The Journal of The Royal Astronomical Society of Canada

Journal

Le Journal de la Société royale d'astronomie du Canada

PROMOTING ASTRONOMY IN CANADA

April/Avril 2025
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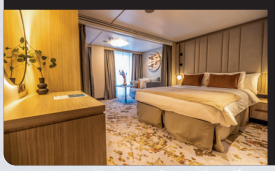

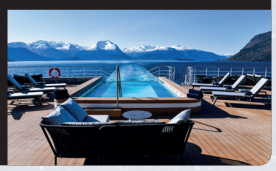

AUGUST 2026

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Royal Astronomical Society of Canada

Société Royale d'Astronomie du Canada

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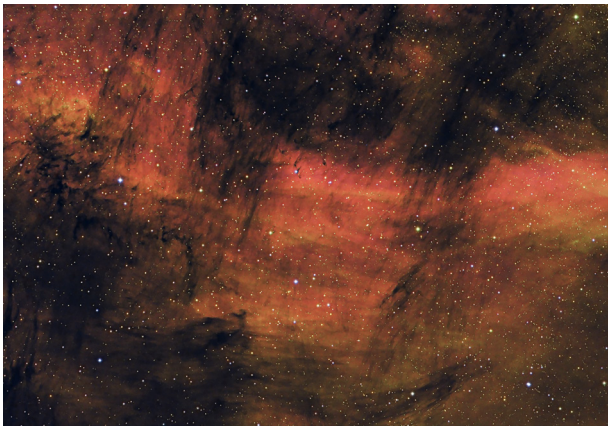
Editor's Note: The images in this issue were generously provided by RASC members from the Astroimager certificate program.

IC 5068—Dan Meek of Calgary writes: What I find interesting about the image is that against a background of bright nebulosity, some universal painter's brush strokes appear to sweep wispy clouds of dark nebulosity across the view. The image is an 8.5-hour narrowband exposure using a Tele Vue NP127is telescope and a QSI583wsg CCD camera on a CGE PRO mount. I took the image from Calgary, Alberta. Camera control and preprocessing was done through Images-Plus. Processing was done through PixInsight with final touch-up, as required, through Photoshop. Guiding was through PHD2 and a Lodestar camera.



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

The RASC's National Council – What does it do?

by Michael Watson, President
Michael.Watson@gowlingwlg.com

The vast majority of the RASC's 4,300 members—as of January 2025—belong to the Society's 30 Centres that are the lifeblood of our organization. About 280 of those members do not belong to any Centres, and are referred to as "National" (formerly "unattached") members.

Each Centre has a council or board of directors that is responsible for the operations of the Centre, the members of which are elected by the Centre's membership. The majority of Centres are incorporated under provincial or territorial corporations statutes, and must follow the requirements set out in those laws.

At the national level, the Society is run by a Board of Directors that is elected by the entire voting membership of the Society. I discuss when and why this came about below, but first I'm going to delve into a little history, and talk about the Society's National Council, which still plays a critical role in the running of our astronomy club. For brevity I'll call the National Council the "NC" in the rest of this column.

Many readers will know that the RASC got its start as the Toronto Astronomical Club in 1868, and became incorporated under Ontario law in 1890. Over almost a century and half after its 1868 inception, it was run by a group known variously as the "Council" or the "General Council," and finally, in 1949, as the "National Council." From 1890 the Council oversaw "the general management of the Society's affairs." Under the 1908 constitution, the Council consisted of the elected officers of the Society, six additional elected members, all of the past-Presidents, and the presiding officer of each Centre (Centres were previously known as "Sections").

In 1968, the Society received Letters Patent reincorporating it under the federal *Corporations Act*. At the 1989 Annual General Meeting, the membership approved a completely rewritten By-Law that had been drafted by the Constitution Committee, of which I was Chair, over the previous three years. Under this By-Law, the voting members of the NC were the five elected officers of the Society (President, First and Second Vice-Presidents, Secretary, and Treasurer), the two surviving immediate Past Presidents of the Society, the chairpersons of all standing committees, and the National Council Representatives ("NCRs") of the Centres. The NC

also had as non-voting members the Society's Honorary President, the Executive Secretary, and the chairpersons of all special committees. This was the structure of the NC for the next 24 years, until the events discussed in the next paragraph took place.

Arguably the most significant change in the governance of the RASC came about as a result of the enactment by the Parliament of Canada of the *Not-for-profit Corporations Act* (the "NFP Act") in the year 2009. Under that statute, all not-for-profit bodies that had been incorporated at the federal level were required to come into compliance with the requirements of the statute. The RASC retained legal counsel, prepared a new governance structure, drafted a new By-Law, and submitted an application for continuance under the NFP Act. The new By-Law was approved by special resolution of the members at the 2013 Annual General Meeting held in Thunder Bay.

What was the most significant change? Under the NFP Act, every not-for-profit corporation had to be run by a board of directors, all members of which had to be elected by the overall membership of the Society. The NC could no longer run the Society, because it consisted of members—the NCRs—who were elected by the members of individual Centres (or appointed) rather than by the Society's entire membership.

But the RASC was of the view that the NC should not be disbanded entirely, because it had performed its governance function well for decades, and partly to honour its long existence and to retain a connection to the RASC's history. So the decision was made to keep the NC in place, but its mandate would not be to run the Society, but rather to act as "a consultative and advisory body," in the words of section 8.1 of By-Law No. 1, : "*8.1 The National Council is a consultative and advisory body. It cannot bind the Board to any of its recommendations or decisions.*"

The NC now consists of only the NCRs of the Centres, without the elected officers, Past Presidents, and standing committee chairs of the Society, as was the case previously. As the Society's By-Law has stipulated for decades, each Centre of the Society is entitled to one NCR for each 200 members (or portion thereof), although this entitlement of large Centres to more than one NCR is not nearly as important as it used to be, since no decisions of the National Council can be binding on the Board of Directors and therefore on the Society. Each year at its last meeting before the end of June—near the time of the Society's annual meeting of members—the National Council elects a Chair, Vice-Chair, and Recorder for the next year. The NC normally meets six times per year, once every two months. It's worth mentioning that both the NC and the Board of directors now meet virtually rather than in person, which started during the pandemic and has continued. Virtual meetings have two main benefits: (i) They save the Society the previous large expense of flying people across the country to in-person meetings, (ii) They enable more members to attend meetings when they don't have to leave their home provinces or territories and take two or more days out of the schedules to attend meetings that usually were held in Toronto.

Since the National Council can't make any decisions that are binding on the national Board of Directors, one might well ask what the National Council actually does, and what is the point of continuing to have a National Council at all? Well, as stated above, the NC is a consultative body. After some years of paying insufficient attention to the NC and the wealth of experience of its members, in the last couple of years the Board of Directors has made a concerted effort to involve the NC in all of the major issues that face the RASC and that the Board has to deal with. At every NC meeting the RASC's President, Treasurer, and Executive Director present reports on the Society's finances and head office activities. We ask for the NC's input on the Society's finances and general operations, and do not make major decisions without consulting first with the NC. This has been to the great benefit of the national Board of Directors, and I believe that a much closer sense of cooperation and working together for the good of our astronomy club has been the result.

But in addition, under the capable leadership over the past several years of NC Chair Judy Black of the Halifax Centre, the NC has undertaken work of its own, for the benefit of all Centres and the general membership. For example, the NC has drafted and completed a new policy for the Society called "National Council Terms of Reference," which will be approved before this year's annual meeting in June. Perusing the NC's meeting agendas and minutes, one sees the NC discussing and dealing with various important topics, of which these are a few:

- updating the Centre Operations Manual (providing guidance for Centres on their operations);
- best practices for Centres for public education & outreach volunteers, including security checks;
- green laser pointer training and use reporting to Transport Canada;
- conducting hybrid meetings;
- communications mechanisms with the NC, including welcome package for NCRs

All of this is to say that your National Council fulfills an important and possibly underappreciated role in the RASC, and deserves our attention and gratitude. I'll finish by saying that Centres and their members can get the most out of the NC by ensuring that their National Council Representatives provide regular detailed reports on NC activities at Centre meetings and through Centre newsletters. That is one of the best ways to keep abreast of what is happening in your national astronomy club! ✶

Compiled by Jay Anderson

Little Red Dots herald the start of the Universe

When the *James Webb Space Telescope* began science operations in the summer of 2022, its superior resolution, light-gathering power, and infrared sensitivity promised to change our view of the first few billion years after the Big Bang. These capabilities gave us a sharper view of the faintest and most distant objects in wavelengths that allowed exploration of the highly redshifted early Universe.

Soon after the start of operations, astronomers noticed something unexpected in the data: red objects that appear small on the sky, located in the distant, young Universe. Come to be known as "little red dots" (LRDs), this intriguing class of objects sparked new questions and prompted new theories about the processes that occurred in the early Universe. LRDs were bright, which suggested huge stellar masses, and were so numerous that theories of the early Universe were unable to adequately account for them. There were claims that models of the Universe were "broken."

By combing through publicly available Webb datasets, a team of astronomers has recently assembled one of the largest samples of LRDs to date, nearly all of which existed during the first 1.5 billion years after the big bang. They concluded that a large fraction of the LRDs in their sample (341 in all) are likely galaxies with accreting black holes at their centres. LRDs numbers form around 400 million years after the Big Bang, reach a maximum at about 900 million years, and largely disappear by 1.2 billion years.

"We're confounded by this new population of objects that Webb has found. We don't see analogues of them at lower redshifts, which is why we haven't seen them prior to Webb," said Dale Kocevski of Colby College in Waterville, Maine, and lead author of the study. "There's a substantial amount of work being done to try to determine the nature of these little red dots and whether their light is dominated by accreting black holes."

In order to study the LRDs in their "natural" state, the science team had to remove biases that affected the observational data. Galaxies are intrinsically red for two reasons: they are made up of old, red stars or they are embedded in dust that filters short wavelengths from our view, leaving only longer red and infrared frequencies For cosmologically distant galaxies, the redshift in wavelengths as light travels from the early Universe will bring about a reddening. This latter factor had to be removed from the JWST observations in order to establish the real nature of the LRDs.

The redshift-corrected spectrum of the LRDs reveals a near-constant brightness through the shorter wavelengths (ultraviolet) followed by a steadily rising brightness as the wavelength gets longer (visible and infrared). Gas within the LRDs was found to be moving at speeds of 1000 km/s, a sign of an accretion disk around a massive black hole. There were also broad emission lines, suggesting a powerful energetic source within the LRDs. These characteristics would be difficult to blame on a large population of bright and massive new stars, as the evolution of so many stars would take more time to develop than was available since the Big Bang.

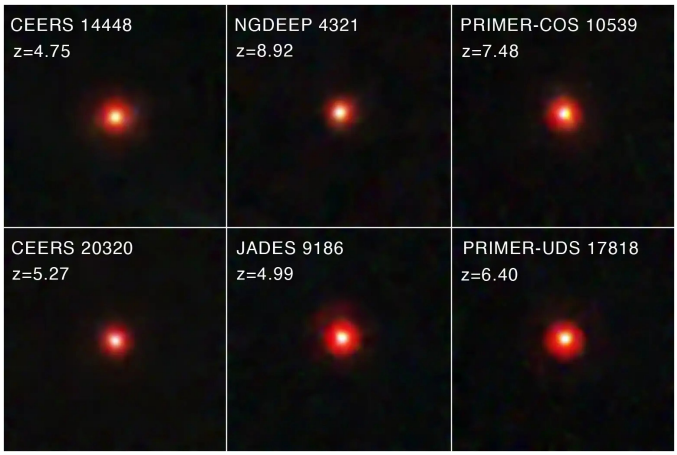

Figure 1 — These "little red dots" are odd yet numerous galaxies in the early Universe picked out from several deep-sky surveys conducted by the James Webb Space Telescope. *Image: NASA / ESA / CSA / STScI / Dale Kocevski (Colby College)*

A way out of the dilemma is to envisage a large population of stars around a massive black hole, essentially a quasar or an active galactic nucleus (AGN). The problem here is that such a large number of AGNs is about ten times higher than extrapolation backward from a more recent Universe would allow. The concentration of stars required is mind-boggling: a Milky Way-worth of stars in a 500-light-year volume. Imagine a million stars in a volume from Earth to Proxima Centauri, our closest neighbouring star.

The uniqueness of LRDs is also revealed in their physical nature—their central black holes are much more massive than the typical black hole in the cores of nearby galaxies. In general, black holes make up about 1/1000th of the mass of closer galaxies, but the LRDs seem to have black hole masses that range from 1 to 10 percent of the total galaxy mass (and one has a mass equal to all of its stars). In effect, the brightness of the LRDs depends much more on the black hole than on the surrounding stars. Also perplexing is the radius of a typical LRD: about 500 light-years, only 1 percent of the size of our Milky Way.

"The most exciting thing for me is the redshift distributions. These really red, high-redshift sources basically stop existing at a certain point after the Big Bang," said Steven Finkelstein, a co-author of the study at the University of Texas at Austin. "If they are growing black holes, and we think at least 70 percent of them are, this hints at an era of obscured black hole growth in the early Universe."

When LRDs were first discovered, some suggested that cosmology was "broken." If all of the light coming from these objects was from stars, it implied that some galaxies had grown so big, so fast, that theories could not account for them.

The team's research supports the argument that much of the light coming from these objects is from accreting black holes and not from stars. Fewer stars means smaller, more lightweight galaxies that can be understood by existing theories.

There is still a lot up for debate as LRDs seem to evoke even more questions. For example, it is still an open question as to why LRDs do not appear at lower redshifts. One possible answer is inside-out growth: As star formation within a galaxy expands outward from the

nucleus, less gas is being deposited by supernovae near the accreting black hole, and it becomes less obscured. In this case, the black hole sheds its gas cocoon, becomes bluer and less red, and loses its LRD status.

Additionally, LRDs are not bright in X-ray light, which contrasts with most black holes at lower redshifts. However, astronomers know that at certain gas densities, X-ray photons can become trapped, reducing the amount of X-ray emission. Therefore, this quality of LRDs could support the theory that these are heavily obscured black holes.

"There's always two or more potential ways to explain the confounding properties of little red dots," said Kocevski. "It's a continuous exchange between models and observations, finding a balance between what aligns well between the two and what conflicts."

Compiled in part with material provided by the Space Telescope Science Institute.

Saying goodbye to *Gaia*

The European Space Agency's Milky Way mapper *Gaia* has completed the sky-scanning phase of its mission, racking up more than 3 trillion observations of about 2 billion stars and other objects over the last decade to revolutionize the view of our home galaxy and cosmic neighbourhood.

Launched on 2013 December 19, *Gaia*'s fuel tank is now approaching empty—it uses about a dozen grams of cold gas per day to keep it spinning with pinpoint precision. But this is far from the end of the mission. Technology tests are scheduled for the weeks ahead before *Gaia* is moved to its "retirement" orbit, and two massive data releases are tabled for around 2026 and the end of this decade, respectively.

"Today marks the end of science observations and we are celebrating this incredible mission that has exceeded all our expectations, lasting for almost twice its originally foreseen lifetime," says ESA Director of Science Carole Mundell.

Gaia has been charting the positions, distances, movements, brightness changes, composition, and numerous other characteristics of stars by monitoring them with its three instruments many times over the course of the mission. *Gaia*'s last targeted observation, on January 10, was of binary pair 61 Cygni. This iconic star attracted the attention of 19th-century astronomers to yield some of the first proper-motion and parallax measurements, techniques used by *Gaia* on some two billion stars.

This has enabled *Gaia* to deliver on its primary goal of building the largest, most precise map of the Milky Way, showing us our home galaxy like no other mission has done before. As such, we now also have the best reconstructed view of how our galaxy might look to an outside observer.

"It contains major changes from previous models, because *Gaia* has changed our impression of the Milky Way. Even basic ideas have been revised, such as the rotation of our galaxy's central bar, the warp of the disk, the detailed structure of spiral arms, and interstellar dust near the Sun," says Stefan Payne-Wardenaar, scientific visualizer for the Haus der Astronomie, Germany, and the IAU Office of Astronomy for Education. "Still, the distant parts of the Milky Way remain educated guesses based on incomplete data. With further *Gaia* data releases our view of the Milky Way will become even more accurate."

In the process of scanning the stars in our own galaxy, *Gaia* has also spotted other objects, from asteroids in our Solar System backyard to galaxies and quasars—the bright and active centres of galaxies powered by supermassive black holes—outside our Milky Way.

For example, *Gaia* has provided pinpoint precision orbits of more than 150,000 Minor Planets (asteroids), and has such high-quality measurements as to uncover possible moons around hundreds of them. It has also created the largest three-dimensional map of about 1.3 million quasars, with the furthest shining bright when the Universe was only 1.5 billion years old.

Gaia has also discovered a new breed of black hole, including one with a mass of nearly 33 times the mass of the Sun, hiding in the constellation Aquila, less than 2,000 light-years from Earth—the first time a black hole of stellar origin this big has been spotted within the Milky Way.

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The *Gaia* scientific and engineering teams are already working full steam on the preparations for *Gaia* Data Release 4 (DR4), expected in 2026. The data volume and quality improve with every release and *Gaia* DR4, with an expected 500 TB of data products, is no exception. *Gaia*'s exoplanet discoveries are also set to increase with the

Figure 2 — A model image of what our home galaxy, the Milky Way, might look like face-on: as viewed from above the disk of the galaxy, with its spiral arms and bulge in full view. In the centre of the galaxy, the bulge shines as a hazy oval, emitting a faint golden gleam. Starting at the central bulge, several glistening spiral arms coil outwards, creating a perfectly circle-shaped spiral. Image: ESA/Gaia/DPAC, Stefan Payne-Wardenaar.

forthcoming datasets thanks to the longer timeframe of observations, making it much easier to spot "wobbling" stars gently tugged by orbiting planets.

