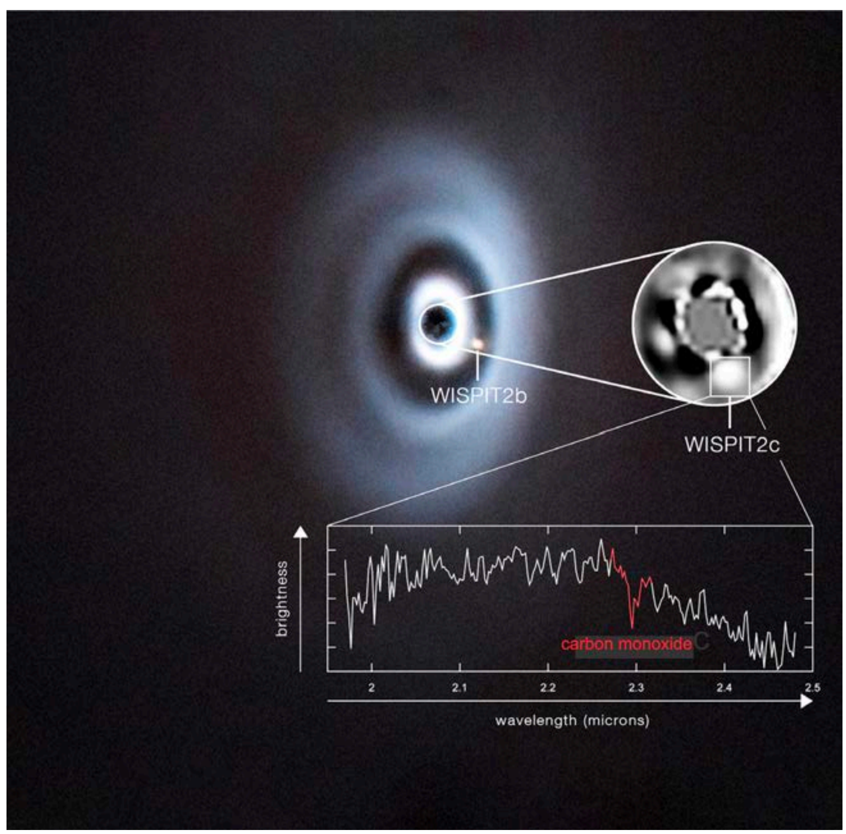

Figure 1 – This image shows two planets forming around the young star WISPIT 2. The images at the top were obtained with ESO's Very Large Telescope (VLT) using the SPHERE instrument. Credit: ESO.

After an additional object was identified near the star, measurements made with ESO's Very Large Telescope (VLT) and the VLT Interferometer (VLTI) confirmed its planetary nature. The new planet—WISPIT 2c—is four times closer to the central star and is twice as massive as WISPIT 2b. Both planets are gas giants, like the outer planets in our Solar System. The separation between the planets is large enough that they are unable to collect the material between them, leaving an intervening dust ring.

To confirm the existence of WISPIT 2c the team employed the SPHERE instrument (Spectro-Polarimetric High-contrast Exoplanet Research) on ESO's VLT, which captured an image of the object. The team then used the GRAVITY+ (which combines the infrared wavelengths from four telescopes) on the VLTI to confirm that the object was indeed a planet. "Critically, our study made use of the recent upgrade to GRAVITY+, without which we would not have been able to get such a clear detection of the planet so close to its star," says Guillaume Bourdarot, study co-author and researcher at the Max Planck Institute for Extraterrestrial Physics, Garching, Germany.

Spectroscopic observations reveal an atmosphere with a strong CO absorption signature, a gas that is prominent in the atmospheres of young giant planets but not in stellar photospheres warmer than ~5300 K. No hydrogen was detected in the spectrum from 2c, unlike its companion WISPIT 2b, suggesting that 2c has a dusty atmosphere. Modelling by the research team, using data from GRAVITY+, suggests a temperature between 1500 and 2600K for the new planet. A third planet was also suspected but could not be confirmed.

Both planets in WISPIT 2 appear in gaps within the disc of dust and gas circling the young star. These gaps result from each planet's development: particles in the disc accumulate, their gravity then pulling in more material until an embryo planet forms and a gap is opened in the disk. The remaining material, around each gap, creates distinctive dust rings in the disc.

Besides the gaps that the two planets were found in, there is at least one smaller gap farther out in the WISPIT 2 disc. "We suspect there may be a third planet carving out this gap" says Lawlor, "potentially of Saturn mass owing to the gap being much narrower and shallower". The team are eager to make follow-up observations, with Ginski noting that "with ESO's upcoming Extremely Large Telescope, we may be able to directly image such a planet."

Compiled in part with material provided by the European Southern Observatory.

Evolution of the Dragonfly telescope

What began in 2013 as a novel telescope made from combining just three commercially available telephoto camera lenses has undergone a dramatic metamorphosis into one of the world's more powerful telescopes. The Dragonfly Telephoto Array has evolved into MOTHRA (Massive Optical Telephoto Hyperspectral Robotic Array), a next-generation telescope built from 1,140 Canon EF 400mm f/2.8 lenses mounted on 30 robotic mounts and operating at a remote mountain site in Chile.

"This is an ambitious effort to build something astronomers have long wanted: a practical way to directly see the cosmic web glowing in space, and to get it done in years rather than in decades," said Roberto Abraham, professor in the David A. Dunlap Department of Astronomy & Astrophysics and associated faculty at the Dunlap Institute for Astronomy & Astrophysics at the University of Toronto. "MOTHRA harnesses advances in optics, detectors, and computing to open an entirely new window on the Universe. There's nothing else like it."

MOTHRA is the successor to the Dragonfly Telephoto Array, developed by Abraham and by Pieter van Dokkum of Yale University and deployed in New

Figure 2 – A rendering of part of the MOTHRA telescope. Each of the mounts has 38 high end Canon telephoto lenses, equipped with special filters to observe the cosmic web. The completed telescope will have 30 mounts, in two buildings, with a total of 1,140 lenses. Credit: Dragonfly FRO.

Mexico. The project was made possible with seed funding from the Dunlap Institute for Astronomy & Astrophysics, and with the Institute's continued support.

Dragonfly was designed to exploit the extraordinary anti-reflection coatings of modern telephoto lenses, allowing astronomers to detect structures far fainter than conventional telescopes can see. Since its commissioning, Dragonfly has discovered new classes of galaxies and ghostly stellar structures, including Dragonfly 44, a galaxy roughly the mass of our own Milky Way but composed of 99.9 percent dark matter, and NGC1052 DF-2, a galaxy seemingly devoid of any dark matter at all. These discoveries have ignited a resurgence of interest in the "low surface brightness Universe" made up of large and faint objects that are difficult to study with conventional telescopes.

MOTHRA represents a dramatic leap forward in this area. By combining 1,140 lenses, the array will achieve the light-gathering power of a 4.8-meter telescope, making it the largest all-lens telescope in the world. This light gathering power is combined with a field of view much larger than that achievable with conventional telescopes, making the array at least an order of magnitude more powerful than its nearest competition.

The new instrument also introduces a first-of-its-kind distributed-aperture hyperspectral design, using tilting specialized ultra-narrow bandpass filters, giving it fine wavelength resolution over a wide range of wavelengths. The filters are placed in front of the lenses, allowing them to have a much narrower bandpass than a location near the focal plane. This allows MOTHRA to isolate the faint glow of hydrogen gas in intergalactic space and bypass atmospheric emissions.

In its current configuration, MOTHRA cameras have a resolution of 2 arc seconds/pixel and a final stacked image resolution of 3 arc seconds. The lenses have a diffraction-limited resolution of 1 arc second, giving room for some improvement in later designs.

"MOTHRA is a telescope designed around a single idea: maximize discovery space for the dim glow of intergalactic gas," said van Dokkum. "The combination of a huge effective aperture, wide field, and tunable ultra-narrowband filtering opens a new observational regime."

The new telescope's primary goal will be to detect the ultra-faint gas between galaxies that traces the distribution of dark matter. This gas outlines the "cosmic web", a vast and complex network of structures seeded shortly after the Big Bang and stretched across billions of light-years as the Universe expanded. MOTHRA will not only reveal where this gas lies, but also how it flows along the filaments of the web.

To scale the project from Dragonfly to MOTHRA, Abraham and Dokkum created Dragonfly FRO, a new Focused Research Organization (FRO) dedicated to building the telescope. FROs are non-profit companies that operate with the speed and focus of technology startups, aiming to solve scientific bottlenecks and build high-impact research infrastructure within a defined multi-year timeline.

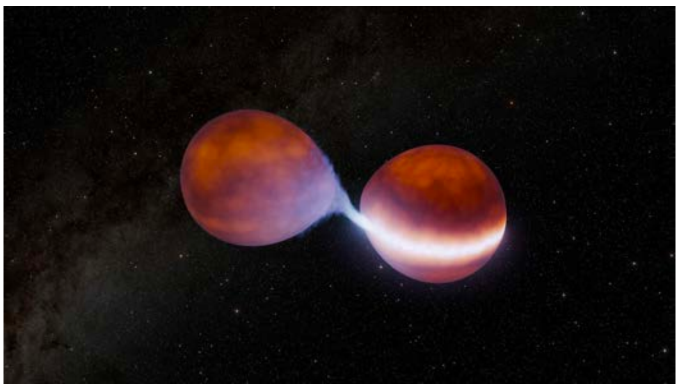

Figure 3 – This illustration shows a very tight-knit pair of brown dwarfs with one siphoning material from the other. Ultimately, the two are expected to merge to form a new star or, alternatively, the brown dwarf gaining the extra mass will ignite to become a star. Either way, this pair of failed stars will have created a brilliant new star. Credit: Caltech/R. Hurt (IPAC)

The launch of Dragonfly FRO and MOTHRA was done in partnership with Convergent Research and has been made possible through a donation from Alex Gerko, the founder and CEO of XTX Markets, a world-leading algorithmic trading firm based in the UK.

"Alex's impact on this project extends well beyond funding," said van Dokkum. "He has been a hands-on strategic partner from the start—shaping how we structured the organization, helping us find the right project partners and site, and guiding us through procurement and infrastructure challenges that would have slowed us down considerably."

MOTHRA is being built at Obstech / El Sauce Observatory in Chile. The telescope's construction started in the spring of 2025 and it is expected to become fully operational by the end of 2026. To learn more about Dragonfly FRO and the MOTHRA telescope – including its mission, technical approach, and updates – visit mothratelescope.org.

Compiled with material provided by the Dunlap Institute.

Dim stellar pair has hope of brighter future

Brown dwarfs get a bad rap in the stellar world, often labeled as "failed stars" for their inability to sustain nuclear fusion at their cores. The mass of these objects falls between planets and stars, ranging from 13 to 80 times the mass of Jupiter. Because they aren't massive enough to sustain fusion, they are far fainter and cooler than their stellar comrades.

Now, a new finding led by researchers at Caltech shows how these dim bulbs can join together to shine more brightly. Searching through archival observations captured by the Zwicky Transient Facility (ZTF) at Caltech's Palomar Observatory, researchers have identified a very tight-knit pair of brown dwarfs in which one is actively siphoning material from the other. The stars' sub-stellar nature gives them a visual magnitude of ~20.

Ultimately, the brown dwarfs are expected to merge to form a new star; alternatively, the brown dwarf gaining the extra mass will ignite to become a star. Either way, a pair of failed stars will have created a brilliant new star.

"The failed stars get a second chance," says Samuel Whitebook, a Caltech graduate student and lead author of a new report on the findings appearing in *The Astrophysical Journal Letters*. "Brown dwarfs don't have internal engines like stars do, but this result shows they can exhibit very interesting dynamic physics."

The finding is a first of its kind: Until now, this type of mass transfer between binary objects had only been seen in much heavier objects, such as white dwarfs, which are the dead corpses of stars like our sun.

The August 2026 *Journal* deadline for submissions is 2026 June 1.

See the published schedule at rasc.ca/sites/default/files/jrascschedule2026.pdf

Fig 4: This artist's impression visualises the massive star γ-Cas and its small-but-dense white dwarf companion. Image: ESA

The brown dwarf pair, named ZTF J1239+8347 (or ZTF J1239 for short) was spotted after scientists sifted through a database known as ZVAR, or ZTF Variability Archive, which is a collection of all-sky data taken repeatedly by ZTF since 2017. The database, which contains 2 billion objects, reveals how those objects change over time. In the case of ZTF J1239, the object was found to significantly change in brightness every 57 minutes.

A further analysis of the source revealed that it is a pair of dim brown dwarfs orbiting around each other very closely; in fact, the whole system would fit within the distance between Earth and the moon. The objects, which are roughly 60 to 80 times the mass of Jupiter, lie about 1,000 light-years away in Ursa Major.

The scientists are not sure how the two faint orbs initially came together; it's possible that a third star could have gravitationally pushed them closer together from separate systems. Once together, the stars would have spiraled closer and closer until one of the brown dwarfs would have puffed up in size due to the gravitational influence of the other, becoming less dense.

"When one star's gravity is overcome by the other's, matter starts flowing from the less dense star to the denser star," Whitebook says. "It's like the matter sloughs off through a nozzle." This nozzle directs material from one brown dwarf to a fixed spot on the other, which then heats up and glows in blue and ultraviolet light. The rotation of this hot spot, as the two brown dwarfs circle around each other, led to the periodic light curve observed by ZTF.

While other types of stars are known to transfer mass between them, this is a first in the world of brown dwarfs. "These are very exotic objects," Prince says. "We've told some of our colleagues about them, and they didn't believe such a thing exists."

Because the newfound pair is faint and close to Earth, the scientists estimate that there are many more like this out there to be found.

"We expect the Vera Rubin Observatory to detect dozens more of these objects," Whitebook says. "We want to find more to understand the population and how common it is. We predict this happens more than you think."

Prepared with material provided by Caltech.

Diminutive neighbour outshines host in x-rays

An invisible companion consuming material from the naked-eye star γ Cas has been revealed as the culprit for unusually bright and hard X-rays coming from the stellar system. This closes the case on a mystery that has puzzled astronomers for more than fifty years. The star gamma-Cas (γ-Cas) is visible in much of the Northern Hemisphere every cloudless night—it makes up the central point of the distinctive "W"-shaped constellation Cassiopeia. It's a binary star with a period of 203 days.

γ Cassiopeia is the poster child for Be stars: hot, variable, rapidly rotating B-type stars surrounded by circumstellar discs. It's a broad class, normally composed of main-sequence stars, but sometimes includes sub-giants and giants. In classical Be stars, emission lines are produced in circumstellar material ejected from the star, but γ Cas is an unusual member of the class in its further emission of x-rays.

Unique high-resolution observations made by the *X-Ray Imaging and Spectroscopy Mission (XRISM)* revealed that the X-rays originating from γ Cas are linked by radial-velocity measurements to the orbital motion of a white dwarf star companion and not to the Be star. The observations are detailed in a new paper led by Yaël Nazé of the University of Liège, Belgium.

"There has been an intense effort to solve the mystery of gamma-Cas across many research groups for many decades. And now, thanks to the high-precision observations of XRISM, we have finally done it," says Yaël.

Despite its prominence in the night sky, it has been shrouded in mystery since 1866 when Italian astronomer Angelo Secchi noticed something odd in its light signature. Its hydrogen 'fingerprint' was bright, whereas in stars like our own Sun this normally shows up as a dark line. This weird feature inaugurated a new class of stars, called "Be" stars, merging the "B" associated with hot blue-white massive stars with the "e" from the peculiar hydrogen emission.

It took several decades before astronomers understood that these emissions were coming from a rotating disc of matter ejected by the fast-spinning star. Such discs can build and disperse over time, resulting in variations in the star's brightness. This makes it a popular target for amateur astronomers who conduct variable-star observations.

For some time, it has been known that γ Cas must have a low-mass companion star and, since it was invisible to spot directly with telescopes, astronomers assumed it might be a white dwarf—a compact object with the mass of the Sun but the size of Earth.

In the mid-1970s, a new mystery emerged: γ Cas was discovered to shine in unusual high-energy X-rays. Further studies found the origin of this X-ray glow to be mostly coming from an extremely hot 150-million-degree plasma, shining with a brightness some 40 times greater than typically expected for such massive stars.

With the dawn of X-ray space telescopes including ESA's *XMM-Newton*, NASA's *Chandra* and the Germany-led *eROSITA*, astronomers have found around two dozen γ Cas -type stars with similar, unusual X-ray emission, making them a special group among Be stars in general. Over the years, the explanation for the high-energy X-rays boiled down to two competing theories. Could the star's local magnetic fields be interacting with that of its surrounding disc, producing the hot material? Or, are X-rays generated by the Be star's disc material falling onto the white dwarf companion?

Finally, an instrument exists with high enough precision to solve the mystery: *XRISM*'s high-resolution spectrometer Resolve. In a dedicated observation campaign *XRISM* revealed that the signatures of the hot plasma follow the orbital motion of the otherwise invisible companion star. In other words, the white dwarf companion consumes material from γ Cas, emitting X-rays as it does so.

"The previous work using *XMM-Newton* really cleared the way for *XRISM*, enabling us to eliminate numerous theories and prove which of the last two competing theories was correct," says Yaël. "It's extremely satisfying to have direct evidence to solve this mystery at long last!"

Understanding that γ Cas objects are Be stars paired with a white dwarf that's accreting material, solves the X-ray mystery. But it also opens up another curiosity in terms of how the wider population of this type of binary systems forms and evolves. Such pairs were long expected to be common, mainly among low-mass stars. However, new research shows they are rarer than predicted and instead tend to occur in high-mass Be stars.

"We think the key is in understanding how exactly the interactions take place between the two stars," says Yaël. "Now that we know the true nature of γ Cas, we can create models specifically for this class of stellar systems, and update our understanding of binary evolution accordingly."

"It's incredible to see how this mystery has slowly unfolded over the years," says Alice Borghese, an ESA Research Fellow specialising in the field of high-energy astrophysics. "*XMM-Newton* did so much of the groundwork in ruling out various theories about γ Cas. And now with the next generation of advanced instrumentation, *XRISM* has brought us over the finish line."

"This wonderful result underlines the strong collaboration between *XRISM*'s Japanese, European, and American teams," adds Matteo Guainazzi, ESA's *XRISM* Project Scientist. "This international team combines the technical and scientific expertise needed to solve the X-ray Universe's biggest mysteries and open new avenues for research." ✶

Constructed with material provided by the European Space Agency.

Research Article / Articles de recherche

Toward a Frequency-based Framework Relating Gravity and Electromagnetism

by Mauricio Vélez-Domínguez
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Abstract

This work proposes a frequency-dependent interpretation of gravitational interactions, describing gravity as an energy–frequency gradient arising from the presence of matter in space rather than spacetime curvature, and explores this description as a possible organizing principle relating gravitation and electromagnetism. Applying this formulation at atomic and large-scale limits yields results consistent with standard theoretical expectations. At cosmological scales, the model further suggests that the oscillatory frequency associated with the gravitational field has undergone redshift since the early Universe. The framework therefore suggests the presence of a primordial gravitational signature in the high-frequency gravitational-wave band (~10^3 Hz), which may constitute a component of the stochastic gravitational-wave background (GWB). Without asserting a formal unification, the framework outlined here offers a potential pathway toward relating gravitational and electromagnetic interactions through a common frequency-based description.

I. Introduction

Attempts to establish a relationship between gravity and electromagnetism date back to the work of Michael Faraday, whose experimental investigations sought evidence of a connection between the two forces (Faraday, 1851)[1]. However, no comprehensive theoretical framework has yet succeeded in unifying them (Kaku, 2004)[2]. On one hand, Einstein's general theory of relativity describes gravity as a geometrical property of spacetime and successfully accounts for the large-scale structure of the Universe (Einstein, 1916)[3]. Quantum mechanics, by contrast, governs physical phenomena at subatomic scales and provides the theoretical framework for the electromagnetic, strong, and weak nuclear interactions (Feynman, 1985)[4]. Despite their respective successes, these two theories remain fundamentally incompatible (Hawking, 2017)[5].

Building on Werner Heisenberg's uncertainty principle, Vélez Domínguez (2026)[6] proposes a frequency-dependent gravitational model that reframes gravitation as a phenomenon arising from spatial gradients in the frequency of the intrinsic energy of space induced by the presence of matter. Extending this concept, the present work offers a possible pathway toward identifying a guiding principle for relating gravity and electromagnetism. This framework treats the undulatory frequency of the intrinsic energy of space as a descriptive parameter for the propagation of gravitation, rather than invoking spacetime curvature. A key feature of this approach is its covariance with general relativity, ensuring consistency across reference frames. In this sense, both formulations rely on the covariant nature of curvature and volume as geometric properties of space (Kaku, 2004)[7].

II. Methods

This first-principles gravitational framework is motivated by a thought experiment inspired by James Clerk Maxwell's assertion that gravitation is "traceable to the action of a surrounding medium (and that) every part of this medium possesses, when undisturbed, an enormous intrinsic energy, and that the presence of dense bodies influences the medium so as to diminish this energy wherever there is a resultant attraction." Maxwell adds "As I am unable to understand in what way a medium can possess such properties, I cannot go any further in this direction in searching for the cause of gravitation" (Maxwell, 1864)[8].