While today marks the end of science observations, a short period of technology testing now begins. The tests have the potential to further improve the *Gaia* calibrations, learn more about the behaviour of certain technology after 10 years in space, and even aid the design of future space missions.

After several weeks of testing, *Gaia* will leave its current orbit around Lagrange point 2, 1.5 million km from the Earth in the direction away from the Sun, to be put into its final heliocentric orbit, far away from Earth's sphere of influence. The spacecraft will be passivated on 2025 March 27, to avoid any harm or interference with other spacecraft.

Compiled with material provided by the European Space Agency.

Life around red dwarfs tenuous

Space is not a friendly place for life. The current exoplanet catalogue offers few Earth-sized bodies in suitable orbits, promoting speculation on the habitability of environments surrounding red-dwarf stars, which make up around 85 percent of the stars in the Milky Way Galaxy. Unfortunately, red dwarfs are cool stars and planets must be very close to them to lie in their relatively narrow habitable zone.

Prospective planets around such stars need to be prepared for extreme weather conditions, according to a new study from NASA's *Chandra X-ray Observatory* and ESA's (European Space Agency's) *XMM-Newton* that examined the effects of X-rays on potential planets around the most common type of stars.

Astronomers found that only a planet with greenhouse gases in its atmosphere like Earth and at a relatively large distance away from the star they studied, Wolf 359, would have a chance to support life as we know it around a nearby star. Wolf 359 is a red dwarf with a mass about a tenth that of the sun. Red dwarf stars live for billions of years, providing ample time for life to develop. At a distance of only 7.8 light-years away, Wolf 359 is also one of the closest stars to the Solar System. *Star Trek* fans may recall Wolf 359 in the "Battle of Wolf 359" from *Star Trek: The Next Generation*.

"Wolf 359 can help us unlock the secrets around stars and habitability," said Scott Wolk of the Center for Astrophysics | Harvard & Smithsonian (CfA), who led the study. "It's so close and it belongs to such an important class of stars—it's a great combination."

Because red dwarfs are the most prevalent types of stars, astronomers have looked hard to find exoplanets around them. They have found some evidence for two planets in orbit around Wolf 359 using optical telescopes, but those conclusions have been challenged by other scientists. Of the two, one orbited at a distance of 1.8 au and the other at 0.018 au. The more distant planet, if it exists, would receive only 0.0003 of the Earth's solar energy; the nearer star would be irradiated by 3.1 times the Earth's share of solar energy.

"While we don't have proof of planets around Wolf 359 yet, it seems very possible that it hosts multiple planets," Wolk added. "This makes it an excellent test bed to look at what planets would experience around this kind of star."

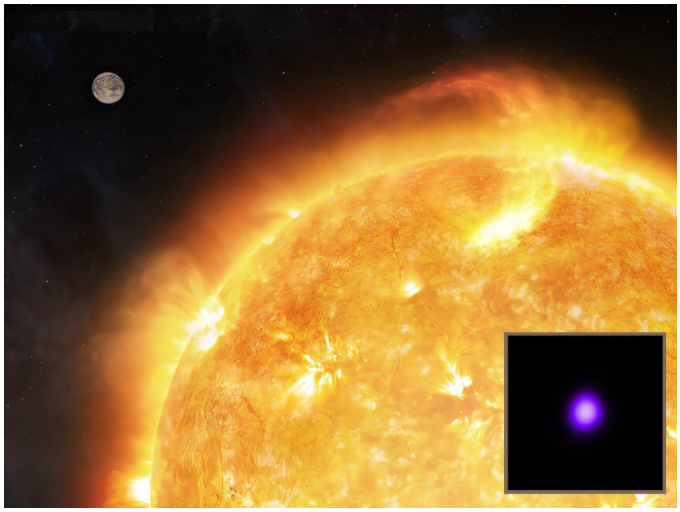

Figure 3 — An illustration of the red-dwarf star Wolf 359, with a small orbiting planet in the distance. An inset image from Chandra *is included at lower right. Credit: X-ray: NASA/CXC/SAO/S.Wolk, et al.; Illustration: NASA/CXC/SAO/M.Weiss; Image processing: NASA/CXC/SAO/N. Wolk*

Wolk and his colleagues used *Chandra* and *XMM* to study the amounts of steady X-rays and extreme ultraviolet (UV) radiation—the most energetic type of UV radiation—that Wolf 359 would unleash on the possible planets around it.

They found that Wolf 359 is producing enough damaging radiation that only a planet with greenhouse gases like carbon dioxide in its atmosphere—and located at a relatively large distance from the star—would likely be able to sustain life. "Just being far enough away from the star's harmful radiation wouldn't be enough to make it habitable," said co-author Vinay Kashyap, also of CfA. "A planet around Wolf 359 would also need to be blanketed in greenhouse gases like Earth is."

To study the effects of energetic radiation on the habitability of the planet candidates, the team considered the star's habitable zone—the region around a star where liquid water could exist on a planet's surface.

The outer limit of the habitable zone for Wolf 359 is about 15 percent of the distance between Earth and the Sun, because the red dwarf is much less bright than the Sun. Neither of the planet candidates for this system is located in Wolf 359's habitable zone, with one too close to the star and the other too far out.

"If the inner planet is there, the X-ray and extreme UV radiation it is subjected to would destroy the atmosphere of this planet in only about a million years," said co-author Ignazio Pillitteri of CfA and the National Institute for Astrophysics in Palermo, Italy.

The team also considered the effects of radiation on as-yet undetected planets within the habitable zone. They concluded that a planet like the Earth in the middle of the habitable zone should be able to sustain an atmosphere for almost two billion years, while one near the outer edge could last indefinitely, helped by the warming effects of greenhouse gases.

Another big danger for planets orbiting stars like Wolf 359 is from X-ray flares, or occasional bright bursts of X-rays, on top of the steady, everyday output from the star. Combining observations made with *Chandra* and *XMM-Newton* resulted in the discovery of 18 X-ray flares from Wolf 359 over 3.5 days.

Extrapolating from these observed flares, the team expects that much more powerful and damaging flares would occur over longer periods of time. The combined effects of the steady X-ray and UV radiation and the flares mean that any planet located in the habitable zone is unlikely to have a significant atmosphere long enough for multicellular life, as we know it on Earth, to form and survive. The exception is the habitable zone's outer edge if the planet has a significant greenhouse effect.

Stellar output and flares are not the only limitations on red dwarf planets. Because of their proximity to the star, the planets will likely be tidally locked, with one side permanently facing the red dwarf, creating a challenging hot side-cold side world. Tidal locking is less likely if there is more than one planet and so we are left with envisioning a suitable world at the edge of the habitable zone in a system with multiple planets. Alas, not all may be lost, as a planet around another red dwarf, Wolf 1069, could be habitable and there are several other candidates in the literature.

In the end, however, there may be more opportunities around hotter stars, even though they are much fewer in number.

Compiled with information provided by the Chandra X-ray Center.

Death by black hole.

In the greater Universe, is there no greater question bothering humankind than "what would happen if a black hole passed through me?"

Finally, we have an answer.

Robert Scherrer of the Department of Physics and Astronomy, Vanderbilt University took on the task of determining the "gravitational effects of a primordial black hole (PBH) passing through the human body… with the goal of determining the minimum mass necessary to produce significant injury or death." It may seem frivolous, but the modelling exercise produces some interesting results, both reassuring and scientific.

Scherrer focused on primordial black holes – hypothetical creatures that were formed in the very early "inflationary" era of the Big Bang when density fluctuations induced gravitational collapse. They can be any size – large enough to modulate the formation of galaxies and galaxy clusters, or small enough to collapse into a size smaller than an atomic particle. Theoretical studies suggest that many of these first black holes have the mass of an asteroid within the dimensions of a hydrogen atom and would be able to pass through a star without significant effects provided they were moving fast enough. They would have masses in the range 10^{14} – 10^{19} kg.

It's these tiny ones that caught Scherrer's attention.

The smallest black holes from the inflationary era (<10^{12} kg) would have evaporated in the 13.8 billion years since the Big Bang due to a process called Hawking radiation. This process invokes quantum mechanical effects to allow black holes to emit radiation at a very low rate, gradually reducing their mass and rotational energy until they evaporated. Because it's so slow, only the smallest black holes would have faded away in the time since the Universe began.

The goal was to establish the minimum size of a black hole that would cause damage to the human body, which in turn would allow Scherrer to place a limit on the number of these objects, since no such injuries are known to have occurred, and so they must be rare. To limit the scope of the study, he settled on two effects: the shock wave created by the black hole as it passed through the body, and the gravitational effect on the body's cells. As a first approximation, he assumed the body was made of water.

Scherrer picked a threshold for damage due to a shock wave approximately equivalent to that of a 22-calibre bullet. From this, he calculated that a black hole with a mass greater than 1.4 x 10^{14} kg would fit the bill.

As the black hole passes through the body, it will be accompanied by strong tidal forces that, if strong enough, could tear the cells apart. It's the gravitational gradient around the black hole that counts here, as the side of the cell nearest the passing particle would experience a much stronger force than that on the far side, pulling the cell apart.

For the modelling, Scherrer focused on brain cells, noting that they are the most sensitive of the body's tissues. He also assumed that the whole brain had to be affected, as the organ is resilient to damage and can recover from local damages. Assuming a black hole velocity of 200 km/s, a characteristic cell size, and a density equal to water, the minimum mass of a black hole that could cause significant damage came out to between 7x10^{15} and 7x10^{16} kg. It seems that the shock wave from a passing black hole is more serious than the gravitational disruption of brain cells.

Interestingly, the mass necessary to cause damage to tissues is near the lower bound of atomic-sized primordial black holes. Moreover, given the current human population and the cross-section of the average human body, along with an estimate of the total population of small black holes, Scherrer comes to a probability of ~10^{-18} interactions with humans per year.

So, sleep well tonight.

For a different and more ominous approach, look up *The Hole Man* by Larry Niven, a chronicle of a different sort that won the Hugo Award for Best Short Story in 1975. ✶

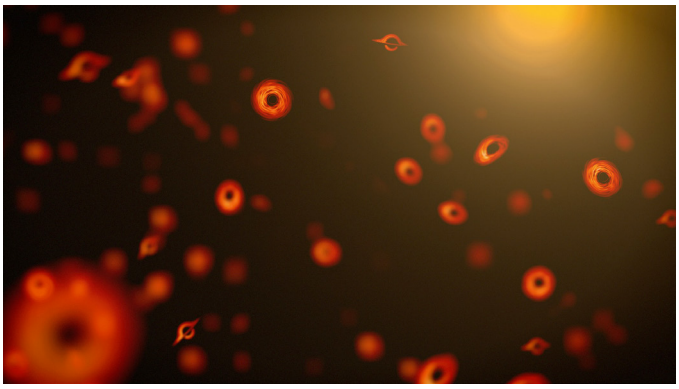

Figure 4 — This artist's concept takes a fanciful approach to imagining small primordial black holes. In reality, such tiny black holes would have a difficult time forming the accretion disks that make them visible here. Credit: NASA's Goddard Space Flight Center

Feature Article / Article de Fond

William Blair Bruce: An Artist's Arctic Eclipse

by Clark Muir, Kitchener-Waterloo Centre
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Abstract

William Blair Bruce was an accomplished Canadian artist born in 1859. Bruce, an impressionist, had a fascinating career moving to Europe as a young man, eventually meeting his wife and settling in her homeland in Sweden. Bruce and his wife joined a tourist expedition to the Swedish Arctic to witness a total solar eclipse during the summer of 1896. Among Bruce's sketches and paintings, resulting from this trip was one of totality featuring the Arctic landscape. Bruce's motivation to witness a total solar eclipse can be traced to his early family life that also has a strong connection to The Royal Astronomical Society of Canada (RASC).

The Artist

William Blair Bruce was born on 1859 October 8, in Hamilton, Ontario. He was the second of three children of Scottish-born William Bruce[1] and Janet Blair. The young Bruce had shown a talent for art during his youth. Through the guidance of his father (an amateur painter) and professional local artist, John Herbert Caddy, his artistic skills continued to flourish. After completing an education at home in Hamilton, Ontario, William moved to France to further advance his career and did so with his parents' blessing. While there, William met another artist, Carolina Benedicks[2]. The two married in 1885. Carolina was born in Sweden and the couple would eventually settle on the island of Gotland in the Baltic Sea. The property, known as Brucebo today, (near Visby, Sweden) is home to an artists' retreat and museum. The Brucebo property is named after the couple and holds many of the works done by both artists.

One element of Bruce's painting is featured in his works of coastal paintings. Many of these emphasize the Moon. These works are so prevalent that it is not a surprise to learn Bruce had an affection for painting under the moonlight. This characteristic is confirmed in a series of preserved letters written by Bruce. For example, Bruce wrote that he enjoyed "painting by the light of the Moon alone in a harmony of citron and grey." In another letter to his family, he wrote that his favourite color was yellow. In a quote it is noted that when he painted these seascapes, "he was painting for himself." These were never intended to be sold but rather Bruce took solace in painting these scenes.

One instance is an undated painting titled "Mirror of the Moon." In this case, the near-first-quarter Moon is shown close to the horizon with some cloud in a twilight sky.

Examining the painting shows consistency with the location of a high northern latitude. It is likely that the Moon was accurately depicted both in position and orientation in the sky as Bruce had painted it, possibly from the Brucebo location.[3]

An explanation for his fascination of the moonlight can be demonstrated by exploring his childhood. For this, we need to introduce his father.

Bruce Sr. was born in 1833 in Scotland. As a young child in 1837, he immigrated to Canada with his family settling in Hamilton, Ontario. Bruce Sr. developed a keen interest in astronomy while attending school. It was an interest he maintained for the rest of his life. Professionally among other pursuits, Bruce Sr. established a Patent and Designs Registration office, which he operated for over 30 years. Bruce Sr. also served as president of the Hamilton RASC Centre from 1911 to 1915.

In the early 20th century, Bruce Sr. built an observatory on his 8-acre property on top of Hamilton Mountain. The "Elmwood Observatory" housed several telescopes over the years including a 3″ refractor made by fellow Hamiltonian, Rev. D.B. Marsh. There was also a long-focal-length 8″ reflector. The Observatory was expanded to include a reception and reading room. A flat roof on top served as an observation deck.

For part of its history, friends of Bruce Sr. and the public were welcomed traditionally on Thursday evenings to observe the night sky from his observatory. Beyond that, Bruce Sr. had a reputation both locally and abroad for his lecturing on astronomical subjects. Bruce Sr. died in 1927 at the age of 94. In 1936, the Bruce property was gifted to the city of Hamilton by Bruce Sr.'s daughter Bell Bruce Walkden. Today this land is simply called Bruce Park.

Although it does not appear Bruce became an amateur astronomer, the influence of his father's passion for astronomy gave him exposure to the night sky. And, as demonstrated, it is apparent in some of his art.

Bruce suffered a devastating setback during his career. The SS Brooklyn sank on 1885 November 8, in the Gulf of St. Lawrence while enroute to North America. On board were about 200 of Bruce's works intended for sale and display in Canada. All were destroyed.

Bruce's best known and arguably his most important work is the exceptional painting "The Phantom Hunter" painted in 1888. At 151 cm by 192 cm, the sizable painting features a hunter who has fallen in a desolate moonlit snow-covered landscape. The hunter is reaching out to a ghostly figure walking away. The snow is brightly lit by the Moon and the fallen figure's shadow suggests the moonlight source is quite low, just above the horizon. A few stars also appear in the sky.

The Phantom Hunter painting was inspired by the poem "Walker of the Snow" written by an Irish poet Charles Dawson Shanly (1811–1875). Bruce painted this shortly after the devastating loss of much of his life's work. The painting, it is suggested, symbolizes his struggle and revival. Furthermore, the disoriented hunter in the painting is Bruce himself. It is also noted that this painting is consistent with the theme of the moonlight prevalent in some of Bruce's other art.

Figure 1 — Total solar eclipse of 1896 August 9; Stora Sjöfallet waterfall, Sweden. Painting by William Blair Bruce "The Solar Eclipse" 1896. Oil sketch. 26 x 29 cm. Owner: Brucebo Foundation. Photographer: Anna Sundström, 2024.

The Eclipse Trip

In 1896, William and Carolina joined a small expedition to view a total solar eclipse in northern Sweden. On the early morning of August 9 that year, an eclipse of maximum duration of 2m 43s followed a path from northern Europe, over Siberia, ending in the Pacific Ocean. For Scandinavia, this would result in an early morning, short-duration totality on the western edge of the path. The Bruces, with the other tourists, travelled to Stora Sjöfallet, a beautiful waterfall in the Swedish Arctic. From this location, totality lasted a brief 1m 10s.

The expedition was organized by the Swedish Tourist Association (STA) and was advertised publicly. A report published by the STA preserves the details.[4]

The eclipse trip was considered daring due to the remoteness of the observing site. Challenges included a lack of accessible roads. That meant travelling by foot over bogs and unpopulated wetlands. Expert porters or guides would be in short supply and would have to be paid. Other concerns involved setting up camps, supplying and cooking food at stations for the group. Boats for crossing and traversing lakes were also needed.

Twelve tourists ultimately would make the trip, including the Bruces. They were at that time residing in Paris, but the rest of the tourists were living in Sweden.