Seeking a plausible cause for Maxwell's observation that the intrinsic energy of the surrounding medium is reduced in the presence of dense bodies, the present framework models space as an undulatory field whose local frequency and energy density are diminished by matter. In consequence, gravitation arises from the change, or gradient, of the energy associated with the decrease in the intrinsic energy of space by virtue of the presence of matter, and not from the bending of the geometry of space, as proposed by Einstein (Vélez Domínguez, 2026)[9].

The mathematical formalism that captures this energy-frequency interpretation is consistent with Newton's predictions for the weak-field limit and with Einstein's general theory of relativity for the strong-field limit (Vélez Domínguez, 2026)[10]:

$$F_g = G\frac{Mhf}{c^2r^2} \qquad (1)$$

Where (F_g) is the gravitational relationship that emerges from the change in energy and frequency caused by the presence of the object of mass (M) and a point-mass particle of mass (m); (G) represents the Newtonian constant of gravitation, 6.67×10^{-11} m^{3}kg^{-1}s^{-1} (NIST, 2022)[11]; (h) is Planck's constant, 6.626×10^{-34} J Hz^{-1} (NIST, 2022)[12]; (c) is the speed of light in a vacuum, 299,792,458 m s^{-1} (NIST, 2022)[13]; (f) is the frequency of the point-mass particle; and (r) the distance separating the objects.

The appearance of the gravitational constant (G), Planck's constant (h), and the relativistic constant for the speed of light in a vacuum (c) in equation 1, suggests the potential intersection of gravity, quantum mechanism, and relativity (Rovelli, 2014)[14].

Incorporating Heisenberg's uncertainty principle into the description of gravitation (Vélez Domínguez, 2026)[15] offers a possible avenue for relating gravitational and electromagnetic interactions, since the theoretical framework governing the electromagnetic force is fundamentally rooted in quantum mechanics and the uncertainty principle (Hawking, 2017)[16]. Maxwell's theory of electricity and magnetism was subsequently reformulated to be consistent with the principles of quantum mechanics (Feynman, 1985)[17]. General relativity, on the other hand, is a classical theory that views gravitation as the curvature of space-time without incorporating Heisenberg's uncertainty principle (Hawking, 2017)[18].

To illustrate the implications of the proposed framework, we consider a thought experiment comparing the electrostatic and gravitational interactions at the atomic scale. Imagine an electron orbiting the nucleus of a hydrogen atom. The electron is kept in orbit by the electromagnetic force. Like gravitation, the electrical force between static charges diminishes in proportion to the square of the distance separating them. This relationship known as Coulomb's Law (Coulomb, 1788)[19]:

$$F_e = k_e \frac{|q_1 q_2|}{r^2} \qquad (2)$$

Where (F_e) is the electrostatic force that the particle of charge (q_1) exerts on the second particle of charge (q_2), and (K_e) is the proportionality constant, or Coulomb's constant (8.987×10^9 N·m²/C²) (Ohanian and Market, 2007)[20]. Here, (q_1) is the charge of the proton in the nucleus (1.602×10^{-19} C) (NIST, 2022)[21]; (q_2) is the charge of the electron in orbit, (1.602×10^{-19} C) (NIST, 2022)[22]; and (r) is the distance between the electron and the nucleus (5.29×10^{-11} m) (NIST, 2022)[23].

Substituting the numerical values:

$$F_e = 8.987 \times 10^9\ \mathrm{N{\cdot}m^2/C^2} \times \frac{|(+1.602 \times 10^{-19}\ \mathrm{C}) \times (-1.602 \times 10^{-19}\ \mathrm{C})|}{(5.29 \times 10^{-11}\ \mathrm{m})^2}$$

Solving yields $F_e = 8.23 \times 10^{-8}$ Newtons, in agreement with the accepted value for the electrostatic force between a proton and an electron in the hydrogen atom (Ohanian and Market, 2007)[24].

The gravitational force between the proton in the nucleus and the orbiting electron is next evaluated. Using Newton's Universal Law of Gravitation (Ohanian and Market, 2007)[25], the gravitational attraction between the electron and the proton in the hydrogen atom is given by:

$$F_g = G \frac{Mm}{r^2} \qquad (3)$$

Where (F_g) is the force of gravity; (G) is the gravitational constant, 6.67×10^{-11} N·m² /kg² (NIST, 2022)[26]; (M) is the mass of proton, 1.672×10^{-27} kg (NIST, 2022)[27]; (m) is the mass of the electron, 9.109×10^{-31} kg (NIST, 2022)[28]; and (r) is the distance between the proton and the electron, or Bohr's Radius (5.29×10^{-11} m) (NIST, 2022)[29].

Inserting the numerical values:

$$F_g = 6.67 \times 10^{-11}\ \mathrm{N{\cdot}m^2/kg^2} \times \frac{1.672 \times 10^{-27}\ \mathrm{kg} \times 9.109 \times 10^{-31}\ \mathrm{kg}}{(5.29 \times 10^{-11}\ \mathrm{m})^2}$$

The calculation yields $F_g = 3.6 \times 10^{-47}$ Newtons, consistent with established results for the gravitational force between a proton and an electron in the hydrogen atom (Ohanian and Market, 2007)[30].

The model's agreement with standard theoretical expectations and observational data at the atomic level can be examined by calculating the gravitational force between the proton in the nucleus and the orbiting electron in a hydrogen atom using the frequency-dependent formulation (equation 1):

$$F_g = G \frac{Mhf}{c^2 r^2} \qquad (1)$$

To proceed, the electron's frequency (f) appearing in the numerator is first determined using Planck's relationship between energy and frequency, which states that a particle's energy (E) is proportional to its frequency (f), with Planck's constant (*h*) as the proportionality factor (Planck, 1901)[31]:

$$E = hf \qquad (4)$$

Moreover, based on Einstein's energy equation,

$$E = mc^2 \qquad (5)$$

Where (E) denotes the rest energy associated with a particle of mass (m), and (c) is the speed of light in a vacuum (Einstein, 1905)[32]. Since both Planck's energy-frequency relation (equation 6) and Einstein's mass-energy relation (equation 7) describe the same physical energy, they may be equated to relate the quantum-mechanical and relativistic frameworks (de Broglie, 1925)[33] and (Penrose, 2010)[34]:

$$fh = mc^2 \qquad (6)$$

Rearranging the expression for the frequency yields:

$$f = \frac{mc^2}{h} \qquad (7)$$

Here, the electron mass m = 9.109×10^{-31} kg; the speed of light in a vacuum c = 299,792,458 m s⁻¹; and Plank's constant h = 6.626×10^{-34} kg·m²/sec.

Inserting the corresponding values:

$$f = \frac{9.109 \times 10^{-31}\mathrm{kg} \times (299{,}792{,}458\ \mathrm{m\ s^{-1}})^2}{6.626 \times 10^{-34}\ \mathrm{kg{\cdot}m^2/sec}}$$

The resulting value corresponds to the frequency (f) of the point mass particle (m): f = 1.2357×10^{20} Hz.

Substituting the numerical values into equation 1, the Gravitational Constant (G) is 6.67×10^{-11} m³kg⁻¹s⁻¹; the proton (nuclear) mass (M) = 1.67×10^{-27} kg; the electron frequency (f) = 1.2357×10^{20} Hz; Planck's constant (h) is 6.626×10^{-34}

kg·m²/sec; the speed of gravity (c) = 299,792,458 m s⁻¹; and Bohr's radius is (r) = 5.29 × 10⁻¹¹ m:, yields:

$$F_g = \frac{6.67 \times 10^{-11}\ m^3 kg^{-1} s^{-1} \times 1.672 \times 10^{-27} \times 1.2357 \times 10^{20}\ seconds^{-1} \times 6.626 \times 10^{-34}\ kg{\cdot}m^2/sec}{(299{,}792{,}458\ m\ s^{-1})^2 \times (5.29 \times 10^{-11}\ m)^2}$$

The resulting value, $F_g = 3.6 \times 10^{-47}$ N, is consistent with calculations made based on Newton's universal law of gravitation (Ohanian and Market, 2007)[35].

Furthermore, the comparison of the magnitudes of the electrostatic and the gravitational forces indicates that the ratio between the electrostatic interaction and the gravitational force is:

$$\frac{F_e}{F_g} = \frac{8.23 \times 10^{39}\ \mathrm{N}}{3.62284 \times 10^{-47}\ \mathrm{N}} = 2.27 \times 10^{39}$$

Stating that the electrostatic force (F_e) is 2.27×10^{39} times stronger than the gravitational force (F_g) (Ohanian and Market, 2007)[36].

To place the magnitude of a factor of 10^{39} in context, consider the radius of a hydrogen atom, $5.291 \times 10^{-11} m$ (NIST, 2022)[37]. On the other hand, the radius of the observable Universe, is estimated to be $4.4 \times 10^{26} m$, or about 46.5 billion light-years (NASA, 2017)[38], exceeding that of a hydrogen atom by approximately 10^{36} (obtained by dividing $4.4 \times 10^{26} m$ by 5.291×10^{-11}). By comparison, the electromagnetic interaction is roughly 10^{39} times stronger than gravitation.

The fact that the electrostatic force is 10^{39} times stronger than gravity is known as the Hierarchy Problem and raises questions about our current understanding of the Universe (Peskin, 2025)[39]. Current solutions include the possibility that gravity "leaks" into other dimensions (Arkani-Hamed, Dimopoulos, Dvali, 1998)[40] and (Randall and Sundrum, 1999)[41], but there is no final explanation for why such a vast discrepancy exists (Peskin, 2025)[42].

This work explores whether the pronounced disparity between gravitational and electromagnetic interaction strengths can be understood within a frequency-dependent characterization of gravitation.

III. Results and Discussion

It is generally accepted that the conditions under which the gravitational and electrostatic forces become equivalent occur only at extremely high energy scales (Hawking, 2017)[43], for example at the Planck scale or during the earliest phases of the Universe (Kaku, 2004)[44].

Extending the model to cosmological scales, this work builds on Vélez Domínguez (2024)[45] and suggests that the undulatory frequency associated with the gravitational field may have undergone a Universe-wide process of attenuation, resulting in a reduced effective strength of gravity over cosmic time. In this interpretation, gravitation is proposed to have experienced a form of cosmological redshift, whereas the electromagnetic force has not. The resulting cosmological gravitational redshift is therefore suggested as a possible explanation of the origin of the observed disparity in magnitude between gravitational and electromagnetic interactions. Within this framework, such redshift is therefore proposed to be the scaling factor that establishes the ratio of proportionality between gravitation and the electromagnetic force.

To test this hypothesis, let 2.27×10^{39} represent the order of magnitude by which gravitation is proposed to have redshifted—that is, to have experienced a decrease in its original frequency—as the undulatory frequency of the intrinsic energy attenuates over cosmic time. Expressed mathematically:

$$F_g \cdot z = F_E \tag{8}$$

Where (z) is the cosmological gravitational redshift that scales the relationship between the gravitational and the electrostatic forces. Substituting in the value of z results in:

$$F_g \cdot 2.27\, x\, 10^{39} = F_{EM} \tag{9}$$

Further substituting F_g and F_E by their corresponding equations, yields:

$$\mathrm{G}\frac{\mathrm{Mhf}}{\mathrm{c^2 r^2}} \cdot z = k_e \frac{|q_1 q_2|}{r^2} \tag{10}$$

To maintain frequency as the guiding principle of the framework, the redshift relations for light, expressed in terms of frequency shift, are employed (Ferreira, 2019)[46]:

$$\frac{f_{emit}}{f_{obsv}} = z + 1 \; or \; z = \frac{f_{emit} - f_{obsv}}{f_{obsv}} \tag{11}$$

Here, f_{emit} denotes the high energy frequency associated with the initial stages of the Universe and f_{obsv} is the current, redshifted frequency of the gravitational field. In this context, this frequency characterizes what Maxwell referred to as the intrinsic energy of the surrounding medium (space), which gives rise to a force of attraction in the presence of a dense body (Maxwell, 1864)[47].

The observed redshifted frequency (f_{obsv}), corresponding to the current gravitational undulation, is obtained by solving:

$$f_{obsv} = \frac{f_{emit}}{(z+1)} \tag{12}$$

By contrast, the primordial undulatory frequency associated with the intrinsic energy of space during the early stages of the Universe may be characterized by an upper limiting scale, given by the Planck's Frequency (Planck, 1899)[48] and (NIST, 2022)[49].

$$\text{Planck's frequency: } f_{\mathrm{p}} = \frac{1}{t_p} = \sqrt{\frac{c^5}{\hbar \mathrm{G}}} \tag{13}$$

Where (t_p) is Planck's time; $\frac{1}{t_p}$ is Planck's frequency (NIST, 2022)[50]; (c) is the speed of light in a vacuum; ($\hbar$) is the reduced Planck constant; and (G) the gravitational constant.

Filling in the variables in equation 17 results in 1.855×10^{43} Hz (NIST, 2022)[51].

To find the redshifted frequency of gravitation, we now substitute in the values of z and f_{emit} into equation 16 above:

$$F_{obsv} = \frac{1.855 \times 10^{43}\ \text{Hz}}{2.27 \times 10^{39} + 1}$$

Which yields 8.15×10^3 Hz, or 8,150 Hz.

Notably, the resulting characteristic frequency falls within the high-frequency gravitational-wave band, spanning approximately 1-10^4 Hz (Kip Thorne, 1995)[52]. As noted by Thorne (1995)[53], "…a number of interesting gravitational-wave sources fall in the high-frequency band: the stellar collapse to a neutron star or black hole in our galaxy and distant galaxies, which sometimes triggers supernovae; the rotation and vibration of neutron stars (pulsars) in our galaxy; the coalescence of neutron-star and stellar-mass black-hole binaries ($M < \sim 1000 M_\odot$) in distant galaxies; and possibly such sources of stochastic background as vibrating loops of cosmic string, phase transitions in the early Universe, and the big bang in which the Universe was born".

Furthermore, according to Servant and Simakachorn (2024)[54], "Signals from local string networks can easily be as large as the big bang nucleosynthesis/cosmic microwave background bounds, with a characteristic strain as high as 10^{-26} in the 10 kHz band, offering prospects to probe grand unification physics in the 10^{14} to 10^{17} GeV energy range".

Given the extreme separation of scales involved, the emergence of this agreement is unlikely to be attributable to random coincidence and instead suggests the presence of an underlying physical connection. It may therefore be hypothesized that the 10^3 Hz high-frequency band of gravitational waves constitutes a potential contribution to the stochastic gravitational-wave background, possibly linking the predicted 8.15×10^3 Hz cosmological redshifted signal to the gravitational-wave background (GWB), the relic gravitational radiation from the early Universe.

IV. Conclusions

This work proposes that gravity and electromagnetism may be related through a frequency-dependent parametrization of gravitation. Within this framework, the large disparity in magnitude between the gravitational and electromagnetic interactions is interpreted as reflecting the extent to which the oscillatory frequency of the gravitational field has attenuated, or redshifted, since the early Universe. Treating this cosmological gravitational redshift as a scaling factor between the two interactions effectively aligns their magnitudes, suggesting that gravity and electromagnetism may have been unified during the high-energy stages of cosmic evolution, when the primordial gravitational frequency lay within a rage comparable to that characterizing present-day high-frequency gravitational waves. The framework outlined in this work therefore offers a potential avenue for exploring a frequency-based connection between gravity and electromagnetism.

An indirect means of testing the hypothesis presented here is through the study of gravitational-wave signals originating from the early stages of cosmic history. Gravitational-wave detectors, such as the Laser Interferometer Gravitational-Wave Observatory (LIGO)[55], are sensitive to frequencies within the range predicted by this model. Should gravitational-wave observations reveal a characteristic frequency consistent with the redshifted primordial oscillations of the intrinsic energy of space proposed here, such evidence would lend support to the view that a frequency-dependent description of gravitation may provide a viable pathway towards relating of gravitational and electromagnetic interactions.

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Astronomical Art & Artifact

The T.W. Webb Manuscript in the RASC Archives Rare Book Collection

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Abstract

In 1910, the RASC was given a manuscript by the Rev'd T.W. Webb, of *Celestial Objects for Common Telescopes* fame. By that time, Webb had achieved a posthumous status approaching that of a patron saint of amateur astronomers. This manuscript is different from Webb's observational notebooks owned by the RAS in London. The manuscript is described here for the first time, and its possible purpose is explored.

Fame Uncourted

Some astronomical manuals can enjoy a notably long life and confer on their authors a notable fame (at least among those with similar astronomical interests). The Rev'd Thomas William Webb's (1806–1885, Figure 1) *Celestial Objects for Common Telescopes* (first published in 1859) was one such work, and its humble author apparently endured with equanimity the ensuing name recognition. In Webb's case uncourted celebrity (of the limited sort available to astronomers) did not alter his good-natured character in the slightest (Mee 1893, 75–79).

His influence among amateur astronomers through his publications extended beyond the British Isles. *Celestial Objects* remained in print in successive editions from the mid-Victorian period to the beginning of manned space flight with the Mercury and Vostok programs. In 1963, Leif Robinson (1939–2011), a future editor-in-chief of *Sky & Telescope* (and honorary RASC member), wrote that:

> "Probably no other book so completely describes the realm of the amateur visual observer as Celestial Objects for Common Telescopes by Thomas William Webb (1807–1885). For more than a century it has been a treasury of descriptive information about the sun, moon, planets, and deep-sky wonders" (Robinson 1963, 95).[1]

Had Webb lived into the 1890s, it is more than likely that he would have been among the first to be elected to honorary membership in the Astronomical and Physical Society of Toronto. Webb's position among Canadian amateurs around 1900 is sufficiently signaled in the pages of *The Canadian*

Figure 1

Astronomical Handbook for 1907 (the first edition of the Society's *Observer's Handbook*). In the section on observing Solar System objects, Andrew Elvins remarks that: "Webb's 'Celestial Objects' should be consulted by every observer…" (44), and C.A. Chant notes following his "The Finest Colored Pairs" that: "For slight variations and also for a much longer list consult Webb's 'Celestial Objects.'" (71).

By that time, Webb had become a sort of "patron saint," or even "tutelary deity" of amateur astronomers. And, like a saint, a figure such as Webb could be memorialized through relics, such as manuscripts.[2]

The Manuscript's Donor

The RASC acquired the manuscript by gift in 1910 from G. Parry Jenkins (1860–1941, Figure 2). The memorializing function of the manuscript as a relic of Webb is made clear in Jenkins's account:

> "Webb was at one time Prebendary [i.e. a member of the college of canons] of Hereford Cathedral, and I lived for

over ten years in the City of Hereford. I got possession of the Note Book in 1889 when I was there, and have treasured it ever since. I now wish to donate it to the Library of the R.A.S.C. in Toronto, where it will, I know, be well looked after for the sake of the one man who probably did more than any one else in his day to popularize astronomy" (as reported in Chant 1910, 162).

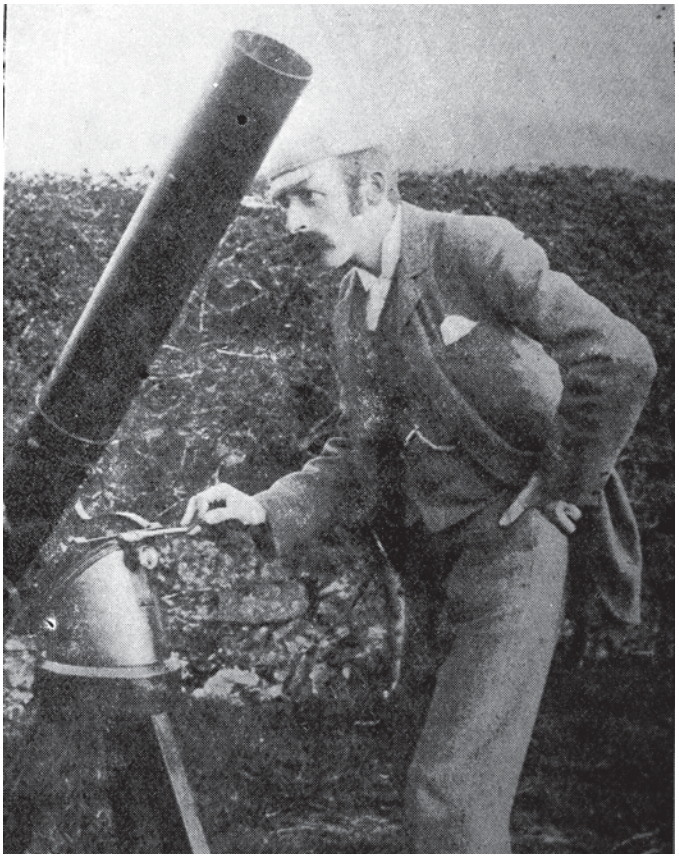


Figure 2 — G. Parry Jenkins

Jenkins himself was a figure of some importance in amateur astronomy in his native Wales, and subsequently in Canada. He was the President of the Hamilton Astronomical Society when it became the Hamilton Centre of the RASC in 1909 (Broughton 1994, 187). He also contributed to the RASC's *Journal* (Jenkins 1911). The Rev'd Silas Evans's capsule biography of Jenkins provides a few more details:

> Mr. G. Parry Jenkins, FRAS - Born in Llancynfelin, in the county of Cardigan, in September, 1860. He was a bank manager in Colwyn Bay for some years, where he was a diligent astronomer, observing, writing, and lecturing. He moved to Canada in 1902, and settled in Toronto [recte Hamilton], where he continued to lecture. In addition he was a Fellow of the Royal Astronomical Society, and a member of the British Astronomical Association, and also a fellow of the Astronomical Society of Canada [i.e. RASC, but he was only a member], and was a member of the Canadian Eclipse Expedition to Labrador in 1905. For some years he was the Vice President of the Astronomical Society of Wales, and he was a fine astronomer, and diligently and actively supported the science, especially through his lectures" (Evans 1923, 285).[3]

Chant saw to it that readers of the *Journal* knew of the donation, and he provided a very brief report of the manuscript, illustrated with a few images (Chant 1910). Unfortunately, he didn't have the space to explore the purpose for which Webb compiled the work (What is the nature of the data it contains? How was it gathered? How was it used?), nor did he note or illustrate its most distinctive feature, the colour code for locating topical information. Curiously enough, someone at the RASC added instructions in pencil to the improvised paper cover "Notebook of/Rev/T. Webb/Don't Catalogue"(!) (Figure 4). That is the advice that seems to have been followed when a catalogue of the former national library of the RASC was published (Broughton 1970).