Every tourist was allowed to bring a small pack of personal items. These were carried by a porter dedicated to assist each of the travellers. Bruce, among other possessions, brought his sketching materials, including dozens of small canvases.

Among the lodging supplies were two large tents that could accommodate 16–20 persons each. In total, 34 porters helped escort the tourists. The entire contingent of the party can be estimated at about 50 individuals.

On the evening of 1896 August 2, the expedition party gathered at the Grand Hotel in the town of Gallivare in northern Sweden. There was excitement among the participants, and they viewed with a laugh the enduring hardships that lay in the days ahead. A quick assessment suggested the average age of the tourists was 42 years old. Their backgrounds were diverse and included careers in the military, commerce, industry, and the fine arts. Six different languages were spoken and at least four tourists were carrying cameras that were hoped would preserve the memory of the eclipse. The one-way trip to Stora Sjöfallet from Gallivare is estimated to be about 120 km.[5]

The prospects for travel were optimistic as the summer had been unusually warm and dry. As an example, when the party crossed the Arctic Circle, the temperature was recorded at +27 °C.

Other details included the daily routine of lengthy hikes, setting up camp, and everything from dealing with mosquitoes to bathing in cold streams on hot days. Typically, hiking started after a breakfast, then a break for a hearty lunch. Other days boats were strategically used when convenient. At about 7 p.m., overnight camp was set during the exceptionally long summer days.

Meals consisted mainly of canned goods and an assortment of other preserved foods. One menu contained artichoke puree, cabbage rolls, and pineapple. Coffee was on supply, as was the potential for fishing.

The occasional comment about Bruce is noted. "Our indefatigable English artist is already sitting there drawing, so there must be something to see." Bruce found the time to sketch during breaks throughout the hiking days.

On 1896 August 7, large rowboats were used to approach the preselected observing site. The eclipse party was spirited by the sight of the majestic mountains and the mist of the wonderfully described waterfall. "Hats off to Stora Sjöfallet!" was cheered by the group.

The night before totality there is a celebratory atmosphere. A campfire was lit. The general mood was one of excitement. Still, a few looked skyward to predict the clouds. Some were worried, others were not.

After a brief sleep, the early eclipse morning begins with a blare of a horn and a flurry of activity. First breakfast and coffee. Then the travellers gathered their personal supplies and scouted the area to find the perfect spot to observe the eclipse.

The photographers, it is noted, were nervously preparing their gear.

There were even flags of the Swedish Tourism Association flying from a flagpole on a newly constructed cabin.

Now in position, they wait.

Professor Rosen, probably a tour organizer, shouts "Now!" First contact; the eclipse has officially started. A small piece of the Sun is shortly afterward seen hidden by the Moon. Noted observations at first were slow, but then, as the partial phase advanced, there

Figure 2 — Painting by William Blair Bruce "Mirror of the Moon" n.d. Oil on canvas. 59.7 x 90.2 cm. Credit: Bruce Memorial, 1914. Photographer: Robert McNair, 2013

were descriptions of strange shadows and darkened landscapes, both in the mountains and from the river. Closer to totality, planets and stars were observed by the participants to come out of hiding.

Totality!

The start of totality—one observer described it as if someone with an electric switch extinguished the Sun. Now they focus on making effective use of their precious seconds.

The corona was immediately detailed. A few within the group had commented on the prominences. One participant reported in having to decide what features he wanted to observe. There is not time for everything. The corona? Planets and stars? The surrounding vistas?

It is all an alien world described as like a lunar landscape with strange colours from black to orange, yellow, and green. But we must hurry to look at it all.

Too late! It is over and the participants compared their individual experiences during those precious 70 seconds. In total 17 photographs were captured.[6]

As for Bruce's painting, someone wrote, "Mr. Bruce, who has made a sketch of the landscape beforehand, has taken advantage of the time to record the tones of colour during the eclipse at lightning speed, and afterwards to make a painting of the event."

Aftermath

After the eclipse, the party concluded their journey by heading back to Gallivare. The six-day trip back included a noteworthy reflective comment. An astute person not identified noted that the spectacular Lapland wilderness must be protected for future generations. Today this waterfall is now part of the expansive Swedish Stora Sjöfallet National Park.

The eclipse details described above preserve observations of a remarkable natural event. Bruce's personal experience was not about science, it was rather, about the spectacle. The entire expedition was viewed as a tourist activity.

The incessant advancements in technology change the way people observe eclipses over time. But our behaviour and reactions stay the same. All the emotions, thoughts, and actions of Bruce and his fellow travellers are identical to the modern experience of totality. These are timeless. The last words in the report were attributed to an unidentified English-speaking traveller.

"By Jove, it is glorious!" ✶

Figure 3 — William Bruce (RASC member and Father of William Blair Bruce) painting of the Grand River, in Ontario, Canada. William Bruce "Rowboat on the Grand River" 1883 watercolour over graphite on paper. 15 x 41 cm. Credit: Bequest of Belle Barron, 1960. Photographer Robert McNair, 2014

Figure 4 — Photo of William Blair Bruce. n.d. Platinum print mounted on paper. 10 x 14.2 cm. Credit: William Blair Bruce Archives. Photographer: Art Gallery of Hamilton, 2024

Endnotes

Bruce created about 40 sketches during this trip. The majority of these and the paintings made afterwards are at the Brucebo Museum, including his exceptional painting of totality. All these sketches are on small canvases due to the obvious difficulties of transporting them securely during the expedition.

On 2024 April 8, a total solar eclipse breezed a path through North America. Hamilton, Ontario, was on it. Bruce Park, where William grew up, enjoyed just under two minutes of totality.

The City of Hamilton, Ontario, received, through a donation from Carolina Benedicks-Bruce and William Bruce Sr., 29 paintings by William Blair Bruce. The inaugural exhibit by the newly formed Art Gallery of Hamilton in 1914 June 28 featured these works.

1 In this paper the father of William Blair Bruce will be referred to as Bruce Sr.

2 Carolina (often spelled Caroline) Benedicks will be referred to as Carolina Benedicks-Bruce after marriage.

3 The position of the Moon in the painting is consistent with a view of the evening sky in August/September after sunset at the latitude of the Bruce's home in Sweden.

4 The details of the expedition exist in the form of an annual report printed by the Swedish Tourist Association (STA), published the following year.

5 Estimated distance is determined by modern methods as no distance appears to have been mentioned in original sources.

6 Some of these photographs were published in the STA report

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Anna Sundström, photographer

The Brucebo Museum, Visby, Sweden

The staff at the Art Gallery of Hamilton, Hamilton Ontario

Randall Rosenfeld, Curator, Dorner Telescope "Museum"

Support SCO

with the Dave Lane Memorial St. Croix Observatory Property Endowment (SCOPE) Fund

Matching Fund Opportunity

Dave Lane was a prominent member and contributor to the RASC at both the Centre and national level. He was also one of several RASC Halifax Centre members that were instrumental in the design and construction of the Centre's St. Croix Observatory (SCO). Dave was a passionate observer and frequent user of the SCO facility and wanted to see it properly maintained for use by Centre members.

Michelle Lane has made a very generous donation to start the St. Croix Observatory Property Endowment (SCOPE) Fund in memory of Dave and has offered an additional matching funds donation. If you are able, please help us build the fund and honour Dave's wishes by donating to ensure the viability of SCO, now and into the future.

Donations may be made via e-transfer to treasurer@halifax.rasc.ca. In the comments field of the transfer, please indicate that your donation is for the Dave Lane Memorial SCOPE fund.

For more information about the fund or about SCO please visit halifax.rasc.ca/index.php/observing/85-st-croix-observatory-property-endowment.

Research Article / Article de Recherche

In Hubble's Nebula (NGC 2261) a jet-like structure to the south has disappeared from images since a decade

by Gilbert St-Onge (gilberts311@gmail.com), D. Bergeron, D. St-Gelais, J. G. Moreau, R. Gauvin, J. B. Desrosiers, C. Dupriez, R. Cazilhac, J. Astreoud, Denis Goyette, M. Hanson,
Collaboration of sixth-grade students of the Collège Mauzan at Gap (Hautes-Alpes, France)

Abstract

Summary of our observations of the variable nebula NGC 2261 which is associated with the star R Monoceros "Herbig Ae/Be star" (Finkenzeller & Mundt 1984) located at the following coordinates, RA 06^h 39^m 09.95^s and Dec 8° 44′ 09.7″ (DSS). This is follow-up and a summary that has been produced annually for the past few years. The latest summary, 2023, is available in JRASC, October 2023, pp.181 to 188. Priority is given to an elongated region of an observable visible jet-like structure that has not been observed since 2015. This was observed in the nebula south of the star R Monoceros. Since 2015, we have found darker traces of a morphology corresponding to this structure at the same location. The 2023/2024 follow-up has detected significant changes in the morphology of the southern counterpart of the nebula NGC 2261. These changes are observed very close to the position where the jet-like structure was detected before 2015. We also present a series of photometric measurements of the star in a table. In addition to a series of spectra of the star over a few years, these reveal some correspondence with the fluctuations of intensity of the star.

Résumé

Résumé de nos observations de la nébuleuse variable NGC 2261 qui est associé à l'étoile R Monoceros "Herbig Ae/Be star" (Finkenzeller & Mundt 1984) situé aux coordonnées suivantes, RA 06h 39m 09.95s and Dec 8° 44′ 09.7″ (DSS). Ce suivit est annuelle et un résumé en est produit depuis quelques années. Le dernier résumé, celui de 2023, est disponible dans le JRASC de October / octobre 2023 pp. 181 à 188. En priorité on vise une région longiforme d'apparence d'un jet détectable en visible qui n'est plus observé depuis 2015. Celui-ci s'observait dans la nébuleuse au sud de l'étoile R Monoceros. Depuis 2015, on a plutôt trouvé des traces plus sombres, d'une morphologie correspondent à cette structure qui est à l'emplacement de celle-ci. Le suivit de 2023 / 2024, a permis de détecter des changements significatifs dans la morphologie de la contrepartie sud de la nébuleuse NGC 2261. Ces changements s'observent tout près de la position ou on détectait avant 2015 la structure en jet lumineuse. En plus une série de mesures photométriques de l'étoile qui sont présentés sur un tableau. En plus d'une série de spectres de l'étoile sur quelques années nous révèle une certaine correspondance avec les fluctuations d'intensité de l'étoile.

Summary (2019 to 2024)

Since 2019, we have been monitoring the NGC 2261 nebula more closely. Our work has determined that a section south of the main nebula, associated with the young star R Monoceros, has disappeared since ~2015. Our follow-up of this nebula aims to try to redetect this source and document its apparent evolution if possible. This dossier also focuses on our work that makes it possible to detect dark traces of what appears to be a structure on the sky where, prior to 2015, we observed an elongated nebula (in the form of a jet) of variable luminous intensity, which is in the southern component of NGC 2261.

Historic

Film photo plates before CCDs, from the Anglo-Australian Observatory (1984–92), show beautiful images of this jet-like structure in the southern counterpart of the nebula. http://taosastronomer.com/postprocessgreinerRosetteandConenebulaeinfo.htm at the bottom of the page.

The oldest CCD images of our group that highlight this structure are from the year 2000. Before that, we focused rather on the variations in the main nebula north of the star R Monoceros.

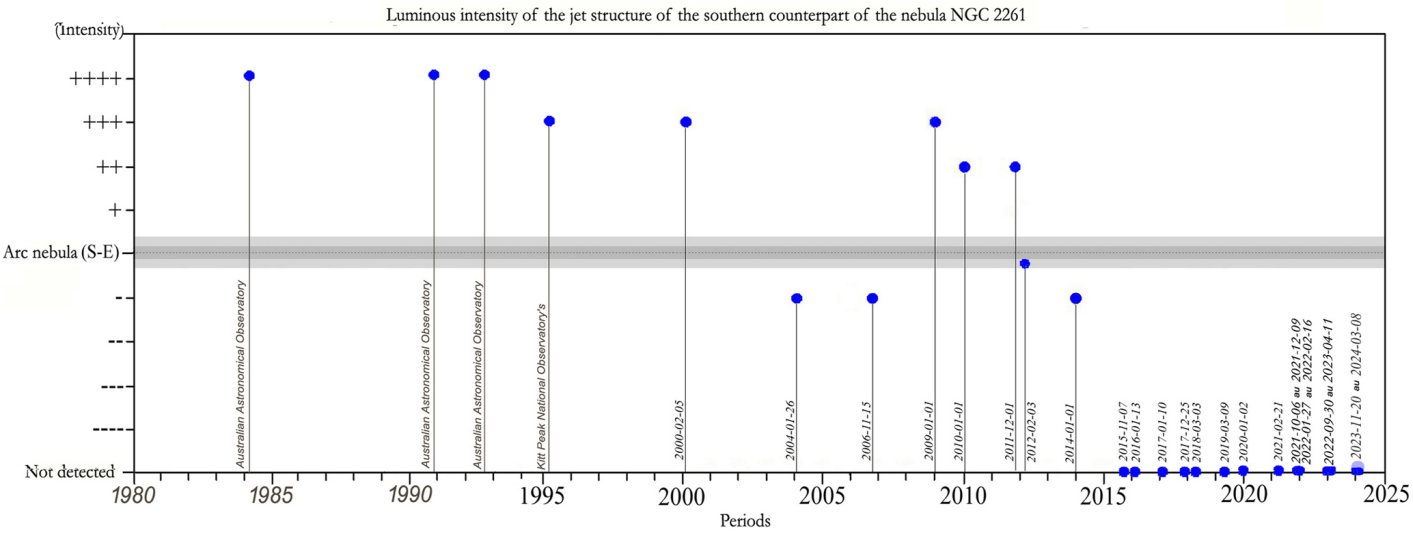
Four documents summarizing our previous work, produced in 2020, 2021, 2022 and 2023, are available at:

2020 *To access the report from 2019/2020 copy and paste the following links to your browser:*
astrosurf.com/cdadfs/CDADFS2/recherches/N2261_2020_V243.pdf
and Rapports de projet de recherche | Fédération des astronomes amateurs du Québec (faaq.org)

2021 *Available at: astrosurf.com/cdadfs/CDADFS2/recherches/NGC2261_2021.pdf*

2022 *G ST-Onge et al, "In Hubble's Variable Nebula (NGC 2261), a jet structure to the south has disappeared from our images since 2015,"* JRASC, August 2022, Vol. 116, No. 4

2023 *G ST-Onge et al., "In Hubble's Variable Nebula (NGC 2261), a jet structure to the south has disappeared from our images since 2015,* JRASC, August 2023, Vol. 117, No., 5



Graph 1

Introduction and history of this aspect of the project

The images by J.G. Moreau presenting NGC 2261 in 2009 and 2019, which showed the disappearance of the jet-like nebula in the southern component of the main nebula, justified the larger, more intense follow-up in the hope of observing the evolution of this region. To see these two images by J.G. Moreau go to Figure 1 in the JRASC, August 2023, Vol. 117, No, 5, Whole Number 822, p 181.

Astreoud Jérôme	T 520 mm at *f*/2 444 mm, observatoire@asso-copernic.org
Bergeron Denis	Telescope Planewave CDK 30 cm *f*/8 FL: 2555 mm, camera: SBIG STL11000M with Luminance filter.
Cazilhac Robert	C14 Edge HD - ASI1600MC no filter - Seeing 5/10
Desrosiers J-Bruno	C14- STF-8300M binned 2×2 without filter
Dupriez C.	Telescope: C9 at *f*/10 with ST10XME
Fralich Russell	ED80 (37×60s) / C6 (17×30s)
Gauvin Real	Camera: Atik 460ex — Astronomik light-pollution filter
Goyette Denis	RC 10″ at FL1524 mm *f*/6 / ZWO ASI2600MC Pro / Binned 3×3
Moreau J. Guy	14″ *f*/3.3 with Keller flattener/reducer 0.73×. 155 minutes with QHY268C, pixels at 3.76 microns, Bayer matrix RGGB
St-Gelais Denis	CDK14, SBIG STL, 1001e
St-Onge Gilbert	C 8″ at *f*/10, SBIG ST7, ST10, and STF 8300

Table 1 – Main investigators and observation equipment used. (In alphabetical order)

Observations of 2021 / 2022 / 2023/ 2024

Our observations come from a dozen Astro-photographers, some from Canada, others from Europe, USA and Mexico, for this period. Instruments of different optical configurations were used: Newtonian, RC, SC, and a refractor. Table 1 is a summary of the equipment used. For details on the equipment used for each period, refer to Table 2023-1 in JRASC, August 2023, Vol. 117, No, 5, page 182.

This continuous follow-up has made it possible to assemble a graph showing the evolution of the intensity of this jet-like structure since 1984, on more than 20 reference dates. Graph 1 shows all the results that could be used to estimate the light intensity of this structure as detected for the total period from 1984 to 2024.

Graph 1 contains all the detection periods that are accessible to us of the jet-like structure in the southern counterpart of NGC 2261. Each measuring point indicates the intensity attributed to this jet-like structure in relation to the reference intensity of the small nebula of a curved shape just to the SE of its position on the images at the corresponding date. (Refer to the Figure 1).

The horizontal and central (darker) line corresponds to the reference point of the intensity. This is the intensity of the small, curved nebula to the SE. It is detected over all observation periods and can therefore be used as a reference to estimate the approximate intensity of the jet-like structure we are searching for. The points above this line are periods where the jet-like structure is more intense than the curved nebula to the SE; The measurement points below this central horizontal line indicate that the jet-like structure is less intense than the curved nebula to the SE; The dots on the axis line, labelled "Not detected," are the periods when this structure is absent from the images, i.e. since November 2015.

Graph 1 shows that this jet-like structure varies over time independently of the small curved nebula to the SE. It is

also clear that, in recent years, it is no longer detectable on our images and that the responsible mechanism that made it undetectable has occurred over, at most, a few years. It can be seen that at this distance the size of this jet-like structure on its long axis is probably less than two light-years wide.

This disappearance seems to have occurred over a very short time, which corresponds to a mechanism that involves the speed of light, so we suspect that the light coming from the star is responsible for the apparent changes in NGC 2261. The jet-like structure is probably a filiform structure, which is a reflection nebula illuminated by the star R Monoceros at the heart of NGC 2261. It can therefore undergo rapid brightness variations of the same type as the large nebula, as described by Lightfoot (1989), who proposed that the rapid changes in the appearance of NGC 2261 are caused by circumstellar (fairly dense) materials that circulate near the star R Monoceros, which cause shadows projected into the nebula. They can be detected on the observable walls of the nebula and its environment. The disappearance of this jet-like structure happened so quickly that it cannot be a jet of ionized matter moving at high velocity of type ((HH) Herbig-Haro Objects).

2023/2024 Observations

(Presented by dates when observations were made)

This year in Dorval we used filters to highlight the near-IR and blue components of the nebula. A filter that detects the near IR "IR 72 Is" and others that are sensitive to blue and green light —filters "B and V" of the "Johnson/Cousins" series.

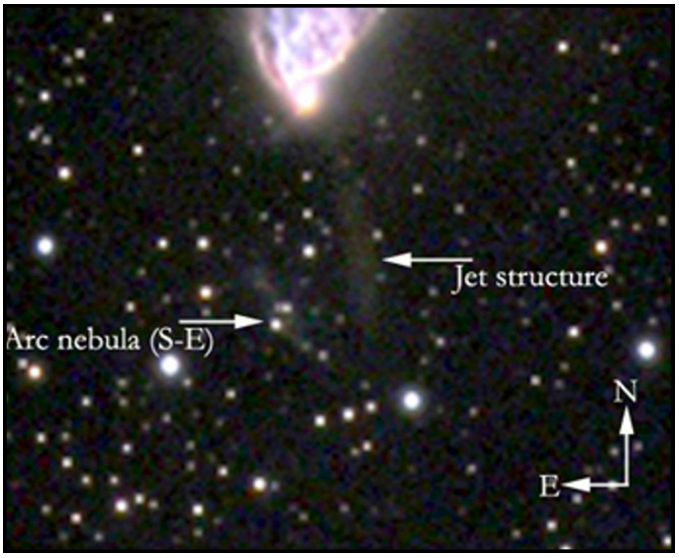


Figure 1 – the southern section of NGC 2261, an image from Christian Dupriez was used for this montage.

The right arrow points to the jet-like structure.

The left arrow points to the small arc nebula to the southeast of the jet-like structure. This serves as a reference for the intensity estimates of the jet-like structure presented on the graph (see Graph 1)

To complete, we made images that we call (L), these are images that do not use any filters.

Table 2 summarizes these filters.

This year we also estimated the magnitudes and we have spectra of the star R Monoceros that allowed us to capture some properties of this star responsible for the nebula NGC 2261.

Filter Name	Wavelength range	Content
IR 72 Is	≈ 793 nm to ≈ 1,000 nm	Near IR continuum
B	~ 410nm à ~ 520nm	Hβ Hydrogen λ486nm Hγ Hydrogen λ434nm HeII λ469nm [OIII] λ4959 and λ5007
V	~ 485 nm to ~ 585 nm	Visible light Oxygen [OIII] λ495.9nm and λ500.7nm
No filter (L) = Light	≈ 400 nm to ≈ 1000 nm	Continuum and spectral lines

Table 2

Figure 2-2 to 2-5

**Images taken from Dorval, 2023 November 20 and 24, 2023 December 13 and 21.*

The quality of the sky in the suburbs of Montréal does not allow us to obtain a sufficiently strong signal to be able to clearly distinguish the southern counterpart of the nebula where the jet-like structure was observed prior to 2015. However, it was possible to make some observations of features specific to the main nebula north of NGC 2261.

The Figures 2-2 to 2-5 allow a visualization of the distribution of visible light, B, V, and near-IR in nebula NGC 2261 as detected at the beginning of 2024. The filters used are described in Table 1.

Figure 2-2; This image is taken using the "V" filter, the visible light between ~ 485nm to ~585nm. This image contains both Oxygen [OIII] 495.9nm and 500.7nm.

Figure 2-3, B+V+IR.

This image allows us to see the distribution of blue, green, and near-IR in the nebula. Near-IR (in red) is dominant very close to the star in the east; there is an elongated concentration that moves away from it toward the northeast. Near-IR is also observed on the west side halfway north in the nebula, a small source (near-IR) at its W end, from there a wider band in near-IR then moves away to the north by widening and decreasing intensity.

Figure 2-4; (IR 72 Is (≈ 793 nm to ≈ 1,000 nm) – Light (~400 nm to ~ 1000 nm)).

This reduction seems to isolate the nebula fairly well in the near-IR range.

By adjusting the images correctly, we can promote the signal of the near-IR, which is well accentuated and isolated. On the resulting image, we can see that the high concentration of elongated near-IR, which escapes from the region of the star in the NE direction, is in two segments: the more intense, closer to the star crossed by a darker line followed by another bright but less intense segment than the first, it decreases as they move away toward the NE of this one. We also see very well the small source (near-IR) on the nebula at its west end, it is bright on this image (indicated by the arrow). This small but more subtle source is also detected in the previous figure 2-3.

Figure 2-5; (L - IR 72 Is) blue + (Light – B) green + (IR 72 Is – Light) red. The result is a tricolor montage image. This figure shows the distribution of the different filters. The two northern extensions (in red) on the sky of each side of the nebula are clearly visible. The small near-IR source is easily visible, predictably, on the wall west of the nebula not far from the star. From each side of the star, E and NW, two thin feathers are observed, one toward the east on the sky and the other to the west end of the nebula. Further from the star, it widens considerably and it becomes very pale.

We are thinking of repeating this exercise to check if this aspect of the observations can show variations in the nebula that can be associated with those observed in visible light?

Observation from Dorval, Québec;

Figure 3

**Images by Réal Gauvin, 2023 12 22 et 2024 02 10*

Figure 3, summary

NGC 2261, five 10-minute photos in luminance with an Astronomic light-pollution filter. 2023 December 22, at 1:30 a.m.

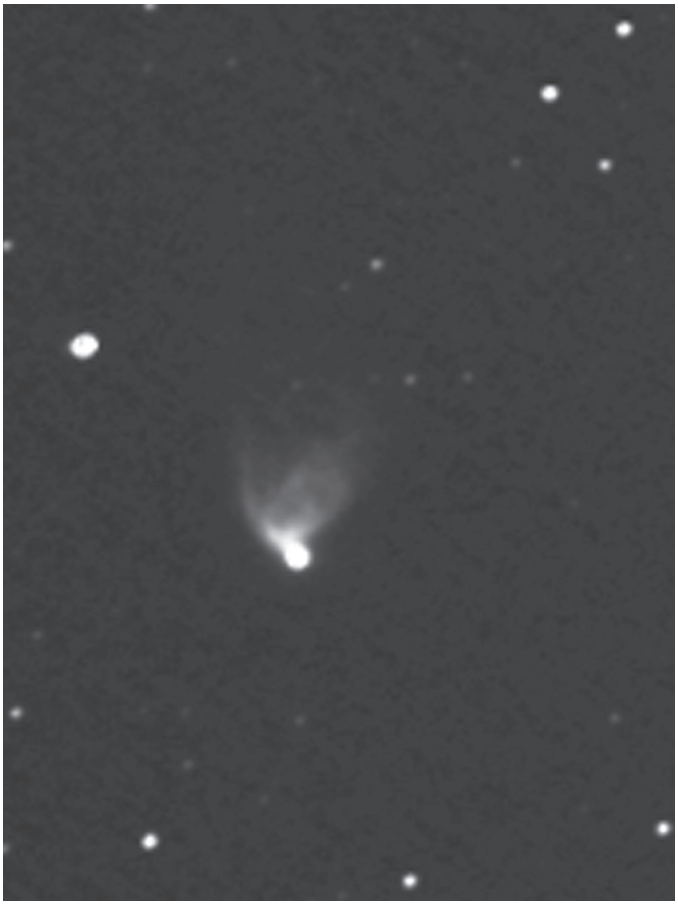


Figure 2.2 –V

Figure 2.3 – B (blue)+V (Green) +IR (Red)

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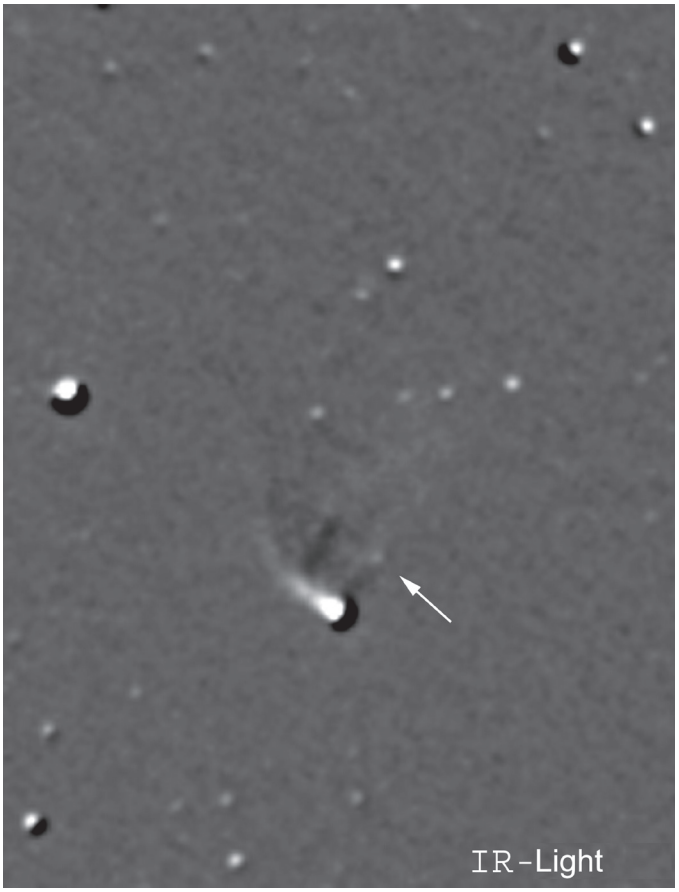


Figure 2.4 –V

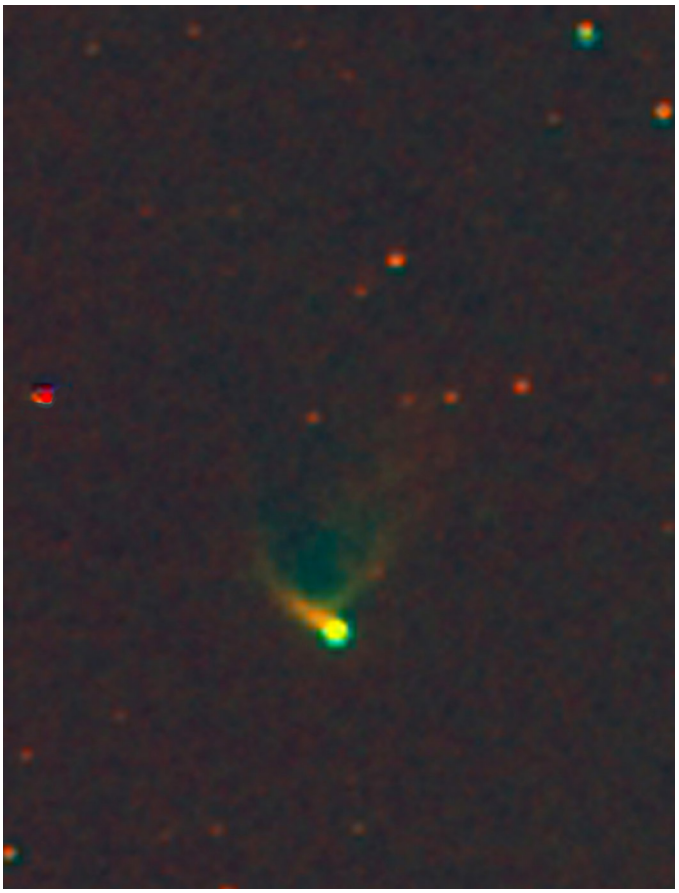


Figure 2.5 – B (blue) +V (Green) +IR (Red)

Telescope: iOptron trusstube 10″ Ritchey-Chrétien with a focal length of 2000mm.

Monochrome camera QHY268M bin2 for 7.52 microns/pixel.

This image clearly shows the darker regions and intense nodules that are observed on the surface of the main nebula north of the star R Monoceros.

We can start to detect intense regions of the nebula further south, just below the star's position.

Figure 4

**Images by Robert Cazilac, 2024 01 15, about 23:00 UT*

Figure 4, summary

Image of 2024 January 15, at 23:00 UT.

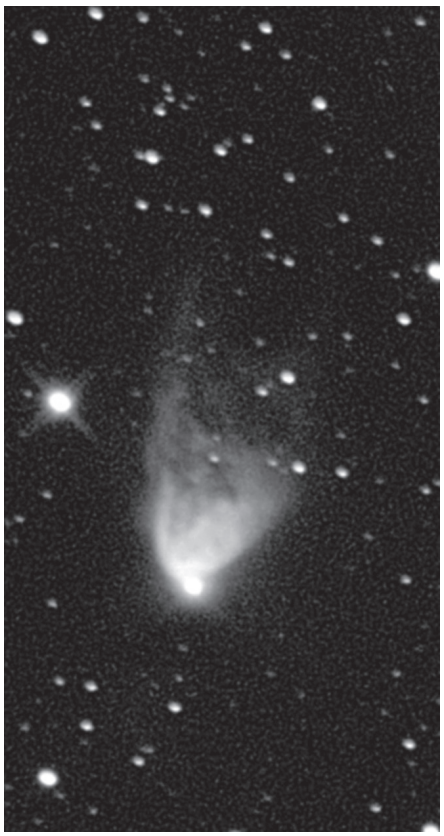


Figure 3

Figure 4

C14 Edge HD *f*/10, no filter, ASI1600MM (pixel of 2.9 microns), 350 subs of 5s. Seeing 5/10, cooling not activated.

Notes

This image shows the presence of the small curved nebula at the SW of the star. This is the reference for estimating the luminous variations of the jet-like nebula targeted by the study.

We also see that, to the south of the star, there is nebulosity that begins to be intense enough to be visible. This is observed on the western side of the star and descends toward the south, it even begins to cover with a small glow the section of the darkened jet-like nebula closest to the star.

Also, we can see very well the delineation of the darker surface where the jet-like nebula was observed before 2015.

Figure 5

**Images by Jean-Bruno Desrosiers, 2024 02 06*

Figure 5, summary

This image shows the southern counterpart of the NGC 2261 nebula. The small curved nebula is detected at the SE of the star.

It shows the nebulosity to the southwest of the star that covers with a small glow the darkest section of the jet-like nebula closest to the star.

Simultaneous photometric and spectroscopic observations are always done in the same way to normalize the data.

Jean-Bruno, observations of 2024 February 06.

It signals a remarkable change in the B–V and V–R indices of the star R Monoceros, compared to the last observations made on 2022 November 04.

The photometric follow-up estimates by Jean Bruno for the star R Monoceros are compiled in Table 3.

Figure 5

Note

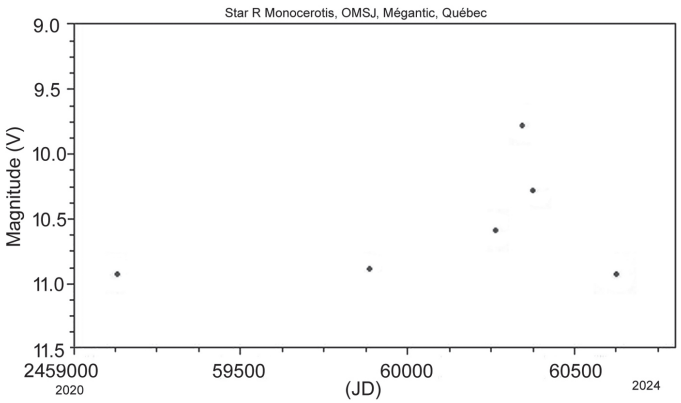
In 2020, magnitudes were:

B = 11.364, V = 10.921, R = 10.479

Then in the following years, the magnitudes increased somewhat, but when last observed in November 2024, they returned to the same levels as in 2020.

Date	CV	B	V	R	I	B-V	V-R	R-I	B-I	V-I
2020-10-11	10.848	11.364	10.921	10.479		0.443	0.441			
2022-11-04		11.577	10.878	10.110	9.925	0.699	0.767	0.184	1.651	0.952
2023-11-16	10.589		10.584							
2024-02-06		10.908	9.778	9.969	8.809	1.129	-0.190	1.160	2.099	0.969
2024-03-08		10.899	10.273	9.880	9.247	0.625	0.393	0.632	1.651	1.025
2024-11-13		11.395	10.918	10.399	9.990	0.476	0.519	0.408	1.404	0.928
Average error		± 0.67	± 1.14	± 0.59	± 1.18					

Table 3 – Étoile R Monoceros / (photometry of the star R Monoceros 2020 à 2024)



Graph 2 – Photometry, BVR of the star R Mon

On Graph 2, we observe three minima of intensities of the star.