Figure 3

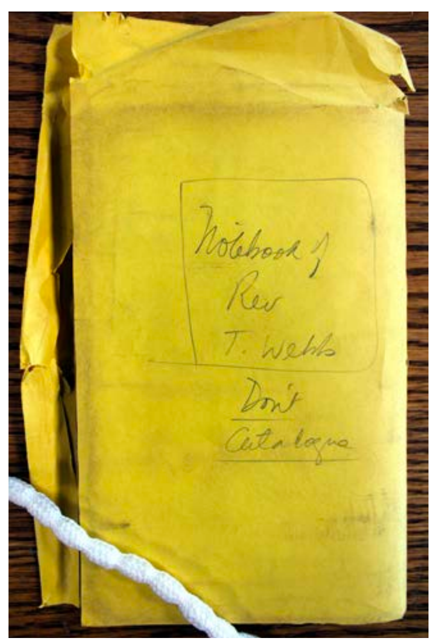


Figure 4

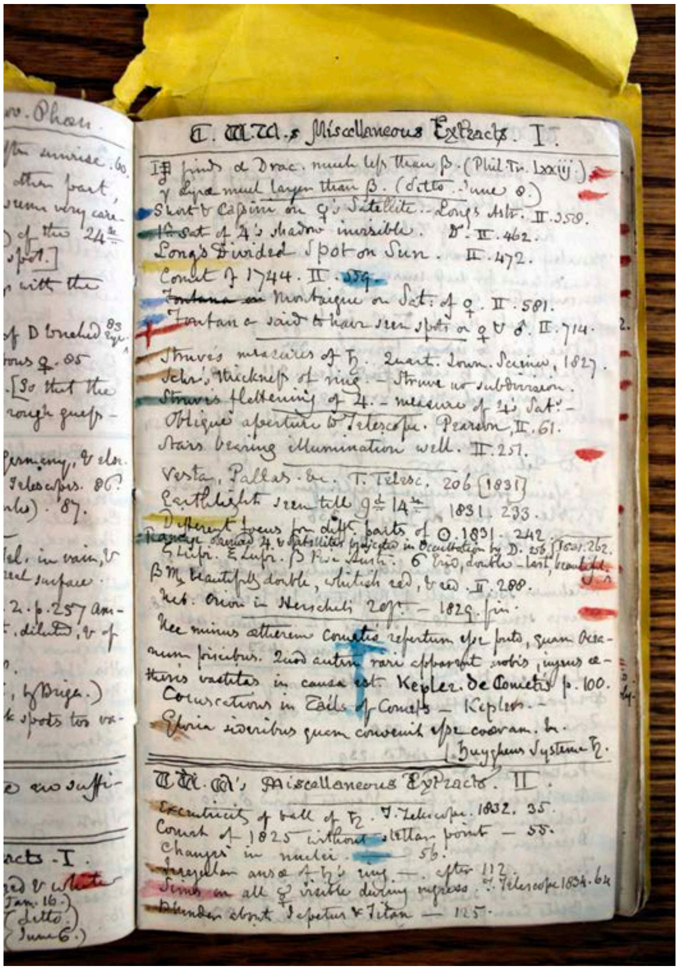


Figure 5

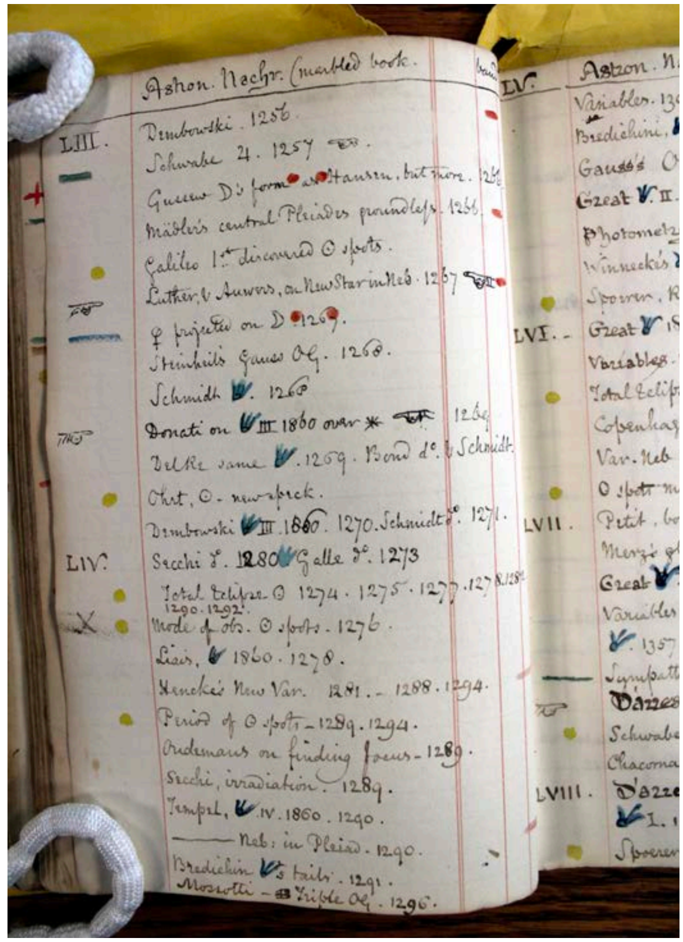


Figure 6

Description of the Manuscript

The 133 pages of the manuscript measure approximately 11.43 cm by 18.1 cm. The manuscript is unpaginated, and most of the pages are unruled (Figure 5). A minority, however are ruled neatly in a ledger format—25 lines in light blue running horizontally, with the page divided into five columns, first a narrow column bounded by a red vertical line, then a wider central column terminated by two closely spaced red vertical lines, and then three very narrow columns, each separated by a red vertical line (pages 3–6, 97–113, and 115–131 Figure 6).

Webb tends to follow the ruling when he encounters it. The book is bound in full leather (Figure 3). The covers are slightly worn at the edges, and the wear is worse on the spine, while the front and back panels are abraded in places. The hinges are cracked but still holding.

Webb was not the first person to own the notebook. The original owner was a Dr. Abraham Walker, who used it sparsely for accounts for the years 1825–1827, occupying only pages 123–129. When Webb adopted the book for his own use, he turned it so that what had been the back became the front, and the top became the bottom (i.e. Walker's entries therefore appeared at the back of the book, and upside down compared to Webb's entries). The notebook is late Georgian and was likely made sometime between ca. 1770 and ca. 1825. In adapting a book someone else had started to his own use, Webb was practising Victorian thrift. It was probably not an unusual practice.

Pages 4–6, the second half of 111–112, the second half of 119–122, and 130–133 are unused.

Webb made his entries in pen and ink (the pen was most likely an avian quill, but could have been a metal nib, or perhaps both were used).

Before turning to the most distinctive feature of the manuscript, something should be said about the content and purpose of the manuscript. On the inside of the front cover, above where Webb placed his signature, he identified the manuscript as an "Astronomical Index" Figure 7.

What is an "Astronomical Index"? It's not a standard genre of astronomical book, although many books on astronomy in the age of print were equipped with indices.

Webb lived before the present age of electronic information, and its promise of easy retrieval, manipulation, and replication. Information in his day (unless committed to human memory) was recorded in purely physical form, as text or numbers conveyed and stored in symbols inked on paper,

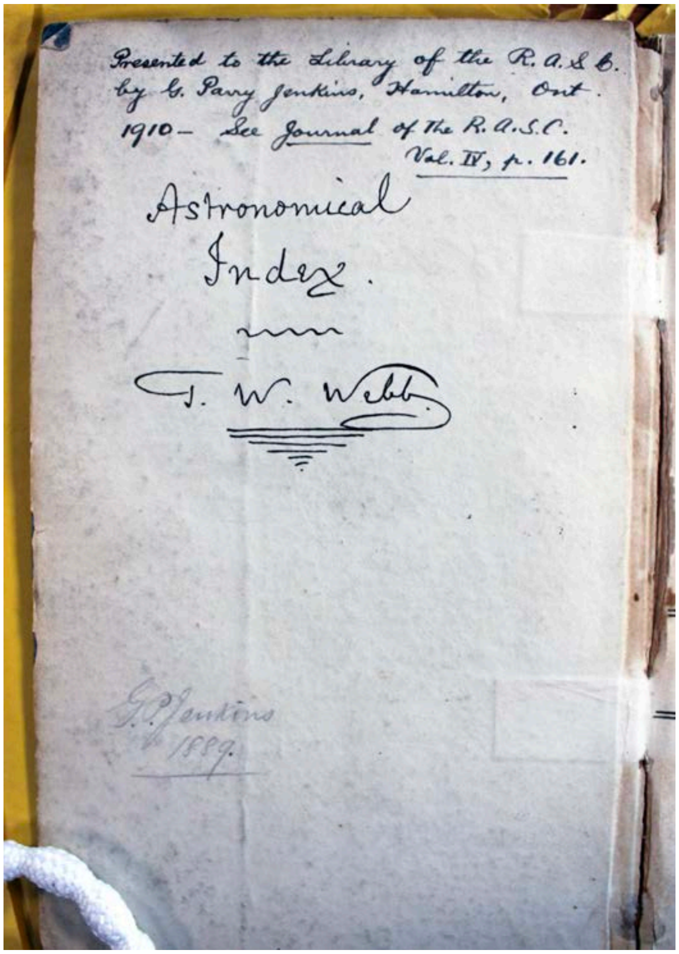


Figure 7

as very real physical objects (scientific images were also concrete physical things). If a copy of something was desired, a printed physical copy had either to be purchased or created by hand (the invention of printing in the 15th century had not made manuscript technology obsolete!). And a means to locate information after it was created was essential. Webb's "Astronomical Index" was a very personal tool to do just that for the technology he had adopted for information storage. An entry in his index for a book may specify the author(s), title (could be abbreviated), subject, volume number, & pages, and for a periodical the name of the publication (could be abbreviated), author(s), subject, volume and issue numbers, and pages. And it identifies the physical location of the information, either printed or manuscript, in his personal library, or in an institutional collection somewhere. So an entry may read "Astron. Nachricht.—in marbled book" (77), or "…extant in *this* little book only. Annuaire. 1842. Arago's Life of H [=William Herschel]" (77).

There are valuable clues in Webb's "Astronomical Index" as to how he collected the citations and built up his personal astronomical library: "...I find since I have received [them] —there are many lacunae in my set [of the Astronomische Nachrichten]. The following notes I made in [the] Library [of the] R.A.S." (113).

The most distinctive feature of the manuscript is the colour code. Watercolours were employed (possibly in cake form and applied with a brush). The intention seems to have been to assign a particular colour to a particular celestial object, or type of celestial object. The motive seems to have been to make the retrieval of information more efficient. Rather than having to rely solely on text to identify which celestial objects were mentioned in the sources listed on a page of his "Astronomical Index," he could tell at a glance just by looking at the colours.

Colour Code

blue line—comets; Venus

blue cross—comets

blue dot—from p. 95 forward replaces the blue line or the blue cross for comets

light-blue daub—Venus

green line—Jupiter; Moon/Earth; (occasionally) Saturn

yellow line—Sun

red line—stars (including multiple stars); clusters; nebulae; Sun (occasionally)

red cross, or sword—Mars

rosé line—Mercury

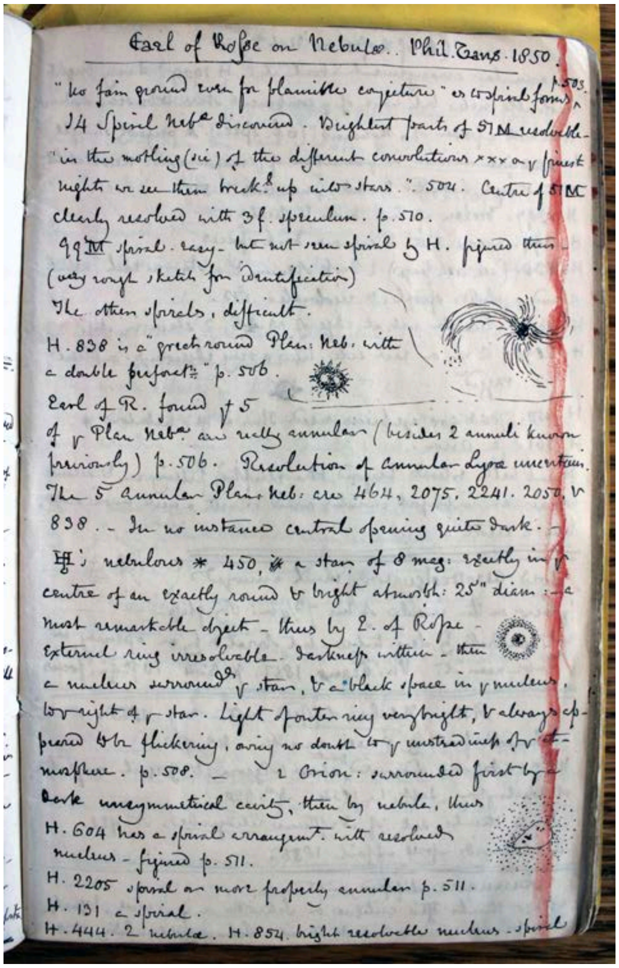
brown line—Saturn

brown waves—Moon

brown daubs (two)—Moon

Note: if successive citations are to the same celestial object the coloured lines could be drawn vertically rather than horizontally.

As can be seen from the tabulation of the colour code, Webb's implementation of his system wasn't perfect. He occasionally used the same colour for several different celestial objects or phenomena, and sometimes he used a colour inconsistent with his earlier practice. Rosé was used in error for a double-star citation, or possibly through the unavailability of his usual red pigment (53). Red (two daubs) was used in error for brown to indicate a lunar citation (67) (there is the possibility that the brown now appears red on account of fading, or through a combination of both fading and an originally too-light application of the brown pigment). In some cases an expected colour was not used (e.g. for the lunar citations on 16–17). Some difficulties in maintaining consistency of colour can occasionally be discerned (e.g. instead of the usual yellow for a solar citation, a very green yellow is used, perhaps caused by the use of a single brush for more than one colour without sufficient rinsing between applications, or a habitually used colour becoming scarce on the market; 76).



Earl of Rosse on Nebulæ. Phil. Trans. 1850.
"no fair ground even for plausible conjecture" as to spiral forms, p. 503.
14 Spiral Nebæ discovered. Brightest parts of 51 M resolvable – "in the mottling (sic) of the different convolutions xxx on y finest nights we see them break.g up into stars." 504. Centre of 51 M clearly resolved with 3 f. speculum. p. 510.
99 M spiral – easy – but not seen spiral by H. figured thus – (very rough sketch for identification)
The other spirals, difficult.
H. 838 is a "great round Plan: Neb. with a double perforat.n" p. 506.
Earl of R. found y 5 of y Plan Nebæ are really annular (besides 2 annuli known previously) p. 506. Resolution of Annular Lyra uncertain.
The 5 annular Plan. Neb: are 464, 2075, 2241, 2050, & 838. – In no instance central opening quite dark. –
H's nebulous ✱ 450, is a star of 8 mag: exactly in y centre of an exactly round & bright atmosph: 25" diam: – a most remarkable object – thus by E. of Rosse – External ring irresolvable. Darkness within – then a nucleus surround.g y star, & a black space in y nucleus, lower right of y star. Light of outer ring very bright, & always appeared to be flickering, owing no doubt to y unsteadiness of y atmosphere. p. 508. – ι Orion: surrounded first by a dark unsymmetrical cavity, then by nebula, thus
H. 604 has a spiral arrangem.t with resolved nucleus – figured p. 511.
H. 2205 spiral or more properly annular p. 511.
H. 131 a spiral.
H. 444. 2 nebulæ. H. 854. bright resolvable nucleus – spiral

Figure 8

Rarely, two colours were used for a citation dealing with two different objects (e.g. a light-blue daub and a red cross to indicate a phenomenon involving both Venus and Mars; 70).

Not unexpectedly he uses traditional planetary symbols, and symbols for prominent observers. More surprisingly, halfway through the manuscript, he introduces the medieval hand symbol, the "manicule" (little hand, Figure 9), as a symbol to bring particular notice to certain citations (e.g. 54). And, delightfully, he has a few "thumbnail" versions of the nebular drawings done with the Leviathan of Parsonstown. These function as finding aids to locate the place of this material in the "Astronomical Index" (Figure 8). It is notable that Webb abandons the use of coloured symbols near the end of the manuscript (113–119).

It is even possible to see developments in the system as Webb progresses through the manuscript. Toward the end of the book his application of colours is much neater than it was earlier, and the symbols are more elegantly drawn (95–111). The red star for Mars is transformed into a red sword, and his symbol for a comet citation is itself coloured blue (97–111), largely replacing the earlier crudely drawn blue lines. Even the "maniculi" can at times be (somewhat) better drawn than earlier in the manuscript (106, Figure 9).

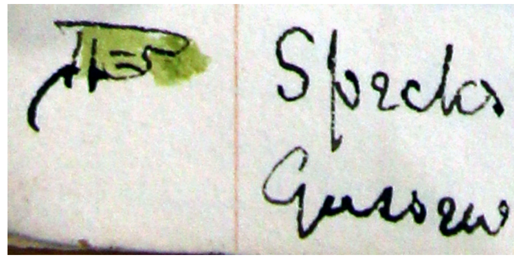


Figure 9

From the late Peter Hingley's description of Webb's surviving observing books in the collections of the Royal Astronomical Society at Burlington House, it would appear that Webb's "Astronomical Index" at the RASC is a very different book indeed (Hingley 2006). Do any of Webb's books of handwritten extracts to which his "Astronomical Index" refers survive? Unfortunately, they don't appear to be listed in the Webb Collection of the Herefordshire Archive Service (to judge from their online listings).

There is no question that Webb's "Astronomical Index" can inform us about aspects of his research methods and that it is a 19th-century example of a technology for information management. When it was originally donated to the RASC, it was clearly considered an object capable of conveying the aura of a universally respected figure in the field. Does it still have any of that power among today's amateurs? ✶

Endnotes

1 It is only fair to add that Robinson also remarked that: "This offset reprint of Webb's classic, delightful though it may be for cloudy-night browsing, does not meet the practical needs of the modern amateur. It is not the place to turn for up-to-date information about celestial objects, observing problems, or techniques. What we need is a brand-new manual for telescope users, written from a 20th-century viewpoint" (Robinson 1963, 96). One might think that Robinson's request was answered a mere three years later with the first edition of Robert Burnham's *Celestial Handbook*, yet it wasn't till 1978 that Webb was truly replaced as a guide to the deep sky when the greatly expanded second edition of Burnham was made widely available. No English language book for observers issued between the 4th (1881) or 5th (1893) edition of Webb and the 2nd edition of Burnham really caught on the way Webb's had, with its combination of concision, wide coverage, and accrued authority. The final three volume edition (the 4th) of Chambers' *Handbook of Astronomy* (1889–1890), or Hutchinson's Splendour of the Heavens (1923) might have been intended as successors to Webb, but neither achieved that status (the physical size of Hutchison's in either its two-volume form of 1923, or the one volume of 1924, could have defeated attempts to deploy it under the stars).

2 There are very real points of comparison between cultural conceptions of scientists, and saints; see Nielsen 2024, 1825.