The 2024 measurements show how quickly the star can reach its maximum and then descend to its minimum.

Summary of observations by J-B Desrosiers, OMSJ, Mégantic, Québec.

Observations focused on the star R Monocerotis.

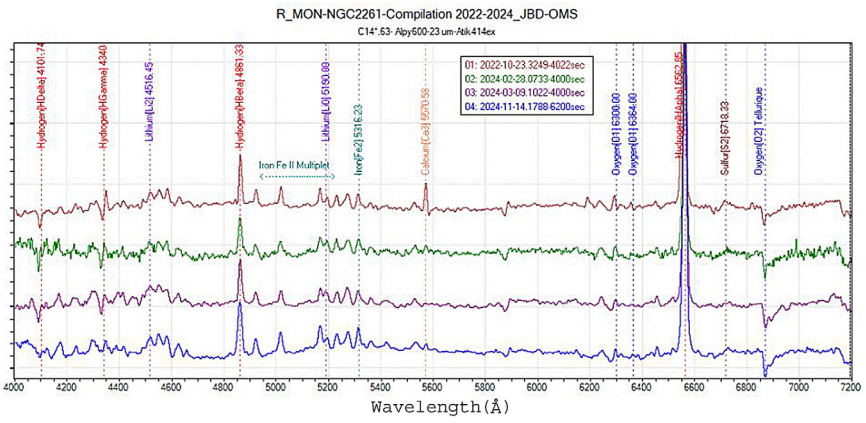
Compilation of spectra 2020–2024

Spec-1

The spectroscopy was carried out with a Schmidt-Cassegrain 355-mm telescope with a focal reducer for (2863mm) and spectro Aly-600 (r=540), Camera: Atik 414ex guided by Atik Titan. Generally, I aim for 4 exposures of 1000 seconds. Processing flattening of the continuum was done using Bass Project software.

Results of the spectra;

Overall, 2022 and 2024 spectra do not show significant change. However, if we look more closely, we can see that the calcium line 5570.58 Å (Ca3) is rising in emission, as are all the Balmer lines. It is also noted that other lines appear to have gained in intensity between the spectra of 2020 and 2024.



Spec-1

According to Kazaryan and Khachikyan, (1972), hydrogen and calcium are in more intense emission when the brightness of the star approaches its minimum. Then, near the maximum brightness of the star, the emission lines become weaker. The absorption lines of hydrogen become dominant in the spectrum; they are then more prominent and deeper.

Greenstein, J.L. & É.E. Khachikyan, (1974) also observed the opposite image, strong emission lines, including that of Ca II when the star was close to its maximum intensity. And inversely, while the star was close to a minimum, the emission lines of Ca II disappeared and the emission lines of other elements became weaker.

Spectra conclusion

The spectrum of the star R Monocerotis (Kazaryan and Khachikyan, (1972) and Greenstein J.L. & É.E. Khachikyan, (1974)), seems to indicate that both scenarios may occur, the maximum intensity of the star may coincide with the time of the dominance of the lines in emissions that will gradually transform into lines in absorptions at minimum intensity. Or its opposite, the maximum may coincide with the time of dominance of absorption lines that will transform into emission lines approaching the minimum.

The J-Bruno spectra (Spec-1) show that there is a transformation of some spectral lines between the phases of maximum and minimum intensity of the star (Graph 2). Mainly the lines of hydrogen delta at ~ 4101.20 Å and hydrogen gamma at ~4340.10 Å, then the line of calcium (Ca3) at ~5570.58 Å.

The college students section of Mauzan à Gap (Hautes-Alpes, France)

The images obtained during the first outing of students on 2023 December 16, are Figures 6.2 and 6.3. They are better than last year because of less turbulence and the telescope was re-collimated.

We took 140 1-minute exposures to avoid maximum turbulence and to avoid saturating the image in bright light, while bringing out the maximum detail even at the heart of the nebula, which is very bright compared to extensions.

The acquisition instruments were: A Newtonian T520 *f*/4.7 on fork-mounted equatorial built by members of the Copernic 05 association, a CPU Sky-Watcher coma corrector, a Nikon Z6 defiltered to have maximum signal even in H-alpha, for a total of 2h10m exposure.

Summary of the project

With two sixth-grade classes, in science and as part of the scientific culture, we have set up an observation program and image acquisition of

Figure 6, 6.1 — Images of the sixth graders of Collège Mauzan à Gap (Hautes-Alpes, in France), framed by Jérôme Astreoud, their SVT teacher, on 2023 December 16. In Figure 6, students are at the observatory of the Copernic 05 astronomy association, where they use the 520-mm telescope. https://www.asso-copernic.org/

Figure 6.2 – A superb image of the Hubble nebula from students at Mauzan College à Gap (Hautes-Alpes, France), the image was taken at the observatory of the astronomy association, Copernic 05.

the variable Hubble nebula NGC 2261 in order to participate in a citizen science program. The acquisitions are pre-processed in class by sixth graders (Figure 6.1) with SIRIL, a powerful and free astrophotography processing software program.

The pre-processed images are then sent to Collège Camille Reymond in the third option astronomy class (inter-institution and inter-cycle link). The students of Collège Camille Reymond process these images in order to obtain the maximum amount of information.

Data will be sent to Gilbert St-Onge of the "RASC/CDADFS," from Montréal, who is studying the variability of this nebula in order to participate in the publication of a scientific article in a publication of The Royal Astronomical Society of Canada. Follow-ups of this nebula are regularly presented.

The project's continuation this year 2024/2025 should allow better imaging through the acquisition of CMOS APSC cameras (AZWO ASI2600MC (colour) and a ASI2600MM (monochrome)). The field will be smaller compared to the Nikon Z6, but the size of the smaller pixels should improve resolution if seeing is good, and the increased sensitivity of these cameras will allow for finer and more detailed images.

The financing of these cameras was made through a NEFE grant application (financial support from the Fonds d'innovation pédagogique awarded by the French state to support initiatives designed to improve the success and well-being of students, and reduce educational inequalities. It is also hoped that the project can be continued in collaboration with a Canadian or Québec institution to give an international dimension to this citizen-science project and thus allow exchanges between students from 2 continents.

Thank you to Gilbert St-Onge for his patience, motivation and interest in supporting our project over several years.

Jérôme Astreoud, teacher, and sixth-grade students of the Collège Mauzan à Gap (Hautes-Alpes, France)

Figure 7 summary

At the 14″ *f*/4.6 telescope, he used the ZWO ASI2600MC camera with 3.76 microns/pixels and filter (Duo Band).

Again this year, Jean-Guy presents us with a superb image of NGC 2261. It shows very well the complex of nodes HH 39, far north on the sky; this one is associated with the star R Monocerotis.

Figure 7-1

In this image we can detect several filiform structures and nodes that intersect on the surface of the main nebula north of the

Continues on page 78

Figure 1 – Moon, Mars, and the CN Tower. Stuart McNair of Courtney, British Columbia, writes: This shot took considerable planning. I had been doing early morning shots of the full Moon setting, and planned, using PhotoPills app, exactly when I could frame the Moon and Mars next to the CN Tower. The final shot captured a fingernail crescent Moon, bathed in Earthshine, with Mars next to it, both beside the CN Tower in a beautiful blue sky. I love shooting conjunctions during the "blue hour." Taken 2015 Mar 21 (first day of spring) at 8:19 p.m. local time in Toronto, Ontario. Canon Rebel T2i, 18-55-mm f/3.5-5.6 kit lens at 50 mm, 1s @ f/5.6 and ISO 400.

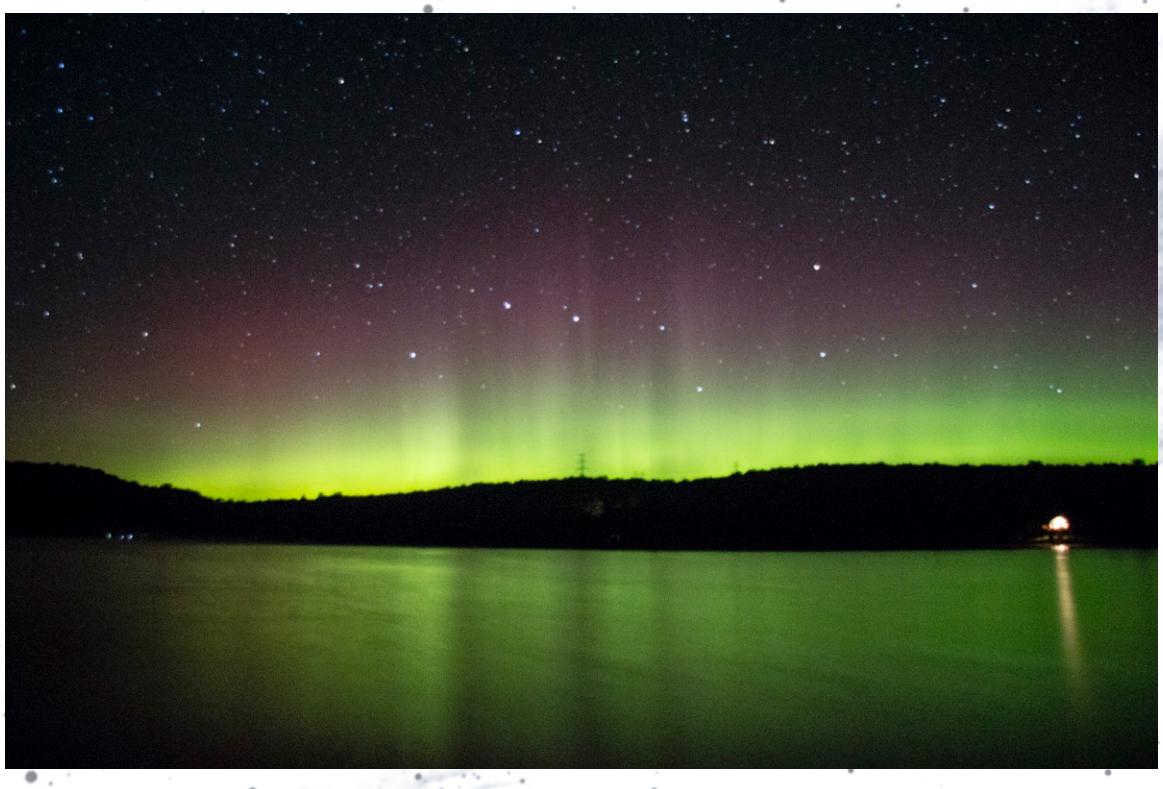


Figure 2 – Ross Lake, Haliburton, Ontario — Kersti Meema writes: The aurora borealis, or northern lights, is the interaction of the charged particles from the Sun with our atmosphere. Late August and early September of 2016 was terrific for the aurora. We had four nights in a row with northern lights of varying intensity. This was one of the brighter pictures I captured. Details: 1:39 a.m., 2016 September 1. Canon EOS REBEL T5i f/4 30-sec ISO 3200, focal length 17mm.

Continues on page 77

What's Up in the Sky?

April/May 2025

Compiled by James Edgar

April Skies

The Moon begins the month as a waxing crescent just a half degree north of the Pleiades (M45), aka The Seven Sisters. And, big Jupiter is not far behind, as the gas giant is 6 degrees south of the Moon on the 2nd. The first-quarter Moon on the 5th is 2 degrees north of Mars. By the 12th, the Moon is full, the smallest in 2025, as it is at apogee the following day (406,295 km distant). Also on the 12th, the bright star Spica is a mere 0.3 degrees away, occulted in the Southern Hemisphere. On the evening of April 16, Antares is 0.4 degrees north of the Moon, also a Southern Hemisphere occultation. Last quarter is on the 21st. By the 24th, Venus is 2 degrees north of the crescent Moon, while Saturn is 2 degrees south – could be a good early morning photo op. Also on that morning, Mercury is 4 degrees south, hugging the horizon – use binoculars from a location with a clear eastern horizon. Even Neptune gets in the picture, if you have a very good telescope! All four planets are clustered together in the morning twilight. New Moon is on the 27th, with the Moon at perigee of 357,118 km, causing large tides in coastal areas. By the 29th, the Moon is back among the stars of the Pleiades (M45). Jupiter is 5 degrees south on the 30th.

Mercury comes into view early in the month, but considered a poor apparition for northern viewers, as the speedy planet is too close to the horizon. It's a great apparition for viewers in the Southern Hemisphere. The Moon glides by on the morning of the 24th.

Venus is now the Morning Star, rising shortly after 5 a.m. It, too, is plagued by the shallow ecliptic angle in the early days of April, remaining visible for only an hour or so. It might be fun to see if you can track it into the daytime sky – it can be done. Later in the month, it reaches 41 degrees elongation from the Sun, beginning to round the curve of its orbit away from us. The brightest planet is joined by the Moon on the 24th and Saturn on the 28th.

Mars, still hanging around the Gemini twins, gradually slides eastward into Cancer, The Crab. The first-quarter Moon shares the scene on the 5th. The Red Planet reaches aphelion on the 17th, the furthest from us in its orbit, and not a very good telescopic target.

Jupiter remains close to the Hyades in Taurus, The Bull, making for good evening views. The Moon is 6 degrees north on the 2nd, and again on the 30th.

Saturn comes out from behind the Sun early in the month, but viewing suffers from a shallow ecliptic angle. Saturn's rings will be backlit as the Sun is behind the planet from our viewpoint. The crescent Moon and Venus are clustered with Saturn on the 25th.

Figure 1 — Late April finds most of the planets are gone from the night sky. Mars and Jupiter remain in early evening. That winter stalwart, Orion, fades away before midnight.

Uranus is gradually dropping southward on the ecliptic following sunset. Too close to the Sun for viewing late in the month.

Neptune is among the stars of Pisces, The Fish, but, again, suffering from the low ecliptic angle. Even telescopes might not be enough to see the distant planet.

The **Lyrid** meteors peak in the early morning of the 22nd.

Continues on page 76

The Sky April/May 2025

Compiled by James Edgar with cartography by Glenn LeDrew

Celestial Calendar (bold=impressive or rare)

Apr. 1 Moon 0.6° north of Pleiades (M45)

Apr. 2 Jupiter 6° south of waxing crescent Moon

Apr. 4 Moon at first quarter

Apr. 5 *Mars 2.0° south of first-quarter Moon

Apr. 12 full Moon at 8:22 p.m. EDT (smallest in 2025)

Apr. 16 Antares 0.4° north of waning gibbous Moon

Apr. 20 Moon at last quarter

Apr. 22 Lyrid meteors peak at 9:00 a.m. EDT

Apr. 24 Venus 2° north of waning crescent Moon

Apr. 25 Saturn 2° south of waning crescent Moon

Apr. 27 Moon at perigee (357,118 km) Large tides

Apr. 27 new Moon (lunation 1266)

Apr. 29 Moon 0.5° north of Pleiades (M45)

Apr. 30 Jupiter 5° south of Moon

May 3 Mars 2° south of waxing crescent Moon

May 3 Venus 2° north of Neptune

May 4 Moon at first quarter

May 4 Mars 0.4° north of Beehive cluster (M44)

May 5 Regulus 2° south of waxing gibbous Moon

May 5 Eta Aquariid meteors peak at 11 p.m. EDT

May 10 Spica 0.4° north of nearly full Moon

May 10 Moon at apogee (406,243 km)

May 12 full Moon at 2:56 p.m. EDT

May 14 Antares 0.3° north of 16-day-old Moon

May 15 double shadows on Jupiter

May 18 Pluto 0.4° north of Moon

May 20 Moon at last quarter

May 22 Saturn 3° south of 23-day-old Moon

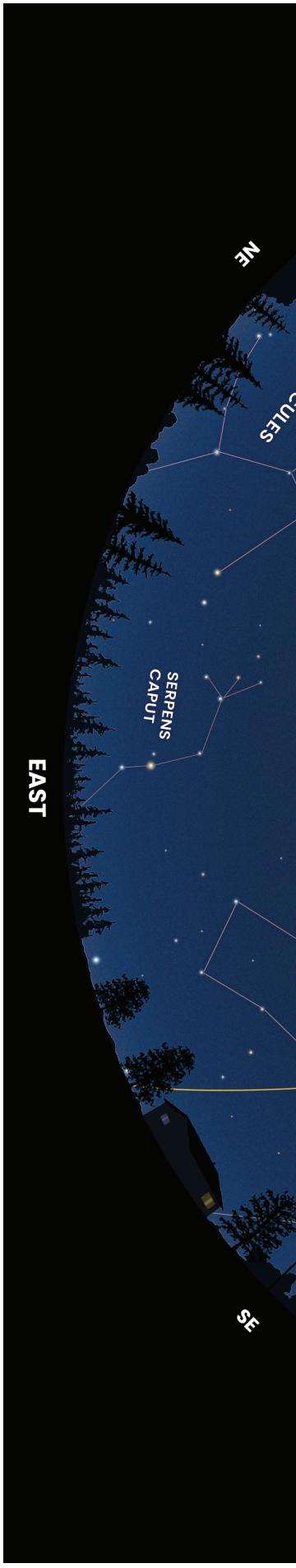
May 22 Neptune 2° south of 23-day-old Moon

May 23 Venus 4° south of thin-crescent Moon

May 25 Moon at perigee (359,022 km)