3 The Welsh text is: "Mr. G. Parry Jenkins, FRAS - Ganed yn Llancynfelin, Sir Aberteifi, yn Medi, 1860. Bank Manager yn Colwyn Bay am rai blynyddoedd, lle y bu yn seryddwr diwyd, yn arsyllu, ysgrifennu, a darlithio, Symudodd i Canada yn 1902, ac ymsefydlodd yn Toronto, lle mae yn parhau i ddarlithio. Heblaw bod yr FRAS, ac yn aelod o'r Gymdeithas Seryddol Brydeinig, mae hefyd yn Gymrodor o Gymdeithas Sryddol Canada Yr oedd yn aelod o'r Canadian Eclipse Expedition, Labrador,

yn 1905. Bu am rai blynyddoedd yn Is-Lywydd Cymdeithas Seryddol Cymru, ac mae yn seryddwr o'r iawn ryw, ac yn ddiwyd a gweithgar o blaid y wyddoniaeth, yn enwedig drwy ddarlithio". The translation into English is by R.A. Rosenfeld.

Acknowledgements

I gratefully acknowledge the help of the Rev'd Canon Andrea Budgey for checking over my translations from the Welsh. This research has made use of NASA's Astrophysics Data System. Artificial Intelligence (AI) played no part in the research, or writing of this article.

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Skyward

Moonrise

by David Levy, Kingston & Montréal Centres

I awoke in the Midsummer not-to-call night, in the white and the walk of the morning:
The moon, dwindled and thinned to the fringe of a finger-nail held to the candle,
Or paring of paradisaïcal fruit, lovely in waning but lustreless,
Stepped from the stool, drew back from the barrow, of dark Maenefa the mountain;
A cusp still clasped him, a fluke yet fanged him, entangled him, not quit utterly.
This was the prized, the desirable sight, unsought, presented so easily,
Parted me leaf and leaf, divided me, eyelid and eyelid of slumber.

– Gerard Manley Hopkins, circa 1876.

The Moon is so much more than an object in the sky. It is a poem that echoes the cosmic thoughts of Hopkins, who was an experienced and passionate observer of the night sky.

The Moon is also a place. Twelve people have walked along its surface, some of whom saw mountains close by.

On the morning of 1969 July 20, 57 years ago, I was the astronomy teacher at Camp Minnowbrook on the west shore of New York's Lake Placid. The entire camp was in the auditorium as the Eagle spacecraft made its way to the surface of the Moon. The landing seemed normal enough although I sensed that Neil Armstrong and Buzz Aldrin were having some difficulty finding a flat landing site free of small craters. But we all heard the precious words, "Tranquility base. The Eagle has landed."

The rest of that day went normally, until dinner when the head counsellor announced an evening program of "free play." I approached him and suggested that the camp might want to watch the Moon walk scheduled for that evening. "Mind your own business and do your job," he barked back at me. Sadly, I returned to our table.

Apparently, the camp director, Lothar Eppstein, had overheard that conversation. He quickly rose and called for our attention. "Evening program is cancelled," he said. "We will all proceed directly to the auditorium from here. History is being made

Continues on page 110

Pen & Pixel

Figure 1 – Just a little bit of Heart and Soul (IC 1805 and IC 1848) is seen here. Taken by Liala Halawa. Liala writes, "For this image I used an AM3 mount, Redcat 71, ASI Air mini, ASI 6200MC-P, ASI 120-mm guide camera, ZWO 30F4 mini-scope and Askar D1 (narrowband) filter. It consisted of 178 frames at 300s exposure, totalling 14 hrs 50 mins. Taken over several nights in March 2026."

Figure 2 – The beautiful Pleiades is seen here, taken by Mark Germani. He says, "I opted to image this object using only a UV/IR-cut filter despite being located in a Bortle 7 zone, as I really wanted to capture as much of the fainter nebulosity and dust as possible. The shorter focal length of the SQA55 afforded a wide FOV to display this star cluster and its associated nebulosity." He collected more than 18 hour's worth of data over 8 nights in January and February 2026. He used an Askar SQA55 with a ZWO ASI533MC Pro, with an iOptron CEM26 mount. He used a ZWO ASIAIR Mini with a ZWO EAF. Processed in Adobe Photoshop and PixInsight.

Continues on page 109

What's Up in the Sky?

June/July 2026

Compiled by James Edgar FRASC

June Skies

The Moon is just a day past full phase on June 1, plus it's at apogee of 406,366 km. By the 8th, the Moon is at last quarter. The waning crescent Moon shares centre stage with Saturn on the morning of June 10. The 13th sees the Moon in the Seven Sisters (the Pleiades) and just a little north of Uranus. This could be a challenging observation, since both objects are just above the horizon at sunrise and the Moon is a tiny, waning sliver. On the 14th, Luna is at perigee of 357,196 km and at new phase. The 16th through to the 19th sees a rash of encounters with three planets grouped together: first with Mercury on the 16th, then Jupiter and Venus on the 17th among the stars of the Beehive Cluster. The Venus encounter is an occultation for most of the Western Hemisphere. On the 19th, Regulus, the bright star in Leo, the Lion, is 3 degrees north of the Moon. First quarter comes on June 21, right on the summer solstice. Then, on the 27th, the waxing gibbous Moon is 0.4 degrees south of Antares, the bright red star in Scorpius, the Scorpion. The Moon is at apogee on the 28th at 406,265 km, followed by full phase once again this month on the 29th.

Mercury reaches greatest elongation east of the Sun on June 15, putting on quite a show for viewers who may never have spotted the elusive planet. The following day, the Moon joins from stage right, making a nice grouping with the three planets Jupiter, Venus, and Mercury – could be a great photo opportunity.

Venus has been climbing the ecliptic, rising high in the western sky, and paired with Jupiter on the 7th. An occultation occurs on the 17th, as mentioned above in the Moon. The brightest planet slides by the Beehive Cluster on the 19th.

Mars, among the stars of Taurus, the Bull, makes for good viewing for the early riser (or for those staying up late). Watch the Moon glide by Mars and the Pleiades on the 13th. At month-end, the Red Planet joins up with Uranus and the Pleiades. Could be a good photo op for those observers who have a telescope fitted with a camera.

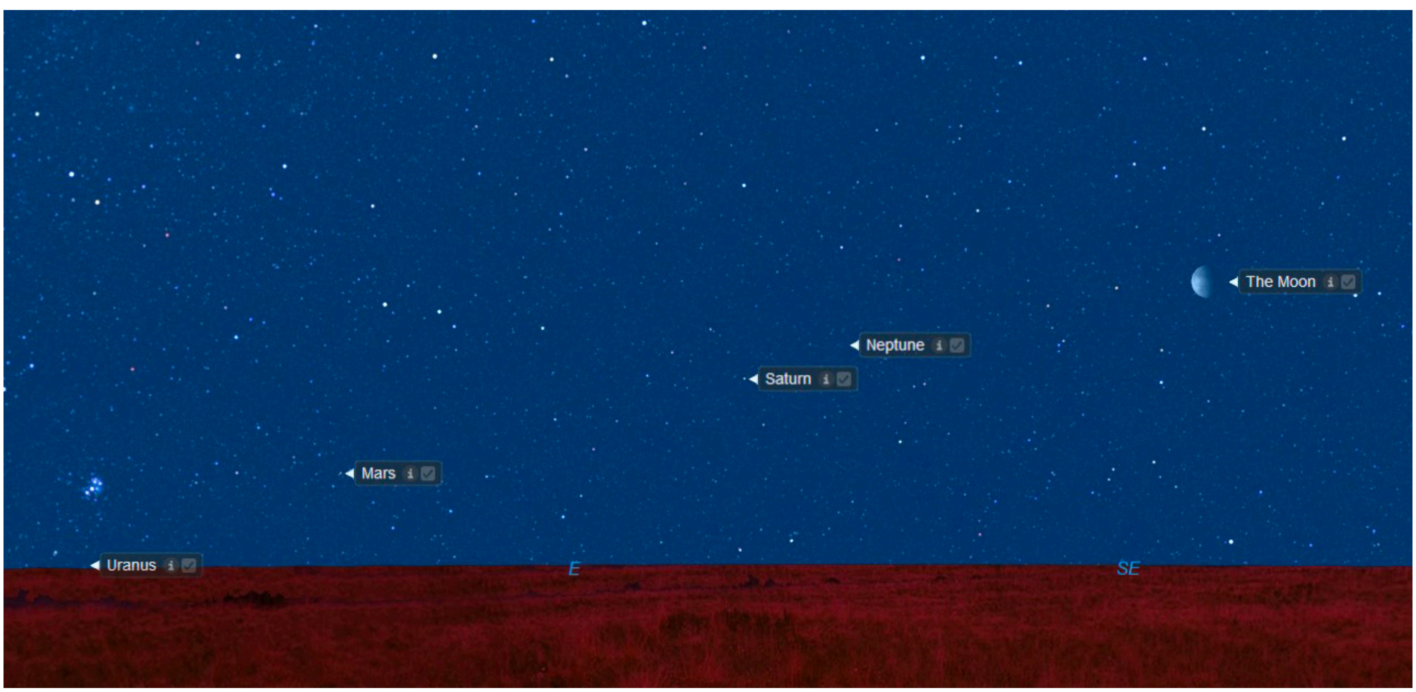
Jupiter joins Venus after sunset on the evenings of June 6 to 11. Even though close to the horizon, Jupiter never fails to please the patient viewer, especially watching the dance of Jupiter's four Galilean moons.

Saturn rises in the early morning hours, joined by the Moon on the 10th.

Uranus in the morning sky, pulls away from the Sun, and is joined by Mars at month-end.

Neptune, just west of Saturn, is high enough in the sky for decent telescopic viewing. The Moon is nearby on the 9th.

June 21 is the summer solstice–the days begin to shorten.



In early June, a four-planet lineup is joined by the nearly last-quarter Moon in the eastern dawn sky. Image credit: Starry Night Pro Plus 8

Continues on page 108

The Sky June/July 2026

Compiled by Nicole Jiang (Toronto Centre) with cartography by Glenn LeDrew.

Celestial Calendar (bold=impressive or rare)

June 2026

Jun. 1 Moon at apogee (406,366 km)

Jun. 2 Mercury 1.3° north of Shoe-Buckle (M35)

Jun. 6 Double Shadows on Jupiter

Jun. 8 Moon at last quarter

Jun. 9 Venus 1.6° north of Jupiter

Jun. 9 Double Shadows on Jupiter

Jun. 13 Moon in Pleiades (M45)

Jun. 14 Moon at perigee (357,196 km) Large tides

Jun. 14 new Moon (lunation 1280)

Jun. 15 Mercury at greatest elongation east (25°)

Jun. 16 Mercury 3° south of waxing crescent Moon

Jun. 17 Jupiter 3° south of waxing crescent Moon

Jun. 17 Venus 0.3° south of waxing crescent Moon, occultation

Jun. 17 Moon 0.6° north of Beehive (M44)

Jun. 19 Regulus 0.3° north of waxing crescent Moon

Jun. 19 Venus 0.4° north of Beehive (M44)

Jun. 21 summer solstice

Jun. 21 Moon at first quarter

Jun. 27 Antares 0.4° north of waxing gibbous Moon

July 2026

Jul. 4 Mars 0.1° south of Uranus

Jul. 7 Moon at last quarter

Jul. 9 Venus 1.1° north of Regulus

Jul. 10 Moon in Pleiades (M45)

Jul. 11 Mars 5° south of waning crescent Moon

Jul. 13 Moon at perigee (359,112 km)

Jul. 14 new Moon (lunation 1281)

Jul. 15 Moon 0.5° north of Beehive (M44)

Jul. 16 Regulus 0.5° north of waxing crescent Moon

Jul. 17 Venus 2° north of waxing crescent Moon

Jul. 21 Moon at first quarter

Jul. 24 Antares 0.6° north of waxing gibbous Moon

Jul. 25 Moon at apogee (405,548 km)

Jul. 29 south delta-Aquariid meteors peak at 7:00 a.m. EDT

Jul. 29 full Moon at 10:36 a.m. EDT

Jun. 28 Moon at apogee (406,265 km)

Jun. 29 full Moon at 7:57 p.m. EDT

Planets at a Glance

	DATE	MAGNITUDE	DIAMETER (″)	CONSTELLATION	VISABILITY
Mercury	Jun. 1	–0.4	6.1	Gemini	Evening
	Jul. 1	—	11.0	Gemini	—
Venus	Jun. 1	–4.0	13.3	Gemini	Evening
	Jul. 1	–4.1	16.0	Leo	Evening
Mars	Jun. 1	—	4.3	Aries	—
	Jul. 1	1.3	4.4	Taurus	Morning
Jupiter	Jun. 1	–1.9	33.1	Gemini	Evening
	Jul. 1	—	31.7	Cancer	—
Saturn	Jun. 1	0.9	16.7	Cetus	Morning
	Jul. 1	0.8	17.5	Pisces	Morning
Uranus	Jun. 1	—	3.4	Taurus	—
	Jul. 1	5.8	3.5	Taurus	Morning
Neptune	Jun. 1	7.8	2.3	Pisces	Morning
	Jul. 1	7.8	2.3	Pisces	Morning


NORTH
NW
WEST
SW
SOUTH
PERSEUS
Double Cluster
CASSIOPEIA
LACERTA
Capella
AURIGA
CAMELOPARDALIS
CEPHEUS
Deneb
Northern Cross
URSA MINOR
Polaris
Little Dipper
LYNX
Castor
GEMINI
Pollux
CYGNUS
VULPECULA
DRACO
Vega
LYRA
URSA MAJOR
M44
Big Dipper
HERCULES
CANCER
LEO MINOR
CANES VENATICI
Regulus
LEO
BOÖTES
CORONA BOREALIS
COMA BERENICES
Arcturus
SERPENS CAPUT
OPHIUCHUS
HYDRA
VIRGO
Spica
CORVUS
CRATER
LIBRA
SCORPIUS
Antares
LUPUS
CENTAURUS

Continued from page 105

July Skies

The Moon has just passed full phase among the stars of Sagittarius, the Archer, as the month begins. The next event is on the 10th, when the Moon is among the stars of the Pleiades, in Taurus, the Bull. On the 11th, Mars and Uranus join with the Moon's waning sliver for a photo op, but you have to up very late or very early–2:00 a.m.! By the 13th, the Moon is at perigee of 359,112 km. New Moon occurs on the following day, and the Beehive Cluster (M44) provides a backdrop on July 15. The 16th sees Regulus 0.5 degrees north of the Moon, and the 17th has Venus 2 degrees north of the thin sliver of a 3-day-old Moon. First quarter occurs on the 21st. On the 24th, Antares is 0.6 degrees north. These two close approaches, first Regulus, then Antares, are occultations in the Southern Hemisphere. On the 25th, the Moon is at apogee of 405,548 km. Full Moon is on the 29th.

Mercury is too close to the Sun for viewing, and even when the speedy planet does become visible in the east, it's just before sunrise and only for a fleeting few minutes.

Venus keeps on pleasing as the Evening Star, gradually getting closer to the horizon with each passing day. The bright planet hasn't reached greatest elongation yet, but the ecliptic governs the viewing angle. The thin, waxing crescent Moon passes by on the 17th.

Mars in the east among the stars of Taurus, the Bull, gains further separation from the Sun, making it easier to spot. Blue-green Uranus shares the spotlight on the 4th, a mere 7 arcminutes away from the Red Planet. See if you can glimpse the two planets with strikingly different colours–a telescope is likely needed. On the 11th, you can see Mars, Aldebaran, the Hyades, Uranus, and the crescent Moon near the Pleiades, all grouped together.

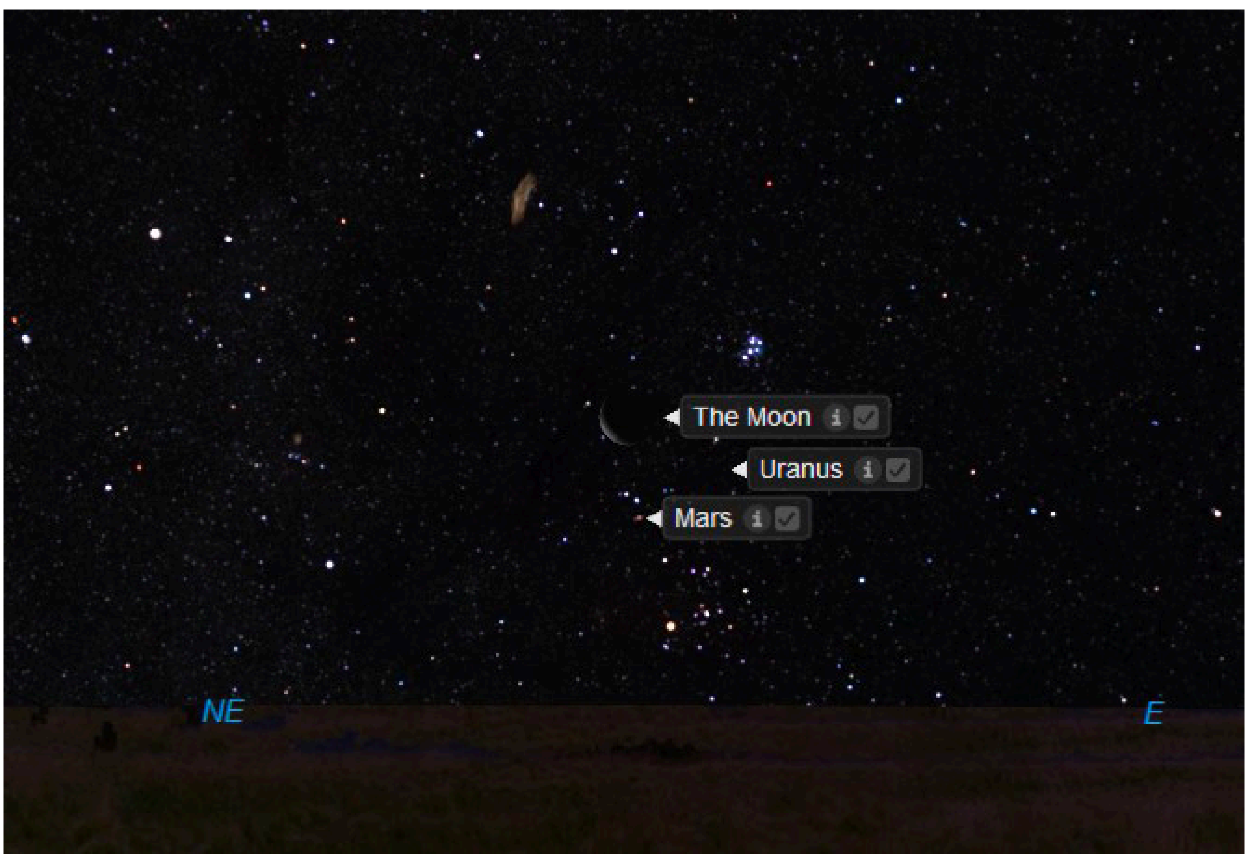
Jupiter is too close to the Sun for viewing.

Saturn rises around midnight in Pisces, the Fish. It appears stationary against the starry backdrop on the 27th, then it begins retrograde motion for the next four months–giving the best opportunity for late-night viewing. The last-quarter Moon glides by on the 7th.

Uranus gains elevation away from the Sun in the eastern morning sky. Watch for the close conjunction with Mars on the 4th.

Neptune continues to dog Saturn, rising an hour ahead of the Ringed Planet, shortly before midnight. The distant blue planet begins retrograde motion on the 9th.

On July 29, the south delta Aquariid meteors peak in the early morning. ✶



July 11 sees a tight gathering of the waxing crescent Moon, Mars, and Uranus among the stars of Taurus, the Bull.
Image credit: Starry Night Pro Plus 8

Continued from page 104

Figure 3 – The March 3 lunar eclipse was captured here by Kimberly Sibbald. This is a composite of 7 images. First hint of Earth's shadow occurred at 02:53 a.m. (7 o'clock position in the image), then she shot every 10 minutes as the partial phase deepened (through 03:37 a.m.), culminating in beautiful totality at 04:36 a.m., with a deep coppery red glow.

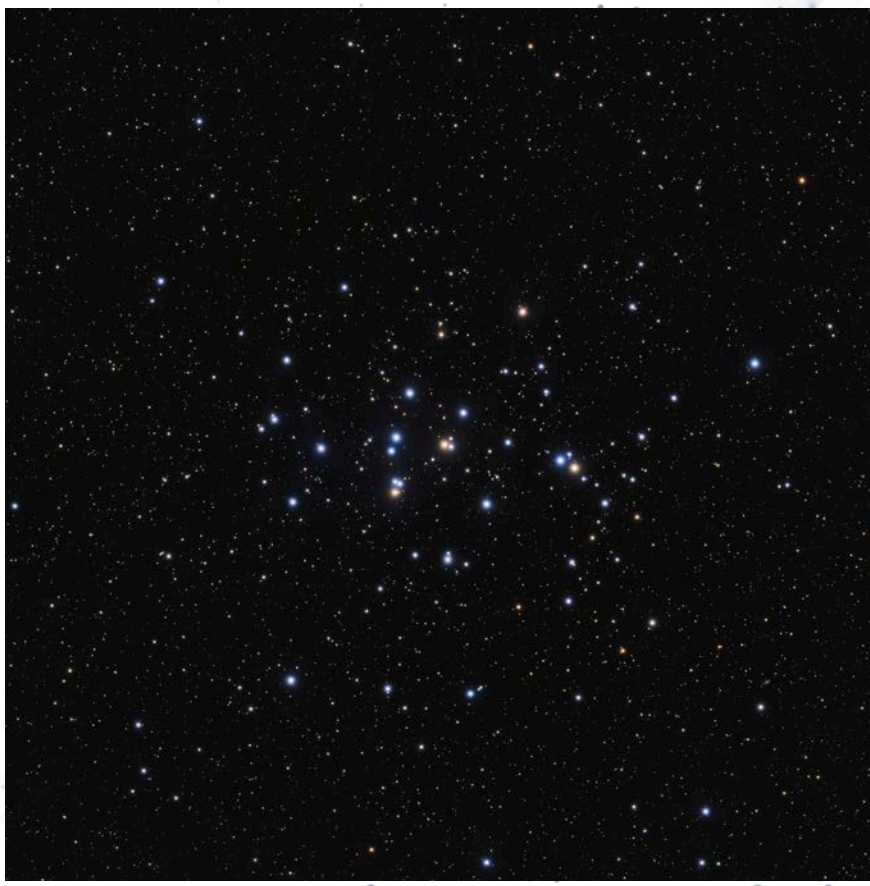


Figure 4 – "The Beehive Cluster or Praesepe (M44) contains about 1,000 mostly blue-white stars and is roughly 600 light-years away. I have seen it with averted vision with the naked eye, and it's a real treat to view and image," says Mark Germani. "The image consists of 4 hours of data from my Bortle 7 backyard with an SQA55 quintuplet refractor and a ZWO ASI533MC Pro camera with a UV/IR cut filter."

Continued from page 103

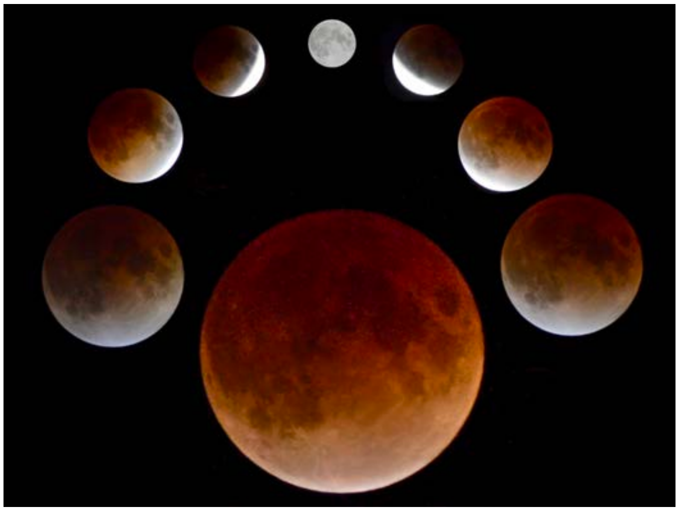


Figure 1 — Montage of the 2026 March 3, total eclipse of the Moon. Used by permission of Mario Motta.

tonight, and we all have a duty to witness it and be a part of it."

That evening, as we sat on our folding chairs, we watched a small, perhaps 12-inch black-and-white TV mounted on the auditorium stage. Walter Cronkite was in charge. He interviewed some interesting people, including a young Gene Shoemaker; it would be 19 years before I would get the chance to meet him, and his wife, Carolyn, in person. Some of it was quite serious; a lot of it was just fun.

Then after a few hours, the picture suddenly changed to the "porch" of the Lunar Module. Armstrong was standing on it. The auditorium, filled with children as young as six or seven years old, went suddenly silent. Slowly, step by step, Armstrong descended the ladder and set one foot, then the other, on the Moon.

"That's one small step for a man,
One giant leap for mankind."

It was more than a major time in history. This was one of the pivotal, defining moments in the history of human civilization. I will never forget that night.

There have been other, more personal, defining moments in my own lifetime. The discovery of my first comet, on 1984 November 13, was one. And the discovery by the Shoemakers and me of the comet that would strike Jupiter was another. Those two times were private. Watching the Moon walk was a joy I shared with 150 young children, and our whole world.

On Wednesday, 2026 April 1, Artemis II began its journey to the Moon. Its four astronauts represented different aspects of American society, including one Canadian. The mission commander was Reid Wiseman, its pilot Victor Glover. The two other mission specialists were Christina Koch and Canadian Jeremy Hansen. I met Jeremy in 2016 at the London General Assembly of The Royal Astronomical Society of Canada, and have never forgotten him. Seeing him emerge from Integrity just a few moments ago was ecstatic.

Our world is going through trying times. But the continuing story of the travels we take to the Moon offers a rare moment of unity. No red countries, no green countries, just one gorgeous world. The other news shows us the world as it is. The Moon journeys show our world's possibilities. They show the world as it can be. ✶

David H. Levy is arguably one of the most enthusiastic and famous amateur astronomers of our time. Although he has never taken a class in astronomy, he has written more than three dozen books, has written for three astronomy magazines, and has appeared on television programs featured on the Discovery and Science *channels. Among David's accomplishments are 23 comet discoveries, the most famous being Shoemaker-Levy 9 that collided with Jupiter in 1994, a few hundred shared asteroid discoveries, an Emmy for the documentary* Three Minutes to Impact, *five honorary doctorates in science, and a Ph.D. that combines astronomy and English Literature. Currently, he is the editor of the web magazine* Sky's Up!, *has a monthly column, "Skyward," in the local* Vail Voice *newspaper and in other publications. David continues to hunt for comets and asteroids, and he lectures worldwide. David was President of the National Sharing the Sky Foundation, which tries to inspire people young and old to enjoy the night sky.*

Keep Calm and Orbit On

The Skies of Aotearoa, New Zealand

by Samantha Lawler, Regina Centre
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I am grateful that I got to spend February and March of 2026 in Aotearoa, New Zealand, for part of my sabbatical from the University of Regina. I was able to combine two fellowships to make this possible. The Erskine Fellowship brings professors from around the world to the University of Canterbury in Ōtautahi, Christchurch, for a few weeks or months at a time, to collaborate with their researchers and better expose students on campus to the worldwide body of research in many different fields. The Beatrice Hill Tinsley Lecture series celebrates the galactic evolution research of the eponymous New Zealand astronomer by arranging for an international speaker to visit a large fraction of the amateur astronomy associations around the country.

I gave 13 public talks in 13 different cities in 7 weeks, with the title "Astronomy vs. the Billionaire Space Race," all about how our night sky is being changed by billionaires and the consequences and pollution we will all share because of this rapid commercialization with barely any regulation.

This trip has been incredible (exhausting, too!) I gave talks in 3 different officially recognized dark-sky reserves, I saw the Milky Way from the middle of cities, I saw aurora australis, and at least 4 separate times on the trip I said the phrase "Wow, this is the best night sky I've ever seen!" It just kept getting better.

I started my trip in the nearly tropical north of the North Island, an especially shocking temperature contrast from early February Saskatchewan. Many of the astronomy associations I visited have telescope and lecture room facilities located within their town's "domain," a large park-like area owned by the town for the use of town residents. Many other clubs and associa-

Figure 1 — The aurora australis in a 13-second exposure, over the Southern Alps and under the southern Milky Way and the Magellanic Clouds, reflecting in Pearson Lake near Arthur's Pass.

Figure 2 — A large group of tourists learning about the night sky from a guide with a green laser pointer, right in the town of Lake Tekapo, with aurora australis, the Milky Way, and the Magellanic Clouds easily visible.

tions, like archery, golfing, and historical societies, also use parts of the domain in different towns I visited.

After my first three talks in Whangarei, Auckland, and Hamilton, my family and I spent a couple of nights in Tongariro National Park, where I got to see the glorious Magellanic Clouds for the first time. There were also a *lot* of satellites, which intellectually, I knew to expect from research papers I have written. But it was still offensive to watch those satellites streaking across a part of the sky I was only just getting to know.

Next, I visited Napier and New Plymouth, which both have excellent public outreach facilities for planetarium shows and telescopic sky viewing, respectively. Both are located right inside towns, but the light pollution in New Zealand is not nearly as bad as in equivalently sized towns in North America. It is an ongoing battle to keep it from creeping brighter, which amateur astronomers are at the forefront of. I also got to visit a Māori Sky Compass (Ātea a Rangi)[1] near Napier, which is a beautiful way to teach traditional navigation.

I finally visited my first official dark-sky reserve in the small town of Martinborough, part of the Wairarapa Dark Sky Reserve. After my public talk, I got to enjoy a visit to an incredibly successful astrotourism operation. Star Safari[2] is run by a husband-and-wife team who both have degrees in astronomy, and they have two decent sized Dobsonians and a huge refractor. They skillfully whip these telescopes around to different targets in the southern sky, while cheerfully and engagingly explaining physics, traditional Māori knowledge, and funny anecdotes to their many customers who have paid to experience truly dark skies.

After a talk in Wellington, I settled into Christchurch for about six weeks, and started my Visiting Erskine Fellowship. I gave both a research talk and a public talk in Christchurch, which resulted in many chats and a new research collaboration. I also had three trips to different parts of the South Island to give talks to other amateur astronomy associations during this six-week period.

I got to visit Rakiura Stewart Island, below the southern tip of the South Island which was completely incredible.

There are magical beaches, gorgeous forest hikes, more wild kiwi wandering through town than I knew was possible, and the whole island is a dark-sky preserve. At one point I was watching a kiwi foraging on someone's front lawn, while the Moon rose above the ocean gently lapping on a beach behind me, and the Milky Way stretched overhead. Magic! My talk there definitely felt a bit like preaching to the choir, since the whole developed portion of the island has dark-sky-friendly lighting. But at the same time, much of the island (including the public library, where I grabbed my own internet access each day) is reliant on Starlink. One of the main points of my talk was to tell people to speak with their government representatives about this: rural and remote populations should not have to pay money to a billionaire-owned foreign corporation for their internet access, we need locally owned options and public infrastructure investment.

Next, I gave a talk in Nelson at the northern tip of the South Island. I was impressed by the ease with which I could see the Milky Way from the middle of the town! I got to spend some time camping in a very dark area of the mountains along the way back from Nelson to Christchurch, near Arthur's Pass, where I nearly lost my mind with excitement over seeing and photographing (see Figure 1) the Southern Lights below the Magellanic Clouds!!

My last talk was in the Tekapo Dark Sky Reserve, where I saw hundreds of tourists (see Figure 2) who were completely excited to experience truly dark skies. There are multiple astrotourism companies operating in the area, providing education and entertainment for the throng of tourists. It was definitely the darkest skies I have ever seen in my life. The ground was lit only by starlight while I watched satellites crawl through the almost annoyingly bright Milky Way.

Research-wise, I really focused on science communication as Reflect Orbital's FCC comment period opened and closed, and SpaceX submitted a brand new, completely grotesque filing to the FCC for one million "AI data center" satellites[3]. I co-authored an article on space law and Kessler Syndrome[4], and another on the completely obscene levels of light pollution we could expect from one million huge satellites[5]. I reached out to the Australian and New Zealand professional and amateur astronomy communities as much as I could through media interviews and articles, to try to drum up more protest against these huge threats to dark skies and astronomy worldwide.

I also did some really great, fast work with University of Canterbury professors: my long-time collaborator, Dr. Michele Bannister, and a totally new collaborator in atmospheric chemistry, Dr. Laura Revell. In response to SpaceX's ludicrous one million satellite FCC filing, we wrote a science communication article[6] about the horrifying atmospheric impacts of one 2-tonne satellite reentry every 3 minutes. We spent a lot of time bemoaning the fact that none of us have funding specifically for satellite pollution studies, even though it's a rapidly growing, severely consequential area. But you know what does have funding? Cows. So, we decided to write a very silly (but scientifically accurate!) April Fool's Day paper about the impact risk to New Zealand cows from reentering Starlink satellites (it's a 1% risk for 2-metre spherical cows over 5 years[7].

Lastly, the three of us also wrote an obituary together: Michele's husband Michael Jason Smith died from brain cancer during my trip. Michael was always hugely supportive of women in science and science education, and while he would have been amusedly horrified by our janky hacked-together cow-culation code, he would have been delighted by the paper itself. Michael, this one's for you. ✶

Endnotes

1 More information available here: https://www.atea.nz/atea

2 More information available here: https://star-safari.nz/

3 Kan, M. (2026). SpaceX To Start Small With 1 Million Satellite Plan, Pushes Back On Critics. PC Magazine, 18 Mar 2026: https://au.pcmag.com/ai/116598/spacex-to-start-small-with-1-million-satellite-plan-pushes-back-on-critics

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5 Lawler, S., Boley, A., & Rein, H. (2026). A million new SpaceX satellites will destroy the night sky – for everyone on Earth. The Conversation Canada. https://theconversation.com/a-million-new-spacex-satellites-will-destroy-the-night-sky-for-everyone-on-earth-277938

6 Revell, L., Bannister, M., & Lawler, S. (2026). A new space race could turn our atmosphere into a 'crematorium for satellites'. The Conversation New Zealand. https://theconversation.com/a-new-space-race-could-turn-our-atmosphere-into-a-crematorium-for-satellites-276366

7 Lawler, S., Bannister M., & Revell. L. (2026). Cow-culation: Reentry Impact Risk to Livestock in the Satellite Megaconstellation Era. https://arxiv.org/abs/2603.29324

Sam Lawler is an associate professor of astronomy at the University of Regina. She studies the orbits of small bodies in the outer Solar System, and increasingly studies and advocates for regulation of the thousands of new artificial satellites streaking through her research images, crawling across her huge prairie skies, and crashing onto nearby farmland. She's active on Mastodon@sundogplanets@mastodon.social and BlueSky@sundogplanets.mastodon.social.ap.brid.gy

Mostly Variable Stars

Did a Cepheid Quietly Quit?

by Hilding Neilson
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When does a variable star stop being a variable star? So many stars are variable, but we rarely see a pulsating variable star stop pulsating. One such star seems to be a classical Cepheid, V19, in the Triangulum Galaxy (M33). This Cepheid was one star in a sample of 35 classical Cepheids studied by Edwin Hubble to measure the distance to M33 (Hubble 1926) using the Leavitt Law (Leavitt & Pickering 1912) and helped solve the question of whether galaxies were actually beyond our galaxy. There is nothing particularly strange about this long-period (about 57 days) Cepheid and, in the data set, the light curve of V19 looked like most other Cepheids with a blue-band amplitude of about 1.1 magnitudes. But, after Hubble's observations there was not a lot done to continue studying the Cepheids of M33 until surveys were conducted in the 1970s (e.g. van den Bergh et al., 1975; Sandage & Carlson, 1983).

But, a century later, the Cepheids seemed to disappear. Macri et al. (2001) returned to this Cepheid and found something strange: the star appeared to just about cease pulsating with an amplitude of less than a tenth of a magnitude. This work was done as part of a larger project called the DIRECT project (Kałużny et al. 1998). Thanks to the earlier surveys, there were about 60 Cepheids known in M33, and the DIRECT project recovered 57 Cepheids that were previously observed. They missed three Cepheids: two of which were short-period Cepheids, hence at the faint limit of their survey. The third was the bright, long-period Cepheid—V19.

Because of this, Macri et al. (2001) returned to this specific star because it was observed in the DIRECT project but did trigger their analysis to classify V19 as a Cepheid. Based on their data, V19 didn't appear to vary significantly, and it was also found to be about one-half of a magnitude brighter than reported by Hubble. Was this a misclassification by either Hubble or the team behind the DIRECT project? To test this Macri converted the observations from the magnitude type that he used to the blue filter and compared the measurements with the observations from the 1970s and just before the turn of the century, as shown in Figure 1. It is clear that around 1970 the Cepheid V19 was still pulsating with an amplitude of a half magnitude and with a mean brightness slightly brighter than in the 1920s.

So, it seems likely that we are observing the Cepheid V19 cease pulsating and become a "regular" star. However, the

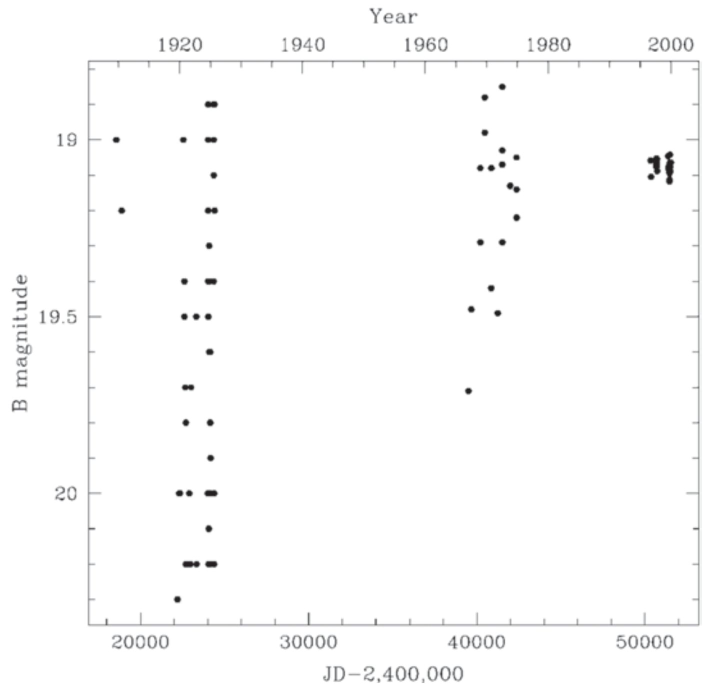

Figure 1 — The change in brightness of the Cepheid V19 over a century in the B-band from Macri et al. (2001). Reproduced with permission of the AAS.

question is why is this happening and why, relative to stellar evolution timescales, is this happening so rapidly? In a previous column, I noted that we have observed Polaris undergo a similar decrease in amplitude in the 20th century, but in recent years the pulsation amplitude appears to be growing again. While V19 and Polaris are both Cepheids, that is about the only thing they have in common.

As a long-period and very luminous Cepheid, V19 is massive star, likely between 10 and 15 solar masses so, relative to lower-mass stars like Polaris, V19 will evolve rapidly. As a Cepheid, the star will cross the Cepheid instability strip (CIS) three times, where the instability strip is the region of the Hertzsprung-Russell diagram where Cepheid pulsation can occur. A Cepheid will cross the CIS first right after the end of core hydrogen burning. This is a very short-lived phase of evolution and only about a few percent of Cepheids are ever observed at this stage of evolution. The other two phases occur when a star is evolving in the blue loop. This is a stage that starts after the star was a red giant star and the core is still inert, but hydrogen can fuse in a shell above the stellar core. This pushes the star to evolve blueward until core helium burning can dominate the energy creation, then the star will turn redward again. This can be seen in Figure 2, from Miller et al. (2020), where stellar evolution tracks are plotted for stellar masses ranging from 3 to 15 solar masses. For the most massive stars, the models do not undergo blue loop evolution. This is due to the properties of the models and the size of the hydrogen shell relative to the size of the stellar core. We know that there should be an upper mass limit for stars to evolve

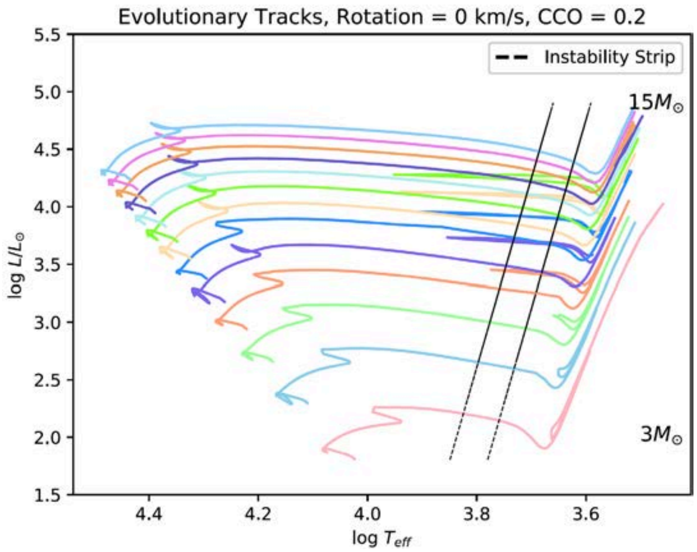

Figure 2 — The Hertzsprung-Russell diagram showing stellar evolution tracks of stars ranging in mass from 3 to 15 solar masses. These stellar evolution tracks show the change in stellar evolution along the blue loop across the Cepheid Instability strip, where stars can pulsate as Cepheids. Reproduced with permission of the AAS.

along the blue loop as Cepheids, though it is still an open question of what the exact mass is. For the models that do exhibit blue loop evolution, it is clearly visible that the width of the blue loop grows with increasing mass. So, Cepheids like Polaris and delta Cephei will likely never reach or will have reached the blue edge of the CIS. However, it is likely that this is where V19 is on the Hertzsprung-Russell Diagram.

If this is the case that Macri et al. (2001) caught V19 crossing the edge of the Cepheid Instability Strip then this would be a great example of observing stellar evolution in action. But, can a Cepheid decrease its pulsation amplitude from one magnitude to almost zero in one century or in only about 600 pulsation cycles? We really don't know for sure. The calculation would require both precise stellar evolution models fit to the observations and precise hydrodynamic models of the pulsation of the star as a function of stellar evolution. One of my students has been working on this and found that, in principle, it is possible, but it will require more detailed models.