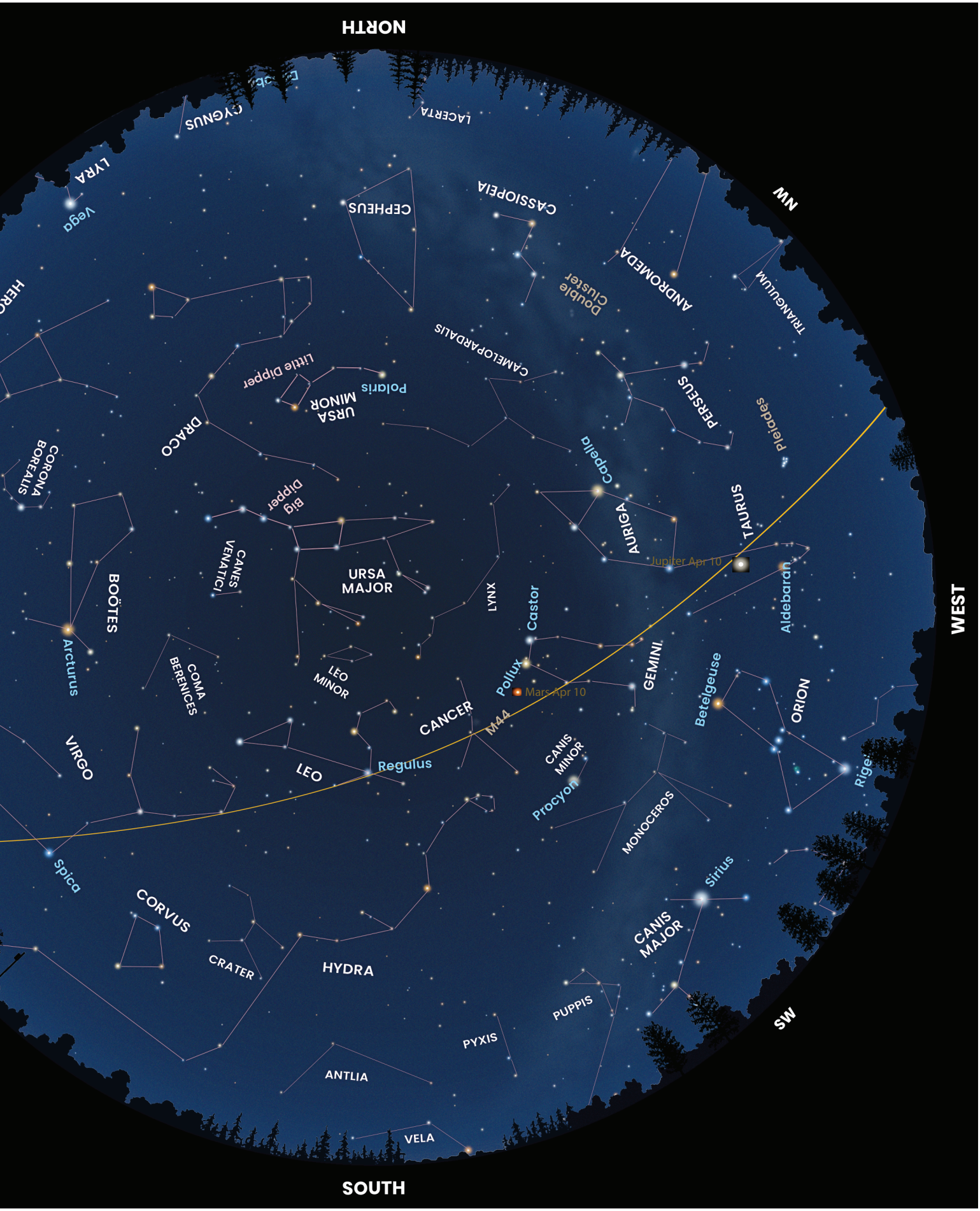
May 26 new Moon (lunation 1267)

May 28 Jupiter 5° south of very thin crescent Moon



Planets at a Glance

	DATE	MAGNITUDE	DIAMETER (″)	CONSTELLATION	VISIBILITY
Mercury	Apr. 1	—	11.1	Pisces	—
	May 1	0.0	6.8	Pisces	Evening
Venus	Apr. 1	–4.3	56.9	Pisces	Dusk
	May 1	–4.7	36.5	Pisces	Morning
Mars	Apr. 1	0.4	8.2	Gemini	Evening
	May 1	0.9	6.6	Cancer	Evening
Jupiter	Apr. 1	–2.1	36.1	Taurus	Evening
	May 1	–2.0	33.7	Taurus	Evening
Saturn	Apr. 1	—	15.7	Aquarius	—
	May 1	1.2	16.1	Pisces	Morning
Uranus	Apr. 1	5.8	3.5	Taurus	Evening
	May 1	5.8	3.4	Taurus	Evening
Neptune	Apr. 1	—	2.2	Pisces	—
	May 1	7.9	2.2	Pisces	Morning


NORTH
NW
WEST
SW
SOUTH
CYGNUS
LACERTA
LYRA
Vega
CEPHEUS
CASSIOPEIA
ANDROMEDA
Double Cluster
TRIANGULUM
CAMELOPARDALIS
Little Dipper
Polaris
URSA MINOR
DRACO
PERSEUS
Pleiades
CORONA BOREALIS
Capella
AURIGA
TAURUS
Big Dipper
CANES VENATICI
URSA MAJOR
Jupiter Apr 10
Aldebaran
LYNX
Castor
BOÖTES
Arcturus
COMA BERENICES
LEO MINOR
Pollux
Mars Apr 10
GEMINI
Betelgeuse
ORION
CANCER
M44
VIRGO
LEO
Regulus
CANIS MINOR
Procyon
MONOCEROS
Rigel
Spica
CORVUS
CRATER
HYDRA
Sirius
CANIS MAJOR
PUPPIS
PYXIS
ANTLIA
VELA

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May Skies

The Moon is approaching first quarter, splitting the evening ecliptic with Mars to the east and Jupiter to the west. By the 3rd, Mars is only 2 degrees south. First quarter is on the 4th, with Regulus coming on the scene on the 5th. On the 10th, Spica, the bright star in Virgo, The Maiden, is just 0.4 degrees north – an occultation in the South Pacific. The Moon reaches apogee that same day at 406,243 km from Earth, and is full the following day, the 12th. Antares is occulted for southern viewers on the 13th; for the north the bright star in Scorpius is a mere 0.3 degrees north of the 15-day-old Moon. Might be a tough target as the bright lunar surface overpowers the star. Last quarter is on the 20th. On the 22nd and 23rd, three planets are joined by the waning crescent Moon – first Saturn, then Neptune, and Venus – all within 4 degrees. Perigee at 359,022 km is reached on the 26th, and new Moon is later that evening. Jupiter is 5 degrees south on the 28th, but that would be a tough sighting for a less-than-day-old Moon. Good luck trying, though!

Mercury puts on a good show for the Southern Hemisphere, not so good for the north. It's still a difficult morning target, being so close to the horizon. By the middle of May, it's too close to the Sun for safe viewing.

Venus, also a morning object, but a little farther west and rising well before dawn. It's part of the trio joined by the Moon on the 22nd and 23rd. The bright planet is approaching it's greatest elongation at the end of the month, then begins drifting along the back side of its orbit but remaining as a great target for early risers.

Mars continues its evening apparition, sliding gracefully from Cancer into Leo near month-end. The Moon, in crescent phase, passes by on the 3rd, and on the 4th, the Red Planet is very near the Beehive Cluster (M44).

Jupiter remains as an evening object, but not for long. By the end of May, it's too close to the Sun to see.

Saturn rises in the early morning, near Venus. The two planets are in Pisces, The Fish. On the 6th, the rings are edge-on, so invisible and casting no shadow on the planet. Thereafter, the south side of the rings gradually appears. The waning crescent Moon passes by on the 23rd.

Uranus is too close to the Sun to be seen.

Neptune is briefly in the morning sky, just before dawn.

The **eta Aquariid meteors** peak on the evening of May 5. ✶

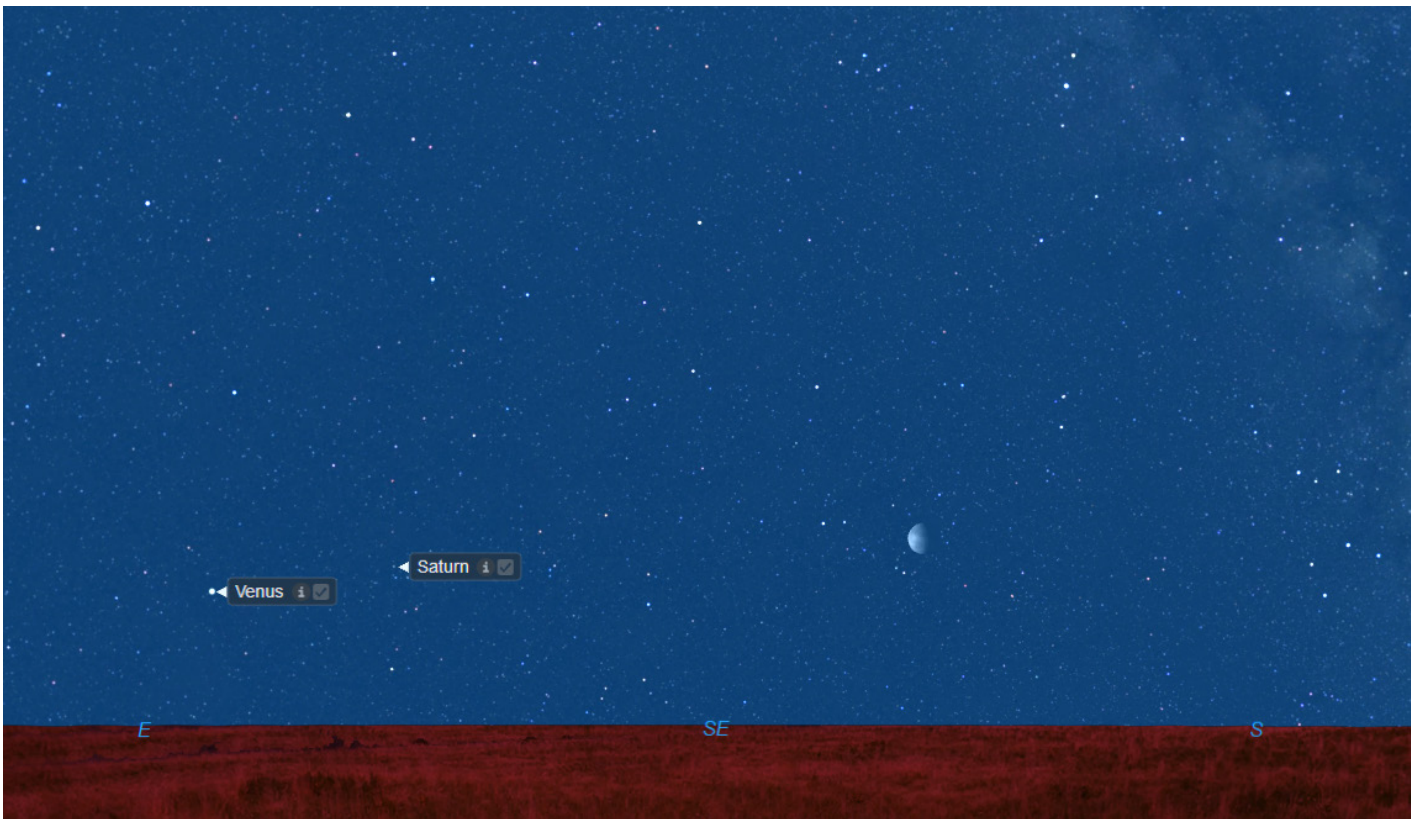

Figure 2 — In mid-May, two early morning planets, Saturn and Venus, are joined by the waning gibbous Moon in the southeast.

Continued from page 72

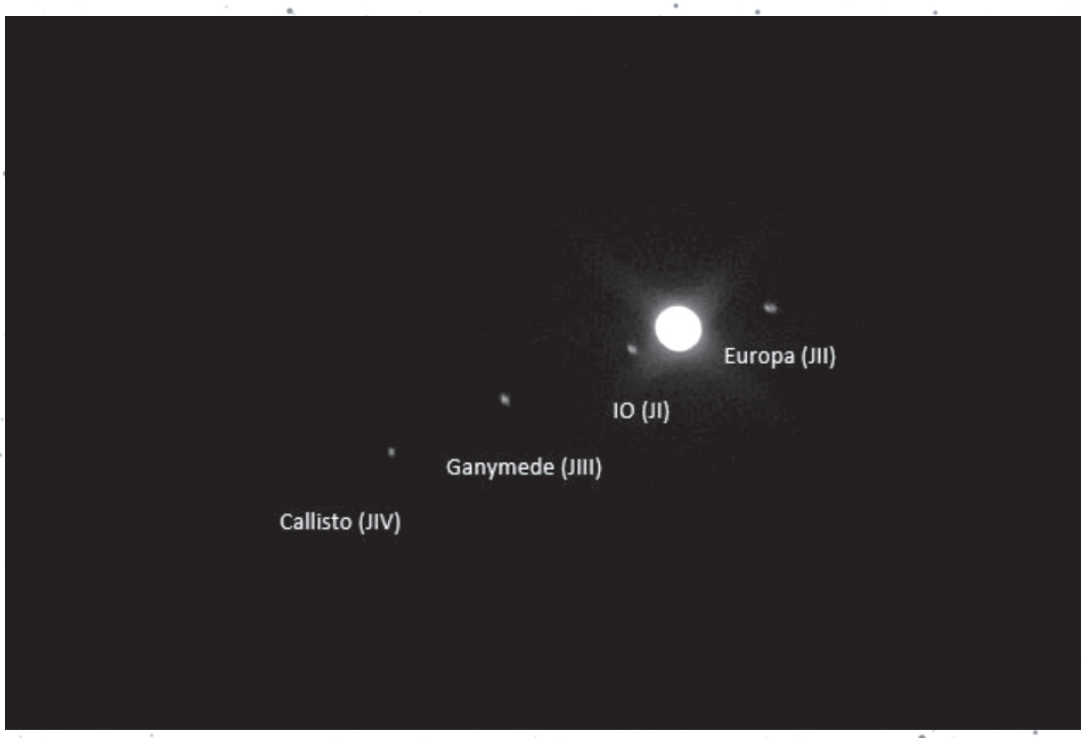

Figure 3 –Omar Alnaji of Mississauga writes: This image shows an overexposed Jupiter with four of its moons: Callisto, Ganymede, Io, and Europa. This was the first proper picture of any planet that I have taken. All I needed was my smartphone and an 8" Dobsonian telescope that I borrowed from RASC Mississauga. It was extremely fascinating to be able to capture four moons of a planet like that. They were much brighter than I expected.

Location: Mississauga, Ontario, backyard; Scope: 8" Dobsonian; Camera: Iphone 11 Pro; Exposure Time: Snapshot

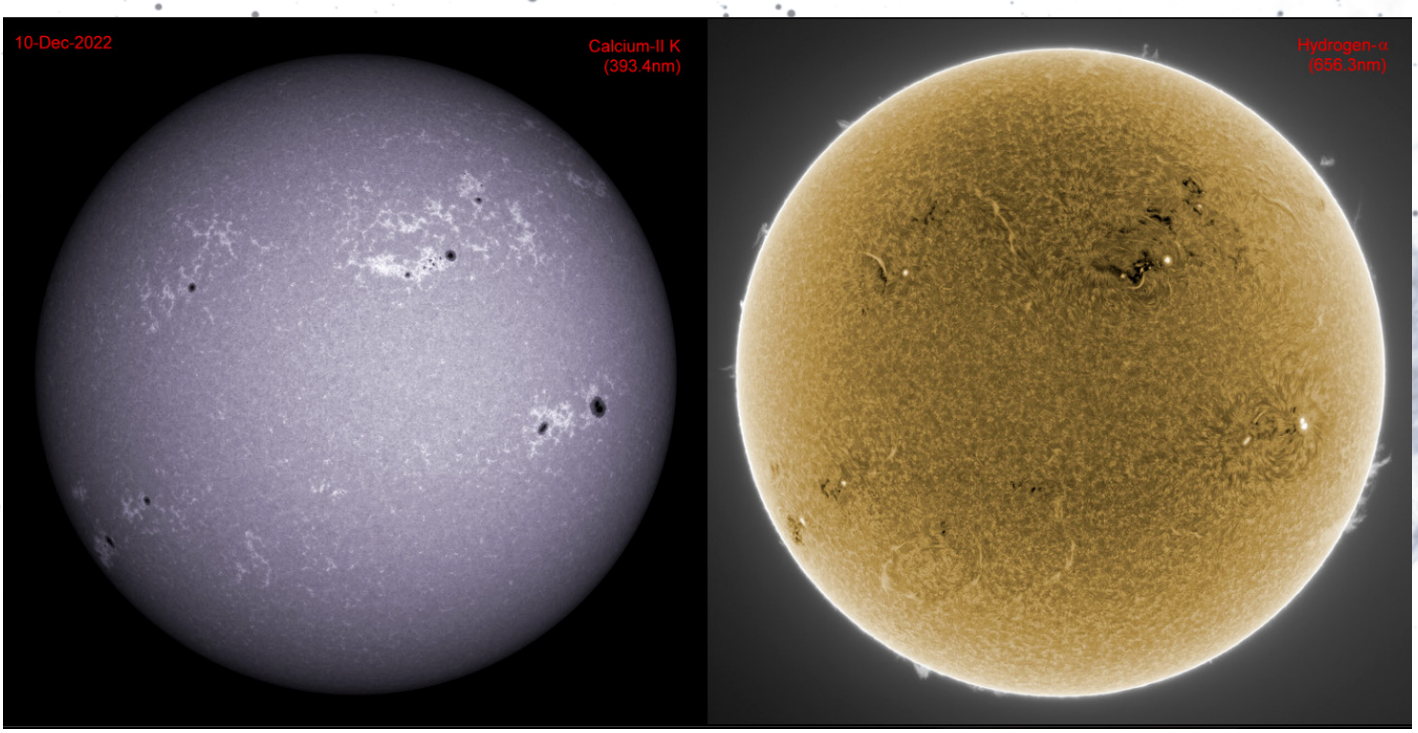

Figure 4 – Jim Thompson of the Ottawa Centre writes: Captured from my backyard on 2022 December 10, at ~11a.m. in central Ottawa. Transparency was average, seeing below average. Best 200 frames from 4000 were stacked using Autostakkert!3, sharpening with wavelets in Registax 6. Colour added in Photoshop. Calcium-II K image: Imaging Source DMK 33UX226 (gain 33%, exposure 1.4ms, gamma 184) + William Optics FLT98 @ native ƒ/6.3 + Baader Planetarium Herschel Safety Wedge + Omega Optics 0.2nm Ca-K filter.