You might wonder why this one Cepheid would matter. It is an interesting question on its own, but how does it impact the big picture. When astronomers attempt to measure the Hubble Constant with Cepheids, we have to lean on the brightest, and hence, long-period Cepheids for this work because at the greatest distances the short-period Cepheids that are most common will be dimmer than the detection limit. As such, the long-period Cepheids will tend to do most of the work in those measurements. Then as we calibrate the Cepheid Leavitt Law (period-luminosity relation) the few long-period Cepheids in most samples are even more important and as they change there could be new uncertainties introduced. Furthermore, if these Cepheids are changing significantly over time scales of decades, then it might be harder to use them as standard candles and repeat observations of those longer time spans.

I don't expect this issue will greatly impact how we study cosmology and measure the Hubble Constant or impact the so-called Hubble Tension, but it is a reminder that one of the limits of cosmological measurements using local sources like Cepheids depends on how well we understand their properties and evolution, and if we are starting to catch Cepheids that cease pulsating then we will need to consider this as we start working on long time-domain astrophysics. ✶

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John Percy's Universe

Ruth Josephine Northcott

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Back in April of last year, I wrote about my late colleague Helen Sawyer Hogg. In her time, she was Canada's best-known and most beloved astronomer, primarily because of her long-running weekly column in the *Toronto Star,* her book *The Stars Belong to Everyone,* her astronomy series on TVOntario, and other public outreach and communication. But she was not the only woman astronomer at the University of Toronto. Ruth Northcott arrived at the same time as Helen did—1935.

Helen and Ruth had rather different backgrounds. Helen was American; Ruth was Canadian. Helen was born in the historic city of Lowell, Massachusetts, Ruth in Solina, a small Ontario village that I had to look up to find out where it was located. Helen did her undergraduate work at Mount Holyoke College, a small, prestigious private women's college, and her graduate work at the Harvard College Observatory (though she got her degree from Radcliffe College because Harvard did not grant degrees to women at the time). Ruth did her B.A. and M.A. at the University of Toronto, a public co-ed university occasionally styled "the Harvard of the North". Helen married Canadian astronomer Frank Hogg in 1930; Ruth never married. When Helen finished her Ph.D. and went with Frank to the Dominion Astrophysical Observatory in Victoria, she was not given a paid position on account of nepotism rules. A similar thing happened in 1935 when they moved to Toronto, where Frank had been offered a position at the university 's newly opened David Dunlap Observatory (DDO). In each case, Helen began as a volunteer. By contrast, Ruth, immediately after graduation in 1935, was offered a position at DDO as a research assistant or "computer"—a term then used for someone who performed complex calculations by hand.

Helen went on to a very successful career in research, using the DDO 1.88-m telescope at its Newtonian focus, three weeks each year, to photograph and study variable stars in globular clusters. For this, her teaching, her leadership in professional societies, and her public outreach and communication, she received many honorary degrees, and prestigious awards, including Companion of the Order of Canada. She was frequently profiled in the media, both university and public.

Outside of astronomy, Helen's interests were simple: her family, gardening, birdwatching, stamp collecting, reading poetry, and knitting. Ruth's were a bit more formalized: she was co-founder of the Richmond Hill Naturalists, and an active member of the Field Naturalists' Society, and of the Toronto Camera Club. She had also studied at the Ontario

Ruth J. Northcott (1913–1969). Photograph by Ballard and Jarrett, Photographers. Source: RASC.

College of Art (now OCADU) and produced many fine water-colour and oil paintings. I am proud to have one of these in a prominent place in my home.

Despite their different backgrounds, Helen and Ruth became close colleagues and friends. Helen was the executor of Ruth's estate after she died in 1969 at a relatively young age. Both of them, over the years, faced the many challenges of being a woman in science. For an excellent overview of the status of women astronomers at the University of Toronto up to 2006, see Clement (2006).

Broughton (1993) notes that Ruth "produced such meticulous lab reports that Professor R.K. Young suggested that she join the Astronomy department as a computer (research assistant)". Between her B.A. graduation in 1934 and the opening of DDO is 1935, she completed an M.A. with a thesis on "the calculation of the heights of meteors," supervised by meteor expert Peter Millman who had arrived on staff in 1934. The thesis included results of visual observations of meteors from the Toronto area. The results were rather concerning: the mean heights obtained for the Perseids (132 km) and for the Leonids (128 km) were not in good agreement with previous determinations. She did not continue this research (but Peter Millman certainly did), but her work definitely helped in her ongoing encouragement and support of meteor observing by skilled amateur astronomers in the RASC.

The primary work of the new DDO 1.88-m telescope was spectroscopy of stars, in order to determine their physical properties and their radial (line-of-sight) velocities, using the Doppler effect. In some stars, the radial velocities varied periodically, indicating that the star was orbiting in a binary star system (a "single-line spectroscopic binary"). In a few stars, the spectrum also showed absorption lines from the second star in the binary system, with radial velocities varying in anti-phase with the same period (a "double-line spectroscopic binary"). The study of spectroscopic binaries may seem old-fashioned but, among other things, it has led to the discovery of the first black hole in space (at DDO by my late colleague Tom Bolton in 1971) and the first exoplanet around a Sun-like star (51 Peg) in 1995. Ruth was co-author of 14 published research papers on determining the orbits and properties of spectroscopic binaries.

In 1944, Ruth joined the Department of Astronomy as a Lecturer. Helen had also joined , in 1941; the teaching capacity of the Department had been greatly reduced with several of the staff away on war duty. Ruth's teaching was in two areas. She was responsible for overseeing lab sections of astronomy courses (remember Professor Young's comments about her lab reports?). That's where I first met her in 1960–61 when I was an undergraduate. She took a personal interest in her students, including taking a photo of each class. I still have mine somewhere. Ruth was also active in the University Women's Club, the University of Toronto Faculty Club, and the Royal Canadian Institute, and she would often take groups of students to dinner before attending public astronomy lectures such as those offered by the RCI.

For almost two decades, she also taught introductory astronomy to evening students in the so-called extension courses, mostly mature students, including teachers upgrading their qualifications. This course was sometimes offered in the summer, which was particularly convenient for teachers. Ruth was well-suited for this course, on account of her approachability, maturity, broad interests—and high standards.

In 1951, she became assistant editor of the *Journal of the RASC* and of the *Observers Handbook*. These had been founded by Clarence A. Chant, the "father" of astronomy at the University of Toronto. Chant had retired in 1935 at age 70 on the day of the opening of DDO, but he continued to work at DDO and to edit the *Journal* and the Handbook. Frank Hogg had been his assistant until his untimely death on New Year's Day 1951. Ruth became editor of both publications upon Chant's death in 1956 and continued until her own death in 1969.

When most people hear the term "editor," they probably think of someone who solicits or selects manuscripts, corrects the grammar, spelling, and punctuation, and coherently assembles them into a book, journal, magazine, or newspaper. For Ruth, being an editor was much more. The NASA Astrophysics Data System (ui.adsabs.harvard.edu) lists 66 papers by Ruth in the *Journal* (and 78 papers in total). A few are research papers, but most are listed as Notes, Notes and Queries, or Reviews of Publications, and are up to several pages in length. Many individual ADS references are to several notes, each with Ruth's R.J.N. signature. Her first publication listed on ADS was a report on the Toronto Centre variable star and nova program—very appropriate, considering her support of "citizen science" by skilled amateurs.

In 1967, she edited and contributed to a special issue of the *Journal—Astronomy in Canada: Yesterday, Today, and Tomorrow*—to mark Canada's centennial. So Ruth was an author, not just an editor. In a sense, she was communicating with RASC members and other astronomy enthusiasts in the same way that Helen was communicating with the Canadian public.

In the case of the Handbook, much of the content is taken from or modified from material in other sources, such as the *American Ephemeris and Nautical Almanac.* Information on the planets, stars, and galaxies, and other tabular material has to be kept up to date each year. This all requires care and attention to detail, as I know from being the Handbook editor for a decade after Ruth's service. Diagrams, such as star charts, were clearly and attractively hand-drawn by Ruth, who was an accomplished artist as well as astronomer. Several sources, including Broughton (1993) mention that, working with R.E. Williamson, she produced what is probably the first radio map of the sky, in galactic co-ordinates, based on Grote Reber's pioneering observations—another example of her talents in art, design, and illustration. Ruth's editorship of the Handbook was especially important to the Society because of its wide sales. It filled a unique niche and was [and still is] our "cash cow" as well as an essential reference. And Ruth had far fewer Handbook contributors and other helpers than the Editor has today.

As Editor, Ruth was a member of the National Council and, since 1965, a member of the Executive Committee. Her wisdom and experience were much appreciated. She had been an active member of the Toronto Centre since 1935, and held several offices there, including President in 1943–44. She was National President in 1962–63—one of only a very small number of women to hold this position, before or since. She received the Service Award in 1967; asteroid 3670 was named in her honour and, after her death, the biennial Ruth Northcott Memorial Lecture was established.

Ruth did not have a Ph.D. In the early years, therefore, one referred to "Miss Northcott and Dr. Hogg." In listings of the astronomy faculty, however, the University of Toronto listed Helen as "Mrs. Hogg." Apparently marital status was considered significant—at least for women. This practice was finally abandoned in 1975.

But the quality, quantity, and variety of her astronomical work made her a full professional. At her death, she was an Associate Professor, the second-highest rank. She was a full member of both the American Astronomical Society and the International Astronomical Union, the "gold standard" for professional astronomers.

I count myself fortunate to have had Ruth (and Helen) as a teacher, colleague, and friend.

For more information about Ruth, see the many entries in Broughton (1993), and the obituary by John F. Heard (1969) in the *Journal.* ✶

Acknowledgement

I am grateful to my colleague Professor Christine Clement for reading and commenting on a draft of this column and providing some useful references. I also thank physics-astronomy librarian NuRee Lee for tracking down and providing a digital copy of Ruth Northcott's M.A. thesis.

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John Percy FRASC is Professor Emeritus, Astronomy & Astrophysics , University of Toronto, and a former President (1978–1980) and Honorary President (2013–2017) of the RASC.

Dish on the Cosmos

A New Map of the Milky Way's Magnetic Field

by Pamela Freeman
(pamela.freeman@ucalgary.ca)

For this month's column, I have another tale of ingenuity and collaboration from the Dominion Radio Astrophysical Observatory (DRAO). The DRAO is known for its technological development, both for use at home and for large international collaborations such as the Square Kilometre Array (SKA). There are some perks for scientists at the DRAO being so close to this kind of instrumentation—they can potentially repurpose the technology for other small projects.

Figure 1 — The 15-m Telescope at the Dominion Radio Astrophysical Observatory. Image credit: Ordog et al. (2026), Luca Galler.

That's what happened with a 15×18-m telescope dish initially designed as a prototype for the SKA. While not chosen for the final SKA design, it had scientific promise as a single-antenna telescope that could rapidly survey the sky.

I spoke with two friends and former colleagues who used this telescope, now called the DRAO-15, to undertake a grand project mapping the Milky Way's magnetic field. Dr. Anna Ordog, a postdoctoral researcher currently at Western University and formerly at the DRAO, and Becky Booth, a Ph.D. candidate with Dr. Jo-Anne Brown at the University of Calgary,, are the lead authors on two papers recently released about the DRAO GMIMS of the Northern Sky (DRAGONS) survey, a complete view of polarized emission at 350–1030 MHz in the Northern Hemisphere sky. It is a part of the Global Magneto-Ionic Medium Survey (GMIMS), surveying the entire sky from 300–1800 MHz in both hemispheres to map out the 3-dimensional structure of the Milky Way's magnetic field.

Observing Galactic Magnetism

The galactic magnetic field can be thought of like that of the Earth, or the Sun, just weaker and with a few more complications. It is not necessarily a neat dipole, with a north and south pole; it is understood that the galactic magnetic field has structure on multiple scales, all the way from the entire galaxy where part of the field "more-or-less" follows the spiral arms, down to individual star-forming regions and stars themselves.

But, Anna explains, "the fundamental principle is still the same. On the scales of something like the galaxy, what we're talking about is motions of electrons, or electric currents that are propagating throughout that entire volume of the Milky Way Galaxy in the gas that forms the overall picture of galactic structure." The magnetic field arises from these moving charged electrons.

Becky adds that there is still a lot unknown in how the field formed, how it has been amplified in strength, and what its complete structure looks like. There's both an observational and theoretical approach to galactic magnetism studies, and Anna and Becky have a hand in developing instrumentation for observations as well as processing and analyzing that data.

The galactic magnetic field cannot be observed directly. The influence of the magnetic field, however, can. When charged particles, like electrons, spiral around magnetic field lines at relativistic speeds, they release emission dependent on the speed of the particle. This is called synchrotron emission. The total emission from a cosmic source teeming with charged particles ends up as a spectrum—emission at a range of frequencies peaking at a certain value. "Everywhere that you have those two ingredients, the relativistic electrons and the magnetic fields, you get the synchrotron emission," Anna says.

"We've got a wash of these high-energy electrons travelling through our galaxy, that's called diffuse synchrotron emission.... The origin of these relativistic electrons that we use, or that produce the synchrotron emission, they're produced in high-energy events like supernova explosions," Becky adds.

Synchrotron emission can be identified because it is polarized, meaning that the oscillation of the electromagnetic wave has a particular direction. Unpolarized light, on the other hand, oscillates in multiple planes. The polarization has encoded information about the magnetic field of the source, since its degree and orientation are determined by the magnetic field.

The emission collected by the telescope is not so simple, though. Between the point of emission and the telescope, the angle of the polarized light rotates as it passes through any medium containing magnetic fields and free electrons. This is called Faraday rotation. It is a frequency dependent effect—lower-frequency light undergoes more rotation, and higher-frequency light less rotation. This is why projects like GMIMS span a broad range of frequencies, as it can capture the differential effect.

With an understanding that the effect also depends on the properties of the magnetic field and electron density that the light passes through, Anna and Becky, and astronomers in their field, can start to tease out information about the galactic magnetic field. With the diffuse synchrotron emission, they can probe how the magnetic field varies, along the line of sight, for all the places in the sky they collect emission. "And this turned out to be extremely complicated," Anna says.

The DRAGONS Survey

Anna describes their survey technique as basket-weaving. "The way that we conducted the survey was just these fairly rapid back-and-forth scans in azimuth conducted at a fixed elevation. And when you combine this with how the sky rotates with respect to the telescope over the course of a night and over the course of a year, these back-and-forth scans produce this intersecting pattern. You're painting the sky in these intersecting brush strokes, if you will. We then calibrate these scans and combine them to produce a map of the sky sampled to represent the resolution of the telescope."

This takes, at minimum, six months, to ensure you capture the entire sky accessible to your telescope. Thankfully, with exclusive use of the DRAO-15 and with the DRAO staff dedicated to completing this project, they were able to complete it in this minimum time. Many of the GMIMS surveys, in comparison, take years to complete, as they use telescopes tasked with many different science goals. The length of time required is also related to the size of the telescope dish used. For a smaller telescope, say with a 15-m diameter, the beam size is larger and there is lower resolution, thus you need fewer brush strokes to complete the painting.

"We were able to do it in 6 months because of the support we had from the entire DRAO community. If we lose a night of observations, we lose a piece of the sky that we needed, and we would have to come back a year later to get that." Becky acknowledges, in our interview and in their paper, some people who provided invaluable service to the project. "As we approached winter, and the snow started to fall, the dish would fill with snow, and that would add torque to the motors and would cut the observation short. So we had volunteers from across the DRAO staff who were willing to come in and shovel the telescope over Christmas."

After collecting the observations, they had to develop data processing techniques. Becky says, "this was the first time the 15-metre telescope had been used for research, and this was probably also the first time this frequency range has been observed across the whole sky in the north…. We had to both characterize the nature of the noise sources coming through this telescope, characterize the telescope, and build a whole pipeline to process the data."

There are some key places producing confusion in their data. First, the Earth's ionosphere also contains charged particles that contribute additional Faraday rotation to the galactic emission. Next, there's radio emission from the ground that is collected by the antenna. Finally, there is radio frequency interference (RFI) from communication devices, satellites, or other human-made radio sources. In DRAGONS, the first two sources of confusion were able to be characterized and removed from the data. Even though the DRAO is an RFI-protected site, some contamination is impossible to mitigate, and 25 percent of the data were lost to RFI. "There were some highs and lows in which we didn't know if we'd ever be able to clear out the contamination in the data or maybe get maps of quality," Becky says. "But the repeated moments of great success, where we couldn't believe we actually produced something, and that something had real scientific information in it, has been, I think, one of the really fun parts of the journey."

The First Results from DRAGONS

"This was one of the main results of the survey paper," says Anna, the lead author of Ordog et al. (2026), "was the fact that these data revealed just how complex the Milky Way is. It's not a simple structure of a magnetic field. There's a lot of variability in there, and this dataset is going to be, I think, a goldmine of information to try to get at that."

"At any distance, you might have some emission, and then along the path from that emission to the observer, there's some rotation. And since you have different combinations of emission and rotation from different distances you end up with not just a single value for what we call the Faraday depth. Instead, you end up with a spectrum of Faraday depth, so a spectrum of Faraday rotation values," Anna explains. To get a 3-dimensional picture, they need to associate their emission with other, known, objects in the Milky Way that have determined distances. Then, they can try to piece together what the structure of the magnetic field looks like.

Becky, an avid hiker, has an apt analogy: "What we're trying to do is like making a map of a forest by asking hikers coming off a trail what they saw along the way. Except for that, hikers have no idea how far they got and they all got to different distances. So, Faraday simple [emission] is like if only one hiker came off the trail. It's a simple conversation. You have one piece of information, but Faraday complex [emission] is if you talk to dozens of them, and none of them know how far they got. Some may have gotten farther than the others. They all are telling you different stories, and now you're trying to untangle it and make a map."

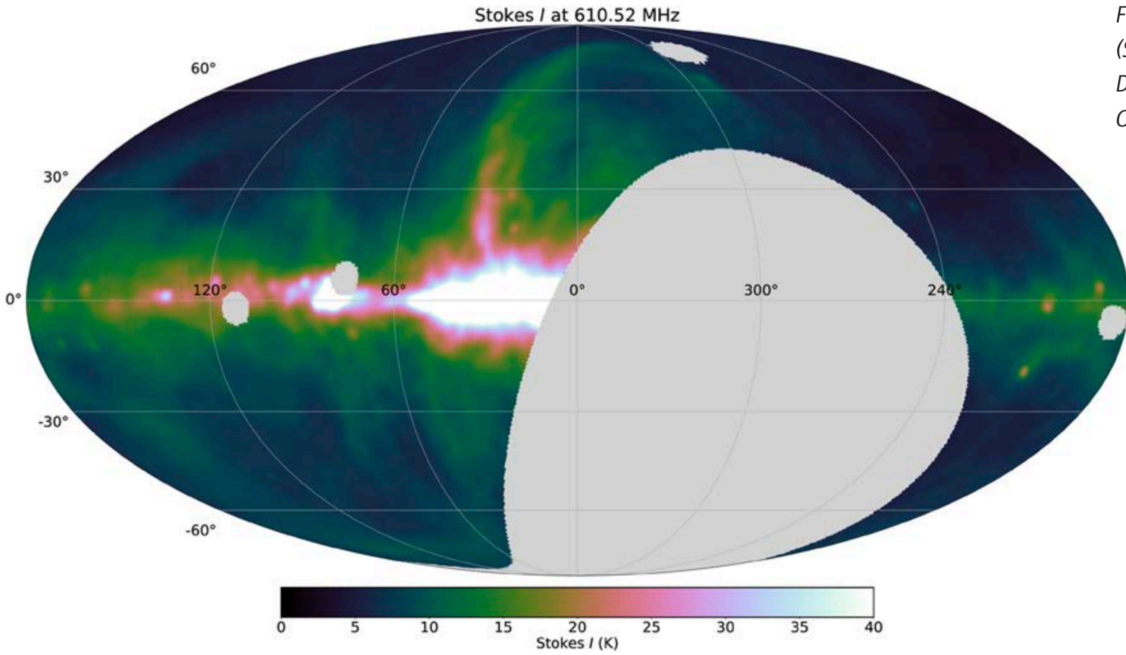

Figure 2 — The total emission (Stokes I) intensity as seen by the DRAGONS survey. Image credit: Ordog et al. (2026).

One of the achievements of DRAGONS is what they call high Faraday resolution. Since there is a complicated structure compiled along the path of emission, they want to be able to separate those components. High Faraday resolution indicates the ability to distinguish between two closely spaced Faraday rotation features in their Faraday spectrum. It's analogous to being able to separate two stars on the sky with high telescope resolution.

Anna mentions the precautions that they, as a part of the larger GMIMS project, must take. "The resolution does vary quite a bit across these surveys, and so when you're comparing them, you do have to be careful to adjust your data sets relative to each other to make sure that you're comparing apples to apples, to make sure that you're comparing the same scales of structure when you're looking at it within the two datasets."

On the other hand, Becky adds, "when we started, I don't think it was fully understood how much you can expect to see similarities and differences across Faraday rotation data sets from different telescopes, and we've been more and more surprised by how instruments across the world seem to be showing us the same thing."

Two of the survey maps are shown in Figures 2 and 3. In Figure 2, we see the total amount of emission detected by DRAGONS. This includes thermal emission—"stuff being hot and giving off emission because it's hot," Becky explains—as well as non-polarized synchrotron and other non-thermal emission. In Figure 3, we see the total amount of polarized emission. In both, the bright horizontal band is the disk of the Milky Way, with the brightest blob in the middle being the galactic centre.

Becky takes me through the maps. "There's a couple things in that map that are interesting. One is the spur that comes out of the middle of the galaxy. That's the North Polar Spur. It is a massive synchrotron emission source in the northern sky, and we don't know what it is. It appears in all polarization maps and [total intensity] maps, and it's been a huge question in the literature of what we're looking at, and how far away is it?

"Over to the left, and up a bit, you see [something that] almost looks like a rainbow or an arc. That's Loop 3, also a mystery, and so these are all synchrotron sources that show up also in total intensity that have been, like, what is it? Is it something that's just local and that's why it's so big, or is it something huge, but far away?

"The standout feature in this map is the blob at about 130 degrees, and that's the Fan Region. The Fan Region is another incredibly bright blob region of synchrotron emission that appears in all polarization maps, and also continues to be, unknown, the origin."

Anna explains, "a lot of that may be just the projection effects of how we look at these things, projected onto a 2-dimensional sky, and so it's challenging to determine what exactly the 3-dimensional structure of these things is." Some of these features may even be connected in yet unknown ways.

In Booth et al. (2026), the follow-up paper led by Becky, they started to analyze the structure appearing in the survey data. They saw reversals in the magnetic field pattern, produced when the magnetic field direction changes from our perspective as observers. This effect could be a real physical change in the magnetic field, or it could be due to our perspective as the structure is flattened in our data.

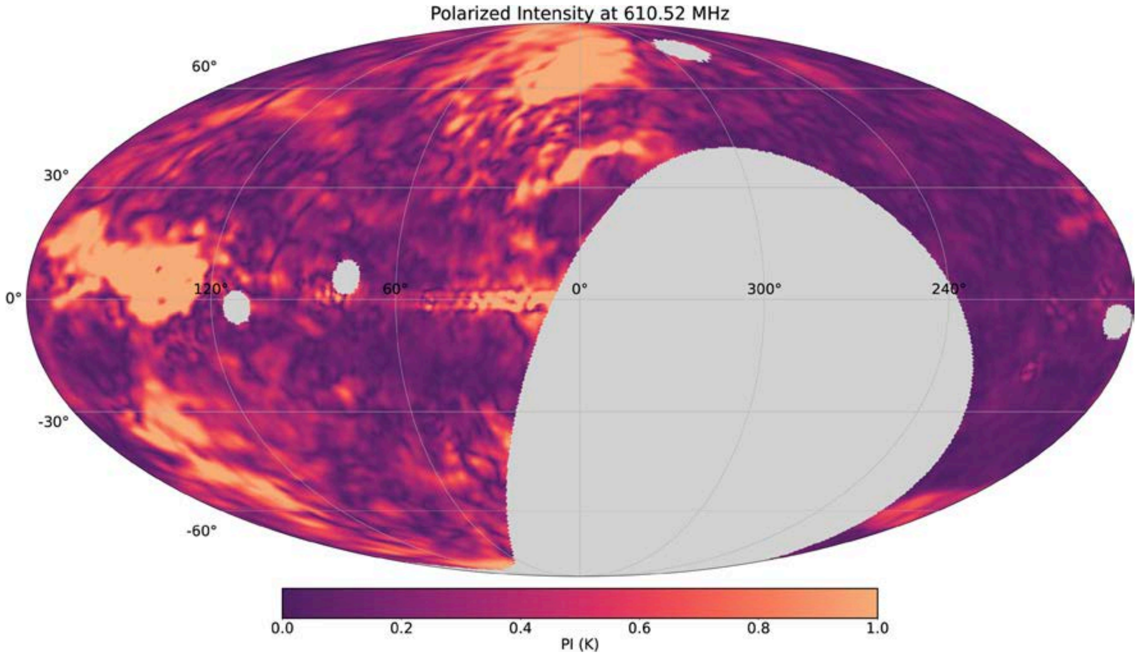

Figure 3 — The polarized emission intensity as seen by the DRAGONS survey. Image credit: Ordog et al. (2026).

There is one reversal that cannot be explained away by perspective. To explain it, they modelled a reversal in the magnetic field—where on one side, the magnetic field is clockwise as viewed from the north galactic pole, and on the other side, it is directed counterclockwise. This reversal is positioned in between our Solar System and the Sagittarius spiral arm. In prior research, it has been found that how the galactic magnetic field is amplified or how it interacts with the spiral arms can produce reversals.

They are finding their results may be dominated by the local magnetic structure. This understanding is allowing them to pull information out of the data, and here it's only the first step for the DRAGONS and GMIMS teams in piecing together a more comprehensive picture. "What we're doing is exploratory science. We don't necessarily know what we're going to find out. That's the best part of my work," Becky says.

The Outlook from the DRAO

The DRAO, along with instrumentation, has developed a niche strength in galactic magnetism studies. The mechanism to study magnetic fields, Faraday rotation, is well suited for long wavelength radio observations. DRAO scientists have used this fact to build studies, skills, and instruments to further this work. Anna says, "now, we're specifically building telescopes that can do more of this and do an even better job of this." They're harnessing modern data processing capabilities to complete projects dreamed of decades ago.

"We turned [the DRAO-15] from an engineering test instrument into a science instrument," Anna says, "but there was a lot of work in the background to get it to that point." Becky and Anna thank two key people from the DRAO for all of their mentorship and support in tackling and completing this project: Dr. Tom Landecker, the Principal Investigator of GMIMS, and Dr. Alex Hill, an Assistant Professor at the University of British Columbia, Okanagan.

"It's, I think, a unique and incredibly valuable experience for a Ph.D. student to have the opportunity to work hands-on directly with a telescope and see an observing project from start to end. This sort of project usually takes a lot longer," Becky adds. "We didn't know what we were going to see…. This was evidence of faith in the project on the part of the DRAO, but also evidence of Tom's commitment to seeing it through, and decades of work on the part of Tom to make GMIMS happen."

"I always really like to highlight just how cool of an experience it was to work at the DRAO, on the one hand, to have that hands-on access to the telescope, but also to be able to collaborate with such a diverse set of experts, from the astronomers, like Tom and Alex, to all of the engineering and technology staff who helped us make this telescope operational," Anna says. "It was an incredible experience." ✶

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Pamela Freeman recently finished her Ph.D. in astrophysics at the University of Calgary. Specifically, she studies the chemical make-up of star-forming clouds with radio telescopes. Generally, she loves to observe anything and everything about nature.

Blast from the Past!

Compiled by James Edgar
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[This obituary appeared in the March–April 1907 issue of this *Journal*.]

IN MEMORIAM.
Hers was the part to glean the scattered grains
Of Truth, which reach us from the starry field;
To weigh results which calculations yield,
See where they tend, and gather up the gains
Of many a night-long watch. She remains
The mistress of a style whose greatness sealed
It to sublimest science, which revealed
Deep study, and far reaching thought contains.

And she who, judging the cosmogonies,
Marked what they lacked, dimly perceived how
A Power outside of Nature guideth all
By ordered paths—a Power which vivifies
And upwards leads. She has gone from us now,
And from her eyes earth's darkening glasses fall.
T. E. HEATH, in *Knowledge*.

Agnes Mary Clerke.
By Elsie A. Dent.

IN the death of Agnes Mary Clerke, which took place on the 20th of January last, the scientific world loses one of its most useful and distinguished members, and this Society one of its most highly valued Corresponding Fellows. Death was due to pneumonia following an attack of influenza. The funeral services took place at the Church of the Servites, London, where Requiem Mass was celebrated on the 23rd of January.

[The following is from the RASC website, www.rasc.ca/corresponding-member-agnes-mary-clerke]

Agnes Mary Clerke (10 February 1842–20 January 1907) was an astronomer and writer, mainly in the field of astronomy. She was born in Skibbereen, County Cork, Ireland, and died in London.

Agnes Clerke was the daughter of John Willis Clerke (ca. 1814–1890) and his wife Margaret (b. ca. 1819). Her father was a judge's registrar.

She was interested in astronomy from an early age, and had begun to write about it before the age of 15. In 1861 her family moved to Dublin, and in 1863 to Queenstown. Several years later she went to Italy where she stayed until 1877, chiefly at Florence, studying at the public library and preparing for literary work. In 1877 she settled in London.

Her first important article, "Copernicus in Italy," was published in the *Edinburgh Review* in October 1877. She achieved a worldwide reputation in 1885, on the appearance of her exhaustive treatise, *A Popular History of Astronomy during the Nineteenth Century*.

Clerke was not a practical astronomer, instead collating, interpreting and summarising the results of astronomical research. In 1888 she spent three months at the Cape Observatory as the guest of the director, Sir David Gill, and his wife, and there became sufficiently familiar with spectroscopic work to be able to write about this newer branch of the science with increased clearness and confidence.

In 1892 she was awarded the Actonian Prize of 100 guineas by the Royal Institution. As a member of the British Astronomical Association she attended its meetings regularly, as well as those of the Royal Astronomical Society. In 1903, with Lady Huggins, she was elected an honorary member of the Royal Astronomical Society, a rank previously held only by two other women, Caroline Herschel and Mary Somerville.

Her sister, Ellen Mary Clerke (1840–1906), also wrote about astronomy.

At the meeting of 1891-12-01 a letter from Miss Clerke was read: "I have great pleasure in accepting the flattering offer which you have been so kind to transmit to me. I shall consider it a high honour to be affiliated, in the manner you propose, to the Astronomical and Physical Society of Toronto, which already gives promise of being a powerful agency for the promotion of astronomical activity in your great country. The first report, which I had the pleasure of receiving yesterday, is full of interest, and I hope on the first opportunity to offer some small contribution to it. I fear I can suggest little that might be effective for pressing the ladies of Toronto into the service. The means already adopted by you, of *showing off* the heavenly bodies, I should have thought most likely to be successful. Popular lectures might be a further help. The main thing is to kindle a spark, the rest might be left comparatively speaking, to take care of itself,—though, indeed, the really effective workers in astronomy are only a few out of many." Miss Clerke's advice on the point referred to had been sought.

On motion of Mr. A.F. Miller, seconded by Mr. John A. Paterson, M.A., Miss Clerke was elected a Corresponding Member. High tributes were paid by the mover and seconder and the Chairman to the distinguished candidate, whose excellent works were in the Society's library and had been read with much interest.

Miss Clerke later replied:

68 Redcliffe Square, London, W.C., Dec. 15th, 1891.

Dear Sir,

Thank you for your kind note of December 2nd, announcing my election as a Corresponding Member of the Astronomical and Physical Society of Toronto. I am very sensible of the honour done me, and feel greatly obliged to Merrs. Miller and Paterson for their evident cordial recommendation of my candidature. I will keep the paper carefully in mind, and try to make it interesting.

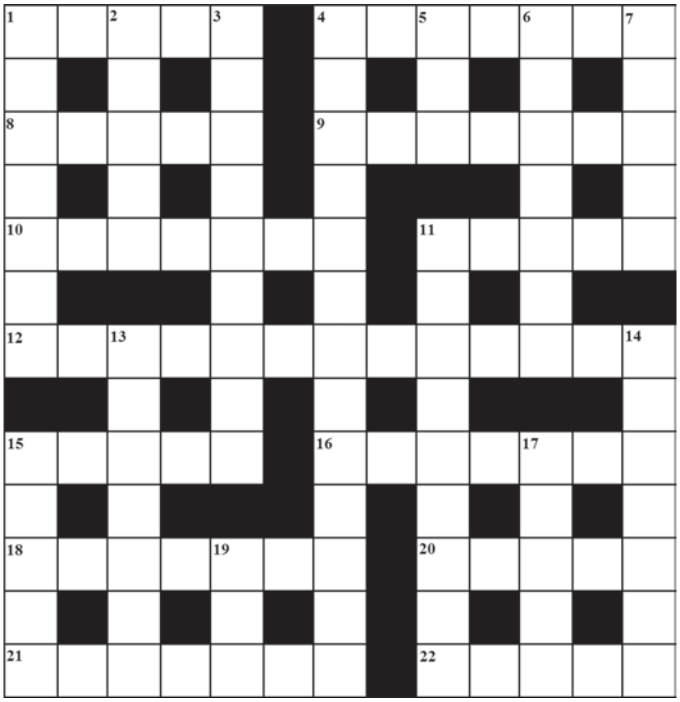
Believe me to be, faithfully yours, Agnes M. Clerke.

The lunar crater Clerke is named after her.

[This research has made use of NASA's Astrophysics Data System.]

Astrocryptic

by Curt Nason (nasonc@nbnet.nb.ca)



ACROSS

1. In rotation, Bethe christened a Jovian satellite (5)
4. Festival featuring a Greek character among the stars (7)
8. Eyepiece used in north of latitude 60 (5)
9. After exercise, Gauss would unwind in the Great Square (7)
10. Like Earth and pulsar jets (7)
11. Old British sailor dances with planetary geologist Lakdawalla (5)
12. No real man's rum gets stirred to label moons (5,8)
15. Headless doctor, drunk, was first to seek exoplanets from afar (5)
16. Relating to a long river swirling about India (7)
18. Star in perfect condition, also known as equatorial (7)
20. Cream spilt around Jupiter (5)
21. Famous person went to the gym and found Charon (7)
22. Some comets and their filters seen in Cygnus (5)

DOWN

1. Cataclysmic chromium robot about to blow (1,3,3)
2. Bar from slewing across the Pleiades to Pisces (5)
3. Divorcee with old scheme to see alien on Another World (9)
4. Bows down below a prismatic arc (13)
5. Three typical stars awarded to a fine girl (1,1,1)
6. Star seen in UMa but is identified in Mus (7)
7. She does double splits in analysis symmetry (5)
11. Four eggheads in spicy mix of Plössls (9)
13. Pyxis user was first to Mars (7)
14. Creepy-crawlies making pointy stars (7)
15. Chromic looks funny without Hertzsprung-Russell (5)
17. Star seen in two ways in a triangle (5)
19. RASCals can join it with small batteries (3)

Answers to previous puzzle

Across: **1** HARVEST (H(anag)ST); **5** TIMER (rev); **8** ROSAT (anag); **9** INERTIA (anag); **10** ERIDANI (anag+an+i); **11** DENEB (hid/rev); **13** ELNATH (anag); **15** OYSTER (2 def); **18** DUBHE (rev+he); **20** ARABICA (anag); **22** ARECIBO (anag+o); **23** NAIAD (anag); **24** FLAME (2 def); **25** NEBULAE (n(anag+a+)e)

Down: **1** HORSEHEAD (hom); **2** RUSSIAN (hom); **3** EXTRA (drop terrestrial); **4** TRIFID (anag); **5** TUESDAY (2 def); **6** METON (me+ton); **7** RIA (rev); **12** BARNARD'S E (2 def); **14** THE KITE (2 def); **16** TRIVIAL (tr(IV)ial); **17** LAGOON (LA+goon); **19** BIELA (B(i)ela); **21** ARNEB (hid); **22** ALF (rev)

2026 Awards

Compiled by Michael Watson FRASC and Randy Attwood FRASC

Judy Anderson – Winnipeg Centre
Service Award

We would like to nominate Judy Anderson of the Winnipeg Centre for the Society's Service Award. Judy has been a stalwart member of the Winnipeg Centre for decades, and in recent years has been one of the Centre's most dedicated volunteers. She is currently in her third consecutive term as Vice-President, during which she worked on writing and revising the Centre's new Bylaws as head of the Centre's Bylaw Committee. Judy has served in nearly every Centre Council position over her RASC career, often for multiple terms, and edited the Centre's newsletter "Winnicentrics" when it was still printed on a Gestetner machine and mailed to members.

For nearly a decade she has booked the featured speakers and local segments for the Winnipeg Centre's meetings, the quality of which attracts RASC members from across the country via the Centre's live-streamed meetings. She has held the Centre together through many lean times through her volunteerism, her example. and her sheer determination. She cares deeply about the Winnipeg Centre and deserves the Society's highest recognition for her efforts to keep the Winnipeg Centre a vibrant community of amateur astronomers.

Nominated by:
Scott Young, Winnipeg Centre
Tracy Knowles, Winnipeg Centre

Judy Black – Halifax Centre
Service Award

It is with great pleasure that we nominate Judy Black for a Service Award in recognition of her exceptional and sustained contributions to Halifax Centre and to the Society as a whole.

Judy has consistently demonstrated outstanding leadership, organization, and dedication. She has served as both a driving and unifying force within the Centre, playing a pivotal role in the planning and execution of events and ensuring that every activity is conducted with efficiency and professionalism.

Judy's contributions to the Halifax Centre's administrative framework have been particularly significant. She has worked tirelessly to develop and maintain comprehensive records, as well as clear documentation of processes and procedures. Because of her efforts, the Centre's policies are current, accessible, and invaluable to the Board of Directors. Her diligence has established a foundation of continuity, transparency, and accountability that benefits the RASC Halifax Centre today and will continue to do so well into the future.

Judy has served the Halifax Centre in several key leadership roles, including:

- President (2020–2022)
- National Council Representative (2021–2025)
- Secretary (2024–present)

In every capacity, Judy has exemplified collegiality and integrity. She fosters an atmosphere of cooperation and goodwill, and she consistently leads by example. If something needs doing, Judy is always among the first to volunteer—whether leading an initiative or supporting others. When she says, "I'll look after that," everyone knows the task will be completed promptly and to a high standard.

As National Council Representative, Judy has strengthened the connection between Halifax Centre and the broader Society. Through her thoughtful engagement and clear communication, she has helped not only Halifax Centre but all Centres participate more effectively in consultation with the National Council and ultimately the National Board of Directors.

Judy's approach to leadership is forward-looking and constructive. She does not dwell on past challenges but instead focuses on opportunities for growth and collaboration. Her inclusive leadership style and ability to build strong teams have been major contributors to the ongoing success of RASC Halifax Centre.

For her exceptional service, commitment to excellence, and lasting impact on the operations and spirit of RASC Halifax Centre, we are proud to nominate Judy Black for a RASC Service Award. Her dedication and professionalism exemplify the highest standards of volunteer service within the Society.

Nominated by:
Tony McGrath – Halifax Centre
Mary Lou Whitehorne – Halifax Centre

Jeff Booth – Toronto Centre, Hamilton Centre (Associate Member)
Service Award

Jeff Booth is the epitome of a RASC member and what the RASC stands for. I (Ed Mizzi) have known Jeff for several years, but I also know that he was active for decades before we met.

To preface, I will tell you that I have never witnessed Jeff turn down a request for help, whether it be for an individual member (or member of the public), an organization, his Centres, the CAO and the RASC in general. Below is a summary of some of Jeff's many attributes, gifts and talents.

1. Sidewalk Astronomy: Jeff has always made himself available to the public, in many locations. Not only does he offer a plethora of knowledge about the night sky, he gets excited when he is able to share naked eye, binocular and telescope views of celestial objects.
2. Guest speaking: I have heard Jeff speak on several occasions, about a variety of astronomy related topics, from astrophotography to current events to space phenomena, such as the Aurora Borealis. He knows how to capture an audience's attention and interest.
3. Slide presentations/workshops: Jeff knows how to create excellent slideshows that complement his talks and provide pictures that help the audience understand the topic. When he is involved in workshop sessions, he leads by example and, as a good teacher, he allows the student to experiment and learn through trial and error, all the while being available as a guiding hand.

4. Observatory outings: I know that Jeff has been involved with the Toronto Centre's E.C. Carr Astronomical Observatory in the Blue Mountains, in many capacities. He thinks nothing of spending days on site helping with maintenance, construction and being an ambassador to visitors.

He has also assisted with the Hamilton Centre's Observatory where we have regular outings.

5. Monthly meetings: Jeff attends my Hamilton Centre's monthly meetings, always wanting to learn more from fellow members and guest speakers. He is always willing to help members with questions about the cosmos or telescopes.
6. Helping others buy a first telescope: Jeff and I have worked together at times, helping people search for their first telescope or one for a child. Whenever I need an opinion or advice for a member or member of the public, Jeff is my go-to person. He has owned and or used many different telescopes so he can advise based on decades of experience.
7 Helping others buy an imaging rig: Jeff is an excellent astrophotographer. Not only has he produced eye-candy type images, he has helped others get into the hobby by making himself available and helping suggest equipment. I have personally been the recipient of Jeff's expertise. He helped me construct my backyard observatory, set up my equipment and teach me how to use capturing and processing software. He is the ultimate troubleshooter.
8. Outreach to schools, clubs, libraries, Girl Guides & Boy Scouts, etc. I doubt that there is a type of group that Jeff has not spoken with. He makes his talks and visits age appropriate and I'm sure he has hardly ever turned down a request.
9. I have also witnessed Jeff's passion for astronomy and for unselfishly sharing with others.

I have observed comets, eclipses, and other events alongside Jeff, sometimes at the most ungodly hours of the night. If there are others around, he turns our sessions into teaching moments, sharing his encyclopedic knowledge with those around us.