Hydrogen-alpha image: Imaging Source DMK 33UX226 (gain 50%, exposure 3.6ms, gamma 271) + William Optics FLT98 @ native ƒ/6.3 + SolarScope 50-mm etalon & blocking filter. Note: prominences captured at different exposure and composited in after (gain 50%, exposure 8.3ms, gamma=35).

Continued from page 71

Figure 6.3 – The southern section of the NGC 2261 nebula is well detected by the Mauzan College group in France.

The more intense nebulosity on the west and south sides of the star is visible, starting to cover a large section of the residual dark surface of the luminous jet-like structure that was detectable before 2015.

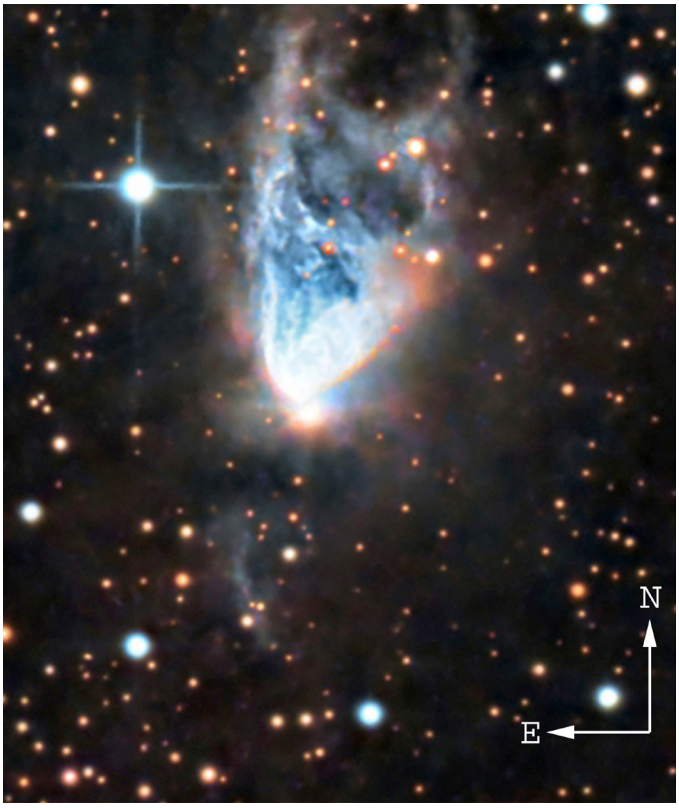

Figure 7-1

star. Several darker regions are detected mainly further north in this nebula. In the region of the star we can see several nebulosities that escape on the sky. Some go very far south, some others to the west of the star moving away from it toward the south, covering almost the entire residual dark surface of the jet-like structure with a low-light intensity. This image confirms the presence of new nebulosity south of the star.

Conclusion

The use of filters to see the most intense distributions in blue, visible, and near-IR in the nebula is an approach under development; we hope to be able to associate some variations of the distribution (B, V, and IR) of these filters with detectable changes in the morphology of the nebula or with variations in the intensity or colour index of the star. This is a developing program, but already we can see that the image of Figure 7 (J-G) seems in agreement with the measurements of IR, blue, and V colourations, which were made in the nebula, in Figure 2-2 to 2-5. The distribution of red is definitely on each side of the nebula to the east and west of it moving away toward the north, the core of the nebula is definitely detectable (blue/green). Closer to the star toward NE, a red region is intersected by a darker section that runs along this wall of the nebula.

Figure 7 – Image de Jean-Guy Moreau, 2024 03 08

The follow-up of the indices of colouration of the star R Monoceros, B–V, V–R, and IR (Table 1), is another aspect of this program in development and which it is hoped to be associated with the spectroscopic observations of the star R Monocerotis and the estimated distributions B, V, near-IR in the nebula NGC 2261 (Figure 2-2 to 2-5), a growing dossier.

In imaging

The arrow in Figures (8 and 8-1) at the bottom indicates the position that the visible jet-like structure had before 2024. In imaging, this large 2024 follow-up has shown that several low-intensity nebulosities are now observed south of the star. Covering a large area of the structure of the residual darkened jet, in Figure 8, we can see the jet-like structure that is darker in 2018 (M. Hanson). Figure 8-1 shows that this region is now, in 2024 (J-G Moreau), covered by more intense nebulae. So it seems that the light of the star is beginning to reach this southern region that was dark for several years. We can't wait to see if the jet-like nebula will reappear.

Really fascinating! ✶

Thank you for revisions and translation—Gerald MacKenzie and Dominique, as well as Karim Jaffer (RASC Montréal Centre)

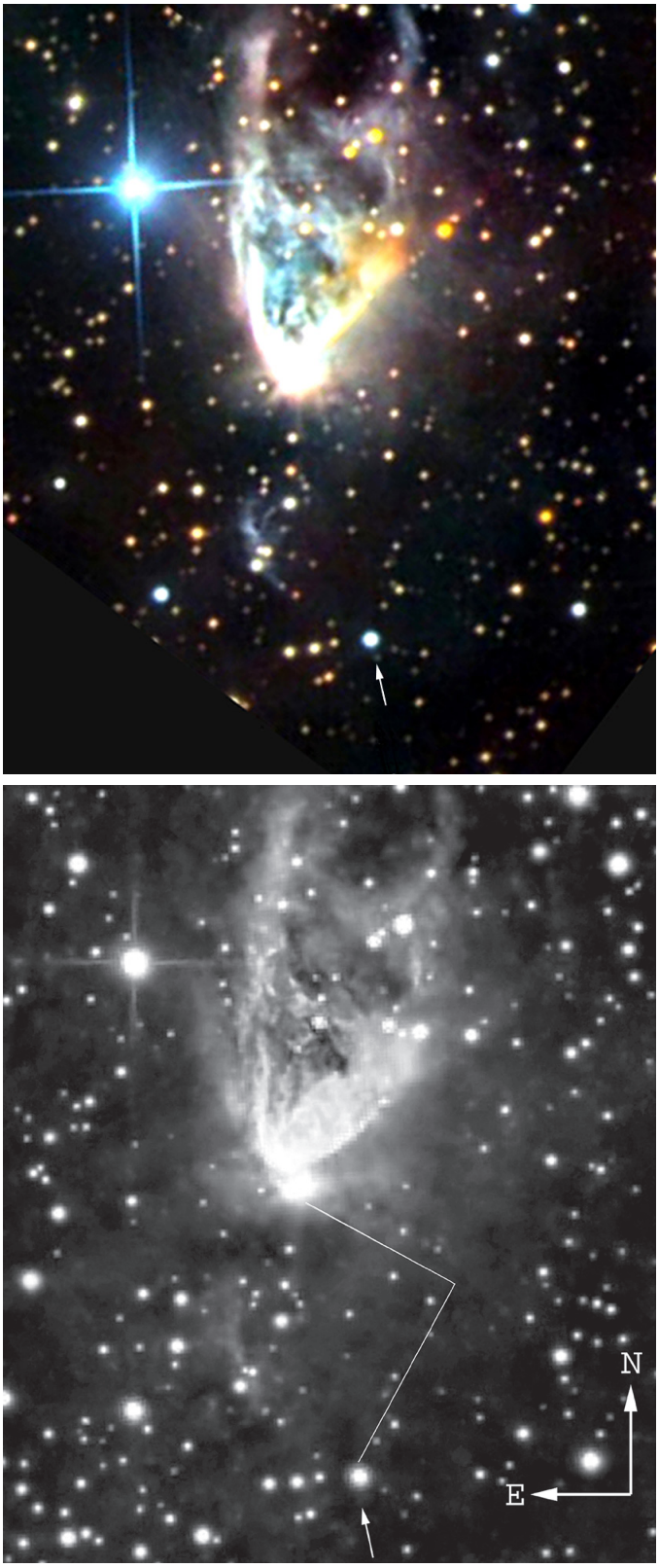

Figure 8 (top), 8.1

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V* R Mon (u-strasbg.fr)

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Et – https://www.astrobin.com/126445/?q= Credit: SDSS/Giuseppe Donatiello, 2014-10-07.

St-Onge G.[1] (CDADFS/ RASC/ SAM, Québec)

Le suivi de NGC2261 depuis 1990 et bien d'autres choses… Sites

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Alain Amsaleg, *France,*

Merci de ta contribution

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Great Images

By Sheila Wiwchar

Sheila Wiwchar of Winnipeg writes: Zodiacal Light—I feel you need some pretty dark Moonless skies to see such a faint sight. I have only witnessed it very few times. Usually I hardly notice until I take an image and view it. I really liked how it reached up through the Pleiades and having Orion to its left. 2019 March 24 at Kaleida, Manitoba; Canon 6D with a 20-mm lens at ISO 1600, ƒ/1.4 for 30 sec. Image generously provided from the RASC Astroimager certificate program.

Skyward

Shakespeare and the Night Sky

by David Levy, Kingston & Montréal Centres

If we begin this month by trying to find the best line Shakespeare ever wrote, that may not be an easy task, or it could be quite easy. I could open my Shakespeare and pretty much point at random to almost any line in the canon. But today I do have something specific in mind. It is a simple prose passage from *Hamlet*, and it could be one of the finest passages he ever committed to paper:

> I will tell you why; so shall my anticipation prevent your discovery, and your secrecy to the King and Queen molt no feather. I have of late, but wherefore I know not, lost all my mirth, forgone all custom of exercises, and, indeed, it goes so heavily with my disposition that this goodly frame, the Earth, seems to me a sterile promontory; this most excellent canopy, the air, look you, this brave o'erhanging firmament, this majestical roof, fretted with golden fire—why, it appeareth nothing to me but a foul and pestilent congregation of vapors. What a piece of work is a man, how noble in reason, how infinite in faculties, in form and moving how express and admirable; in action how like an angel, in apprehension how like a god: the beauty of the world, the paragon of animals—and yet, to me, what is this quintessence of dust?
>
> –*Hamlet*.2.2.292–306.

The magic of this passage begins with the "goodly frame." Hamlet is speaking of the planet on which he lives as almost a consecrated thing. It is surrounded by a most excellent and protective canopy, the air; without it we would never be here or could have evolved here as a species. But the lines reach their zenith with the "brave o'erhanging firmament," a reference to the night sky in a way virtually none of us could even imagine. It gets better: "this majestical roof, fretted with golden fire." I can think of no more appropriate way to characterize the night sky. Shakespeare is ready to call the magnificence of the night sky, on any night, a holy thing and experience. I have heard the night sky described in many ways during my lifetime, but never so exquisitely.

Figure 1 — Shakespeare's birthplace

Many readers of this column take advantage of the night sky as a target of their cameras; I am one of those who does not. I am primarily a visual observer, and from night to night, season past season, and year after year, I am still spellbound by the simple joy of the night sky. It is not that I have never photographed. I used to be quite the celestial shutterbug. And between 1989 and 1996, I took literally thousands of pictures of the sky, mostly using the 18-inch Schmidt camera at Palomar Mountain Observatory. Just two of those images, recorded on 1993 March 23, began an adventure with a comet that eventually collided with Jupiter. Perhaps that was enough. In a sense, it is time for me to give my camera a rest, open my eyes, and simply enjoy the night sky's golden fire. ✶

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 paper 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.*

The June 2025 *Journal* deadline for submissions is 2025 April 1.
See the published schedule at rasc.ca/sites/default/files/jrascschedule2025.pdf

John Percy's Universe

Helen Sawyer Hogg

by John R. Percy, FRASC
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Older readers of this *Journal* (like me) may remember Helen Sawyer Hogg, or even have met her. She was Canada's best-known and most beloved astronomer. For me, she was a colleague, mentor, and shining star. But she may be unfamiliar to younger readers, hence this column. My colleague Professor Christine Clement (2024) has recently published an excellent account, in this *Journal*, of the nature and importance of Helen's research on variable stars and globular clusters, so I shall not dwell on that aspect of Helen's many accomplishments here. Christine's research notes are here[1]. There are also some excellent obituaries (e.g. Clement and Broughton 1993), and a short book by Michael Webb (1991) for young readers. Maria Cahill has promised a forthcoming book about Helen, emphasizing her work as a science communicator. There is really a need for a full biography of this remarkable woman. Lots of archival material is available.

Helen Sawyer was born in 1905 in Lowell, Massachusetts, the daughter of a lawyer and a former teacher. She and her family observed Comet Halley in 1910, undoubtedly fostering Helen's interest in astronomy. But that interest really blossomed when she attended Mount Holyoke College. She began as a chemistry major but also took an elective course in astronomy. The instructor, Dr. Anne Young, took the class to see a midwinter solar eclipse on 1925 January 24. She also invited the eminent Harvard College Observatory (HCO) astronomer, Annie J. Cannon, to visit the college for a few days. Cannon was one of several notable woman astronomers who an earlier HCO Director, Edward Pickering, had hired. The combination of an eclipse, an inspiring instructor, and two or more female role models induced Helen to change her major to astronomy.

Cannon also recommended Helen to the renowned HCO Director, Harlow Shapley. He awarded her a scholarship and became her graduate advisor, setting her on the research track that my colleague Christine Clement has described so well. These were exciting times at HCO, both in terms of the research and in terms of the people. One of Helen's fellow graduate students was Cecilia Payne, arguably the most brilliant woman astronomer of her generation. Another fellow graduate student was Frank Hogg, a Canadian. He and Helen fell in love and they married in 1930. Helen received her Ph.D. in 1931 (from Radcliffe College, since Harvard did not award such degrees to women at the time). Incidentally, HCO was not all work and no play. There is an oft-reproduced picture[2] of the staff performing a version of Gilbert & Sullivan's *H.M.S. Pinafore.* Another Canadian HCO astronomer, Peter Millman, is brandishing a gun, and Helen is holding her ears. *The Observatory Pinafore* was written in 1879 by Winslow Upton, and first performed in 1929, under the direction of Helen Sawyer and Harlow Shapley.

Figure 1 — Helen Sawyer Hogg, proudly wearing her Order of Canada medal. Source: University of Toronto.

In 1931, Frank was offered a staff position at the Dominion Astrophysical Observatory (DAO) in Victoria, B.C. Cecilia Payne might have been a better-qualified candidate, but it would have been considered unseemly for her to use the telescope at night, alone with a male telescope operator. There was not a position available for Helen (there were nepotism rules at the time, among other things) but DAO Director, John Plaskett, awarded her a small research grant that she used to hire a housekeeper to look after her young daughter, Sally, and he also awarded her observing time—on the second-largest telescope in the world, the 72″. And she had a chaperone—Frank.

In 1935, they moved again. Frank had taken a position at the University of Toronto's newly opened David Dunlap Observatory in Richmond Hill, Ontario, with a telescope similar to but slightly larger than the one at DAO. Helen resumed her research, again as a volunteer. Then on New Year's Day 1951, tragedy struck. Frank died of a heart attack, leaving Helen as a single mother of three children. But she persisted, thanks

to encouragement and support from Harlow Shapley and her colleagues in Toronto. In 1949, she had received the Annie J. Cannon Prize from the American Astronomical Society. The prize is named in honour of the HCO woman astronomer who had encouraged and facilitated her entry into astronomy. How appropriate! And it came at a crucial stage in her life. By 1957, she had been promoted to Full Professor at the University of Toronto—the highest rank.

Teaching

Helen's work at DDO was initially research but, when WWII came, male staff were called away on war work, and she took on teaching duties. When I was an undergraduate at Toronto from 1958 to 1962, she taught an introductory astronomy course for honour students in the humanities and social sciences; they had to take such a course as a degree breadth requirement. With her diverse knowledge, and her interest in the history and communication of astronomy, she was an ideal teacher. Helen had one doctoral student—Christine (Coutts) Clement. Christine has continued Helen's research work in exemplary fashion.

Public Education

Although Helen's first duties were research and teaching, it is not surprising that public education became a priority activity. Clarence Chant, the founder of the astronomy department and of DDO, was famous for his lectures and articles, and his book *Our Wonderful Universe.* He retired in 1935 but continued his work at DDO for another two decades. Helen's Ph.D. advisor, Harlow Shapley, was a notable public educator, the author of over a dozen books for general readers. In the decade before his death, Frank had begun writing a column—"With the Stars"—for the *Toronto Star*, Canada's largest-circulation newspaper. Within two weeks of his sudden death, Helen took over the weekly column and continued it for over 30 years. It became a basis for her book *The Stars Belong to Everyone* (Sawyer Hogg 1976) and for her many public lectures. She also hosted an 8-episode series on astronomy on TVO, Ontario's public television channel. I recall being a guest, along with Carl Sagan. Helen also contributed a long-running column on "Out of Old Books" in this *Journal*; a link to the columns can be found here[3].