To conclude: Through the RASC, I have met many amateur astronomers and I have yet to meet one who was not generous with their expertise and time. Jeff epitomizes that generosity but adds a passion that is difficult to describe. He has often quipped to me, saying "Ed, it's not so much about the end result, it's about the journey." He lives that mantra, but takes so many others along with him in his journey.

Nominated by:
Ed Mizzi – Hamilton Centre
Arnold Brody – Toronto Centre

Richard Corbet – Sunshine Coast Centre

Service Award

Since joining our Centre, Richard Corbet has been a valuable and active volunteer, generously contributing his time, extensive knowledge, experience, and analytical skills, likely rooted in his engineering background, in a variety of ways. The following are examples of Richard's contribution to facilitate outreach, promote membership and raise funds.

Since 2018, he has written a monthly astronomy article for the local Sunshine Coast's *Coast Reporter* newspaper, the primary media outlet for our 30,000-person community. Club members often hear friends referring to the *Coast Reporter* articles in conversations, indicating that Richard's articles have raised the profile of the club, astronomy and related issues. Richard's articles have become a key medium for outreach and awareness-building for the Club. Importantly, Richard is the "go-to" person for youth-oriented outreach events, as he communicates effortlessly with young people. This has been a contributing factor to the number of both youth and adults who visit the Observatory for night sky viewing.

Richard regularly volunteers at our outreach events, and people come forward asking to see "the guy that writes those astronomy articles". One often finds him surrounded by visitors at observing sessions as he answers questions and entertains them with astronomical knowledge. Physical disabilities don't hold him back.

Since 2020, Richard has presented a "Skies This Month" *PowerPoint* at our monthly meetings, complete with *Stellarium* simulations, photos, and easy-to-understand scientific information. These presentations are recorded, edited, and posted to our Centre's *YouTube* channel. Many club members find this information useful for planning their observing focus for the time periods covered by Richard. On occasion, Richard has included some fascinating explanations of atmospheric conditions and how these affect observing as well as his own calculations of terrestrial body movements, which exemplify his knowledge and skills in astronomy.

Richard is the "go to" for youth-oriented outreach events since he communicates so effortlessly with young people. Physical disabilities don't hold him back. One usually finds him surrounded by visitors at observing sessions as he answers questions and entertains them with astronomical knowledge. I know from his stories that he's been doing this work for other RASC Centres that he hung out with before our Sunshine Coast Centre was founded in April 2008. Richard is currently serving as a Director-at-Large on our Centres Executive. I know from his stories that he has been doing this voluntary work for other RASC Centres that he was involved with before our Sunshine Coast Centre was founded in April 2008.

We believe that it is time that Richard's hard work and significant contributions to the Sunshine Coast and beyond, in effective awareness building of astronomy on a voluntary basis, be recognized, and we nominate him for the RASC's Service Award.

Nominated by:

Charles A. Ennis, Sunshine Coast Centre
Richard Bolt, Sunshine Coast Centre

Glen Harris – Prince George Centre
Service Award

On behalf of the Prince George Centre of The Royal Astronomical Society of Canada, we are pleased to nominate Glen Harris for the RASC Service Award in recognition of his outstanding and long-standing service to the Centre and the broader astronomical community.

Glen has been an active and dedicated member of the Prince George Centre since July 25, 2001, contributing more than two decades of sustained volunteer service. Throughout this time, he has played a vital role in nearly every aspect of the Centre's operations, offering both technical expertise and steadfast leadership.

One of Glen's most significant contributions has been his work in building and grounds maintenance, ensuring that the Prince George Observatory remains safe, functional, and welcoming for members and the public alike. In addition, Glen had taken responsibility for managing all electronics associated with the Centre's 24-inch telescope, a complex and critical role that requires advanced technical knowledge and commitment.

Glen had also served the Centre with distinction in executive leadership roles, acting as Treasurer and Secretary for the past ten years. In these positions, he provided stability, sound governance, and dependable administrative support, enabling the Centre to operate efficiently and focus on its mission.

Beyond infrastructure and governance, Glen had been deeply involved in public outreach and education. He has regularly supported open house events and observatory tours, taught RASC NOVA courses, and delivered numerous presentations that have helped inspire interest in astronomy among audiences of all ages and experience levels.

Most notably, Glen had been a key contributor to the Prince George Observatory's 24-inch Robotic Telescope Project, where his technical skill, problem-solving ability, and dedication have been instrumental in advancing the project toward successful implementation.

Glen Harris's exceptional service, sustained commitment, and wide-ranging contributions exemplify the values of volunteerism, excellence, and community engagement that the RASC Service Award is intended to recognize.

Nominated by:

Malhar R. Kendurkar, Prince George Centre
Gil Self, Prince George Centre

Malcolm Park – Kingston Centre
Service Award

No stranger to the astrophotography world, with an image on the back cover of the 2026 *Observer's Handbook* of M16 also images in the Nicole Mortillaro's book *Night Sky Almanac*, to his own website where he sells his images, has multiple postings to Instagram, Facebook, and many more platforms.

With a remote telescope hosted in San Pedro de Atacama, Chile, he images the southern wonders and studies the sky for asteroids with ID number X15. Not forgetting the northern skies, he images and also chases aurora and weather storms.

A member of the RASC since 2014 but with being with Kingston since April 2020, he has always stepped up and helped out where he could.

Malcolm is always spearheading projects with presentations and connections, reaching out to Peter Cerevolo to assist in discussions on a mirror project for the RASC Kingston Centre, to creating an Astrophotography 101 class via ZOOM that helps others who are interested in doing astrophotography. There have been over thirteen sessions, and special guest speakers, Kerry-Ann Lecky Hepburn and Ben Law. It has been a very well presented program with much information and teachings.

He was the Vice President of the Centre from 2022–2024 and when asked to become the President he agreed, and is still the President of the Kingston Centre. He was one of the key people to help steer the Board through the administration process of the By-laws and ONCA government paperwork, which is not an easy job.

The latest project has been to help spearhead and bring together a donation of the 25-inch Obsession Attila Danko telescope for outreach work, in connection with the Lennox and Addington Dark-Sky Preserve. Plans are underway for minor fixes and the County of Lennox & Addington will be building a storage facility for the telescope for use in the spring of 2026.

He was also past President and Vice President of the NYAA (North York Astronomical Association), and is a primary organizer of Canada's largest star party—Starfest.

Nominated by:

Kim Hay - Kingston Centre
Roger Hill - Kingston Centre

Matteo Statti – Hamilton Centre, Mississauga Centre (Associate Member)

Young Astronomer Award

It is with great enthusiasm that we nominate Matteo Statti for the prestigious Young Astronomer Award of The Royal Astronomical Society of Canada (RASC) for 2025. Matteo is a 4th-year Astronomy and Astrophysics student at York University with a passion for telescopes, and plans to pursue a PhD in astronomical instrumentation. Matteo's dedication to the field of astronomy, coupled with his exceptional contributions to public outreach and research, make him a standout candidate for this honour.

Matteo has been an active and invaluable member of the RASC's Hamilton Centre for multiple years. His passion for sharing the wonders of the Universe has shone brightly through his involvement in numerous outreach events, where he has inspired countless individuals of all ages to look up and explore the cosmos through his antique telescope. Additionally, Matteo has delivered engaging and insightful presentations at the Hamilton Centre's monthly club nights, showcasing his ability to communicate complex astronomical concepts with clarity and enthusiasm.

Beyond his work with the Hamilton Centre, Matteo has extended his contributions to the Toronto and Mississauga RASC Centres where he is a regular attendee of MRASC meetings and observing sessions and a frequent supporter of MRASC public outreach observing at Riverwood Conservation in Mississauga. These activities further demonstrate his commitment to fostering a vibrant astronomical community.

Matteo is also a member of the RASC National History Committee and, since 2022, has worked as a curatorial assistant at the RASC national office for the future Dorner Telescope Museum. Matteo collects, restores and builds telescopes. His personal telescope collection includes over 20 antique, vintage and modern telescopes. He has built a 6" 3D printed reflector telescope and is currently building a 16" Dobsonian telescope that he plans to enter at Stellafane in 2026.

His involvement with both the David Dunlap Observatory (accepted into the 2025 Dunlap Institute Summer School for Radio Astronomy) and the Alan I. Carswell Observatory has further solidified his reputation as a dedicated and skilled young astronomer, actively contributing to the advancement of public education and research in astronomy.

Matteo's academic and research pursuits are equally impressive. For the past 4 years, Matteo has worked as an astrophysics researcher studying eclipsing binary stars for Vanderbilt University in Nashville, Tennessee, and quasar research for York University. In 2023, he attended the Antique Telescope Convention in Italy, where he deepened his appreciation for the history and evolution of astronomical instrumentation. Most recently, Matteo travelled to Sejong University in Seoul, South Korea, to further his research on quasars, showcasing his drive to expand his knowledge and contribute to cutting-edge astrophysical studies on an international scale.

In recognition of his outstanding achievements, Matteo was recently awarded the RASC Hamilton Student Astronomer of the Year award for 2025, a testament to his dedication, hard work, and impact within the astronomical community.

Matteo Statti exemplifies the qualities of a young astronomer who is not only passionate about the science of the Universe but also deeply committed to sharing that passion with others. His contributions to research, education, and outreach make him a deserving candidate for the Young Astronomer Award for 2025. I am confident that Matteo will continue to make significant contributions to the field of astronomy and inspire future generations of stargazers and scientists alike.

Nominated by:

Jane Tumbin, Victor Abraham – Hamilton Centre
Kirby Alguire, Allan Connery – Mississauga Centre

Rylan Wakeman – Niagara Centre

Young Astronomer Award

Rylan and his family have been members since 2018. At the beginners' meetings (held immediately before the Centre regular meetings) Rylan was always an enthusiastic participant. When questions were asked to the group, you could count on Rylan to have the correct answer. Our Beginners group leader stepped down in the summer of 2024 and Rylan volunteered to take over, doing a great job. He purchased a Seestar S50 smart telescope and now is an astrophotographer as well, sharing his photos and experiences in our Centre newsletter.

Rylan started his studies in September of this year at the University of Waterloo in the department of Physics and Astronomy.

Our Centre Executive feels he is most deserving of this award!

Nominated by:

Robert Lewis – Niagara Centre
Jeanette Bax – Niagara Centre

The Northern Star Documentary Team – Victoria Centre

QILAK Award

The Northern Star documentary dramatizes and popularizes a crucial milestone in the history of Canadian Astronomy and the person behind it: The creation of the Dominion Astrophysical Observatory in Victoria, and John Stanley Plaskett, the farm boy from Ontario who became successively a photographer, engineer, and Canada's first astrophysicist. This documentary production tells how Canada moved to the front ranks of astronomy and the exploration of space. Skilful narration and cinematography bring to life the story of Canadian astronomy, supported by interviews with key science popularizers and key scientists across the country, including Canadian astronauts.

Producer/director Nick Versteeg was inspired to create this documentary when he read Peter Broughton's 2018 biography of Plaskett. Versteeg has explored a number of topics in a career that has spanned more than four decades, and he decided to create this documentary after discussions with Broughton and astronomers.

To make this documentary, Versteeg embarked on the difficult work that goes into such a production. This includes obtaining financial support from a variety of private and government sources. A key supporter was Vancouver Island's employee-owned television station, CHEK, which gave Versteeg and DV Productions a broadcast license for the show. He then assembled a team to make Northern Star a reality, starting with famed author and science journalist Bob McDonald, who narrated the documentary. He then brought author and space historian Chris Gainor on board to create a script, along with top cinematographer Aizick Grimman who directed filming.

Once the funding was in place, the team worked with skilled filmmakers and actors to tell the story of John Plaskett, the Dominion Astrophysical Observatory and Canadian space exploration. In June 2025, Northern Star was premiered on CHEK television in its original two-hour format, and a shorter one-hour format version has also been created. Talks are going on to show this documentary on television networks around Canada.

Few Canadians know the story of astronomy and astrophysics in Canada, and our leading role the exploration of space with telescopes on the ground and in space. Northern Star tells this story in an impressive and accessible form.

The Victoria Centre of the RASC, as approved by the current Council, and the Friends of the Dominion Astrophysical Observatory, are proud to nominate the Northern Star documentary team for the 2026 QILAK Award.

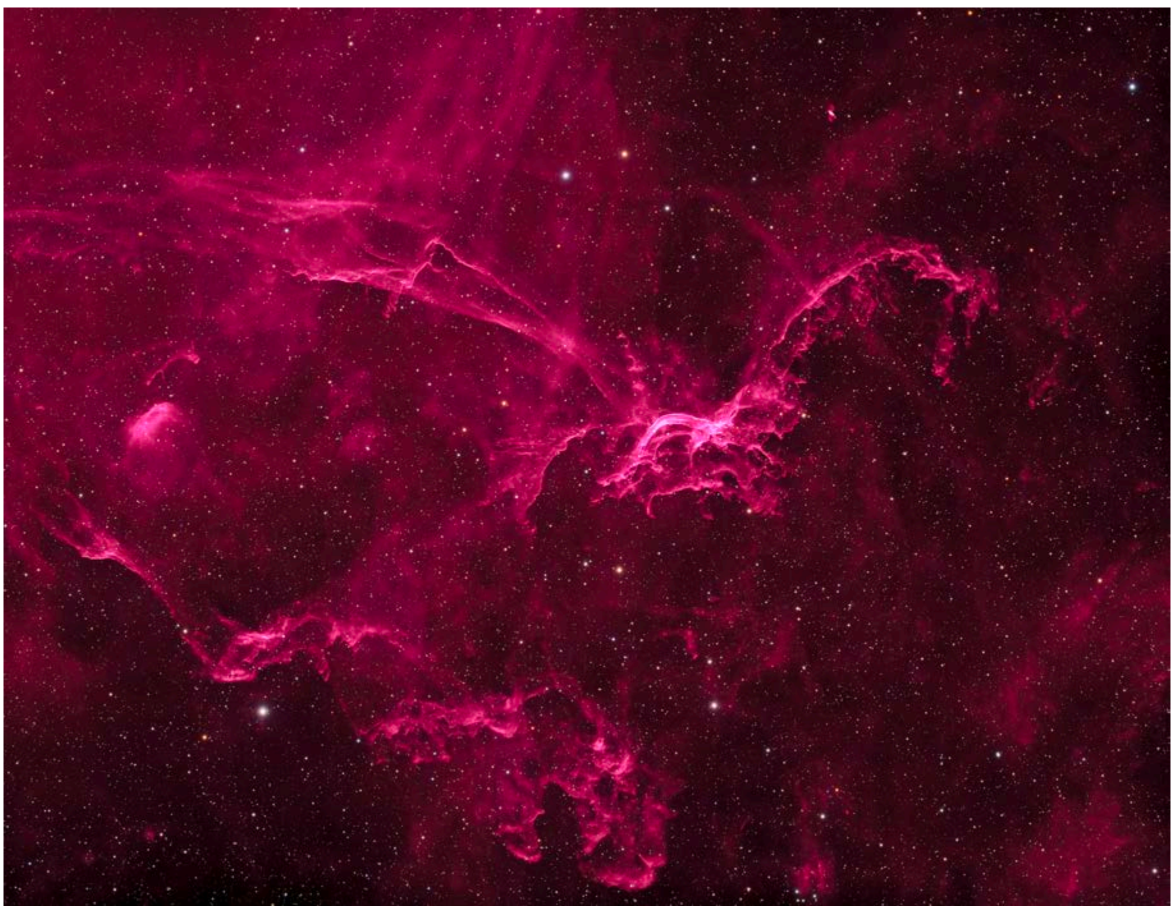
The Northern Star documentary team members are worthy awardees for the QILAK Award, as popularizing both key events in the history of Canadian Astronomy and their long-term impact.

Nominated by:

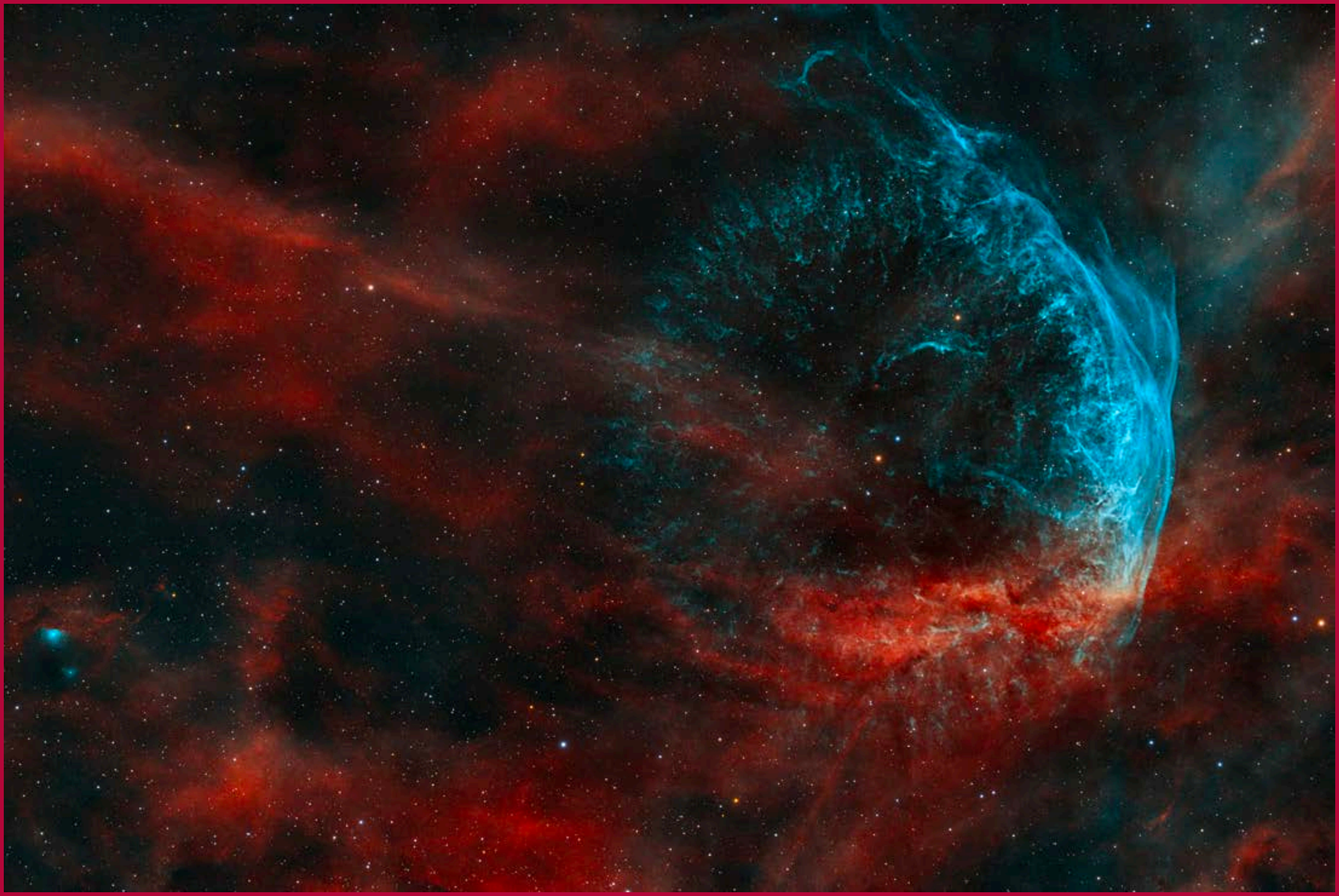
The Victoria Centre of the RASC. ✶

Great Images

By Steve Leonard



What's better than a dragon? A flying dragon, of course. Steve Leonard imaged the Flying Dragon (Sharpless 113). He says, "A curious feature that stood out during processing of the image was the corkscrew-like 'pigtail' feature near the core, which has a strikingly helical structure. I am wondering if this structure is magnetic in origin, and if it could be a magnetic flux rope with the glowing hydrogen filaments tracing the invisible topology of interstellar magnetic fields in the region. While I have seen this feature in others' images of the Flying Dragon, I have not come across any discussion of it or its astrophysical origins. If you are aware of what this feature is or how it was formed, please let me know!" He used an Astro Tech AT115EDT 4.5" triplet refractor at f/5.6, with an EQ6-R mount, NINA, ASI 1600MM Pro camera, Chroma 3 nm HA filter, Astrodon RGB filters, 30 hours $H\alpha$, 2 hours total RGB. Processed in PixInsight. Taken from Markham, Ontario; Bortle 8/9.



Journal

This incredible image of WR 134, was taken by Rob Lyons. WR 134 is a Wolf-Rayet a star, "a type of star that is massive, burns fast, and dies hard in supernovas. They have intense energy output and strong solar winds, which you can see at work here. The solar wind has created a shockwave bubble in the oxygen that lies in the surrounding area, and its intense energy output is causing that oxygen to emit light in a blue/teal colour. It is as beautiful as it is fascinating." Rob imaged this with "a pair of matching 8" Edge HD telescopes, one with a 2600MC Pro colour camera, and the other with a 2600MM monochrome camera. I used hydrogen and oxygen filters to create this HOO image. This was captured over 3 nights in July for a total of 26.5 hours of exposure."