Maria Cahill, a professor of English and communication at Husson University in Bangor, Maine, has written a doctoral thesis on *The Stars Belong to Everyone: The Rhetorical Practices of Astronomer and Technical Communicator Helen Sawyer Hogg*. She has also written articles and given talks on the topic, including at the 2019 RASC General Assembly at York University[4]. This reminds us that the effective communication of science is a legitimate and important academic discipline.

For her work in public education, Helen received the Klumpke-Roberts Award from the Astronomical Society of the Pacific in 1983—a rare honour, since almost all the other recipients have been based in the US.

Leadership

Helen was noted for her leadership in a wide variety of organizations, from the international to the local, often as president, and often as the first woman in such a position.

She was very active in international astronomy, including through the International Astronomical Union, the world organization of professional astronomers. Her publications, catalogues, and bibliographies of variable stars in globular clusters were used by astronomers around the world. She filled a number of leadership positions in US organizations, including the American Astronomical Society, among others; she served on the AAS Council from 1965 to 1968.

The American Association of Variable Star Observers (AAVSO) is an organization through which skilled amateur astronomers can contribute to astronomical research by observing the changing brightness of variable stars—Helen's favourite kind. In its early days, at the beginning of the 20th century, the AAVSO was closely connected with HCO, where many female astronomers worked. Several women served as AAVSO president before her, so her 1939–1941 presidency was notable, but not unusual. Women have continued to serve admirably in leadership roles in the AAVSO. However, the observers are almost all greying white males.

The RASC is rather different. Its roots go back to 1868, but it had only one female president before Helen in 1957–59—Annie Vibert Douglas in 1943–44—and it has had only three since. As in the AAVSO, the majority of amateur astronomers in Canada are male. Helen received the RASC Service Award (1967), served as Honorary President (1977–1981), and was the only Canadian to be appointed an Honorary Member.

The Royal Canadian Institute (now the Royal Canadian Institute for Science) was even more lacking in female leadership. It was founded in 1849 and played an important role in Canadian science in the second half of the 19th century. Helen was its first female president, in 1964–65. And there were then 21 male presidents before the next female, Margaret Thompson, in 1986–87.

By the mid-20th century, the RCI's major activity was holding free public lectures on science, in the University of Toronto's Convocation Hall, often attended by 1000 or more. During her presidency, Helen encouraged the RCI to seek new audiences for science—such as high school students—through new programs such as essay prizes, mentorships, and summer science programs. I had the pleasure of serving as an

instructor at one such summer science program, at Lakefield College School.

The RCI was a very conservative organization at that time. At lectures, Council members (male) sat in the first row, often in formal attire; their wives sat in the second row. When I served as president in 1985–86, my science-professor wife was expected to help serve tea after the lectures.

The Canadian Astronomical Society (CASCA) is the organization of professional astronomers in Canada. Helen was its founding president in 1971–1972. At the time, there were bitter disagreements, among Canadian astronomers, particularly over the cancellation of the Queen Elizabeth II Telescope on Mount Kobau in B.C.—a topic discussed in great detail and depth in this *Journal* by Vic Gaizauskas (2011). Helen's eminence, experience, and diplomacy were absolutely essential to the success of the new organization. But there were then 15 male presidents before the next female one, Gretchen Harris in 2002–2004.

Recognition

Helen received a score of awards, most notably Companion of the Order of Canada—the highest rank, and equivalent to a knighthood. She was also a Fellow of the Royal Society of Canada. An asteroid, two observatories, and several lectureships and scholarships are named in her honour. She received six honorary doctorates.

In Summary

Helen was certainly Canada's best-known astronomer, as a result of her research, teaching, leadership, and especially her outreach—her newspaper column, books, articles, TV series, and public lectures. As for "most beloved": words like gracious, generous, and thoughtful were invariably used to describe her. Her hobbies were simple: gardening, bird-watching, stamp collecting, reading poetry, and knitting. She was known for bringing freshly baked hermit cookies to meetings, and for the "astronomical booties", which she knitted for babies of the department faculty, staff, and even graduate students (my daughter received a pair). They extended above the knee, and were guaranteed not to fall off! ✶

Acknowledgements

I am especially grateful to my colleague Professor Christine Clement for her writings about Helen, for reading a draft of this column, and for generally helping to preserve the legacy of this remarkable scientist and woman. ✶

Endnotes

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

Great Images

By Tony Schellinck

Tony Schellinck of Halifax Centre writes: I used the Tele Vue Powermate for this shot of M33 on 2015 November 8 at Port Mouton, Nova Scotia, which is why the galaxy is clipped slightly—it is a big target. I have photographed this galaxy and M51 below several times as I think they are the most interesting and beautiful top-down spirals to photograph in the night sky. Each photo I take seems to paint a different picture of what these galaxies look like.

46 240-second raw photos, 20 darks, flats, and dark flats, ISO 1600; Canon T1i, 8" Sky-Watcher Newtonian Astrograph, CGEM mount, Tele Vue Powermate 2X, Sky-Watcher 80-mm ED and Orion Starshooter with PhD for guiding. Each photo stacked and processed initially in Images Plus. Stretched in IP Digital Development. Colour balanced and background neutralized. Star reduction app in IP used to reduce star sizes. Image generously provided from the RASC Astroimager certificate program.

Mostly Variable Stars

An Introduction

by Hilding Neilson
(hneilson@mun.ca)

When the Production Manager of the RASC *Journal*, James Edgar, contacted me and asked if I would be interested in writing a column about variable stars my first thought was "That is a broad topic." Almost all stars are variable in some way, from seismology in the Sun and many other stars to granulation and star spots in M dwarf stars to eclipses and tidal distortions due to stellar and exoplanet companions to the more traditional radially pulsating Cepheids and long-period variable stars to the more enigmatic heartbeat stars. And that is not a complete list in any way. But, James patiently responded that I can choose the stars that could be of interest, it's the variability that makes them interesting. And that's true—we learn so much from the variability of stars. Pulsation is a tool for probing the internal structures of stars and how they evolve and change with time. Arthur Eddington was the first to show in 1919 that by measuring the rate of change of the pulsation in the prototype delta Cephei that the star could not be generating energy from gravitational collapse and that laid the groundwork for proving that stars generate energy from nuclear fusion before nuclear fusion was even understood.

So, who am I? My name is Hilding Neilson and I am currently an assistant professor in the Department of Physics & Physical Oceanography at Memorial University of Newfoundland & Labrador in St. John's where I am an astronomer and I am a member of the local St. John's RASC Centre. I am Mi'kmaq from Ktaqmkuk (Newfoundland). You might be surprised that, in a city whose nickname is Fogtown, there would be an active academic astronomy group, but my students and I are studying stellar pulsation, exoplanets. and stellar atmospheres. Along with that, I am working with an international group of scholars on questions about the search for extraterrestrial life, connecting with humanities and legal scholars to consider better and more-inclusive futures in outer space. and working to develop protocols for combatting the ever-increasing light and satellite pollution. Perhaps, more importantly, I work on ways to build a professional astronomy field that includes Indigenous knowledges and uses the methodology of Two-Eyed Seeing, or Etuaptmumk, given to us by Elder Albert Marshall. One of the ways I have been approaching this is in a collaboration with some fantastic researchers to develop the website www.astrodigenous.ca that is a search engine to help people find Indigenous astronomy resources in thepublic domain.

But, variable stars to me is like coming home. My first research paper was a theoretical study of pulsation-enhanced winds in classical Cepheid stars motivated by the first detections of excess infrared light using optical interferometry. That work was with my Ph.D. supervisor, Professor John Lester at the University of Toronto, but I received a lot of support from some of the wonderful variable-star researchers like Prof. Christine Clement, the late Prof. Tom Bolton of Cyg X-1 fame, and, of course, Prof. John Percy. My research on variable stars continued with papers on the Cepheid Leavitt Law (the period-luminosity relation); tests of stellar evolution models using measured rates of period change for Cepheids (many of which were compiled by Prof. David Turner (Turner et al. 2006), who also taught the first course I ever took in astronomy); models of the expected properties of binary systems that contain Cepheids and more.

Much more recently, I had the honour of working with two astronomy enthusiasts, John Simpson from Scotland and Nicolaus Steenken from Germany, who were interested measuring the change of linear polarization from the long-period variable star V Canum Venaticorum. The two observers compiled measurements over three observing seasons, and we were able to use the data to build a model of V CVn as a runaway star with dusty bow shock interacting with a pulsation-dependent dusty wind (Neilson et al. 2023). The polarization and position angle measurements are shown in Figure 1, and in Figure 2, we show a cartoon of our proposed model. We were able to develop this model by noting that if

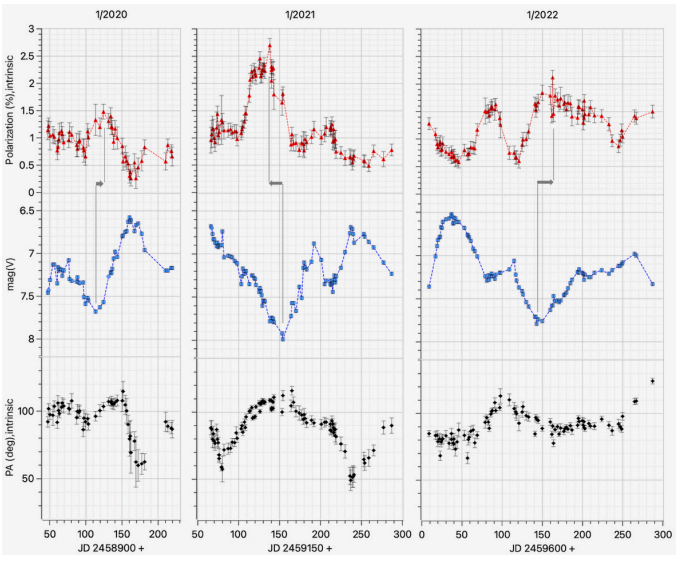

Figure 1 — Photopolarimetry of observed pulsation cycles. Intrinsic polarization curves in red are shown in the upper row. The light curves in blue are shown in the middle row. The intrinsic position angle (PA) is shown in the lower row in black. In all three, pulsation cycles polarization and photometry are generally anticorrelated, and this is especially true around times of brightness maxima and minima. However, the curves are not exactly anti-correlated as indicated by the gray arrows. Reproduced with permission from Astronomy & Astrophysics, © *ESO*

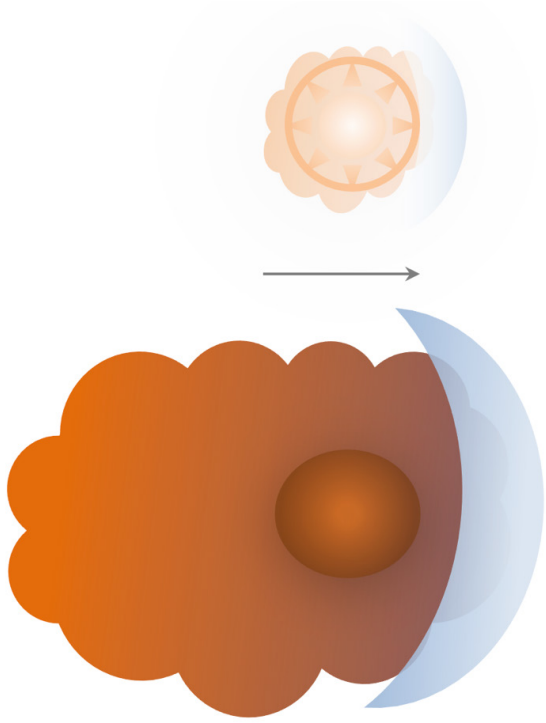

Figure 2 — Schematic representation of the interaction between the pulsating star and the bow shock. Top: at maximum brightness and minimum polarization, the dust is accelerated from the photosphere in a dense shell (circle) and the mass-loss rate is greatest. The star moves relative to the interstellar medium in the direction of the arrow. The wind shell is denser than the bow shock (light blue) and it dominates the fraction of scattered light. Bottom: around minimum light there is less radiative acceleration, and dust forms in the photosphere, while the mass-loss rate is much smaller. The shell formed at the previous flux maximum has expanded asymmetrically. The cloud-like structure of the dust envelope is supposed to show turbulence. A bow shock (blue) dominates the observed polarization and is incorporated into the smaller density CSM. A lead/lag of the polarization and the light-curve can occur if convection causes the dust density in the line of sight and in the bow shock to develop differently. Reproduced with permission from Astronomy & Astrophysics, *© ESO*

an unresolved star is seen with a large amount of polarization then there must be some structures like a disk or companion so that the unresolved system isn't circularly symmetric. However, because of the variability of the polarization and the fact that V CVn has a large proper motion, we are able to discount the presence of those structures and instead hypothesize a variable stellar wind. This result has spawned a new direction of research into a population of polarization variable stars.

However, I continue to have a challenge of what this column is about, is it radially pulsating variable stars, or any kind of variable stars? I am writing this column while sitting in Pearson Airport waiting for my flight home to St. John's. The day before I was in a meeting about an infrastructure project completely outside of astrophysics, but I was in the meeting with a group of Indigenous people as we all shared our understandings of star stories and constellations and how these stories are part of our Indigenous identities, languages, and our connections with the Land (I use the capital "L" here to highlight this is a relationship and connection with the Land as an animate being). I left the meeting feeling rejuvenated and hopeful, but most importantly, it reminded me that every star has a story, and most stars can have many stories. Some of these stories connect us to where we live or to our heritage—Indigenous or otherwise. Some of these stories tell us about the lives of stars, the formation of planets, and potentially life on those worlds; or those stories help us understand the expansion and acceleration of the Universe. Either way, every star tells a story.

So I guess this column is going to be that, a column about the stories of the stars and our connections to them as artists, scientists, and humans. I am going to write about some of the science we learn through one lens of the Two-Eyed Seeing methodology and about some of the ways we learn about the stars through an Indigenous lens. Mostly, this column will be about the stars, variable or no, but sometimes I might stretch the connection like a discussion on how variability might help us find evidence of extraterrestrial life. I will, almost certainly, write a hot-blooded rant about light and satellite pollution and how it is ruining the night sky and outer space. If you want spoilers, you can for free read online my contribution to the book Mythologies of Outer Space (ucp.manifoldapp.org/projects/9781773855882) by Jim Ellis and Noreen Humble, as well as contributions by Robert Thirsk, Chris Oak, space archaeologist Alice Gorman, and more. So, clear skies and bright stars until next time. ✶

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Dish on the Cosmos

Fast Radio Bursts Remain Mysterious

by Pamela Freeman
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It has already been an eventful year for the fast radio burst (FRB) community. On New Year's Day, two studies published with the Canadian Hydrogen Intensity Mapping Experiment (CHIME, Figure 1) telescope in British Columbia seemed to confirm the long-suspected origin of FRBs: magnetars. A mere three weeks later, another two studies from the CHIME collaboration, using a new CHIME companion telescope, presented a confounding result: a repeating FRB that originated near a dead galaxy, a place where astronomers do not expect to find FRBs or magnetars.

FRBs are, as the name suggests, millisecond-long pulses of radio emission. They are energetic, emitting the same amount of energy as the Sun does in days. Astronomers observe and classify FRBs by a frequency-dependent signal called a dispersion measure. While the burst releases radio waves across a broad range of frequencies, the plasma in between stars and galaxies slows the waves down, with greater effects at lower frequencies (JRASC April 2019).

Their supposed origin, so far, is based upon observed clues. Some are repeating—identical dispersion measures are seen at different times—meaning that the source cannot be a one-off event. A short duration means that it is coming from a small object, as a large one would need incredible synchronization for the observed pulse to be so short. The light is often polarized, with the observed waves vibrating in a defined plane, suggesting the source has an intense magnetic field. Putting all these together, one of the leading theories of FRB origins is is magnetized neutron stars. stars. Of these sources, there are two leading models. In one, FRBs come from within the star's magnetosphere as its magnetic field lines twist and turn until releasing excess energy in a burst. In the other, an energy flare released by the star shocks debris a large distance away from the magnetosphere, causing a burst of radio waves.

In 2020, bright pulses of radio waves were detected toward a magnetar, a highly magnetic neutron star, within the Milky Way. The close proximity meant the pulse appeared incredibly bright, brighter than extragalactic FRBs, even though the intrinsic brightness was lower. It also meant it was easier to pinpoint the source and collect follow-up observations. This magnetar was seen to produce an X-ray burst at the same time. Despite this novel connection, one source was not enough to certify that magnetars are the sole progenitor of FRBs, let alone to understand the exact powering mechanism.

The first new study of 2025, led by McGill doctoral student Ryan Mckinven, presented as the as-of-now non-repeating FRB 20221022A. This burst was almost thought to be a misclassification—it showed a change in polarization angle typical in pulsar data and rare in FRB data. In fact, it had never been seen in a one-off FRB before. The polarization angle describes the plane of vibration of radio waves and may change as a magnetic field rotates relative to our view; a magnetic field such as the dipolar one of a neutron star.

Mckinven and the team found the burst came from a galaxy 200 million light-years away. The companion study, led by Massachusetts Institute of Technology postdoctoral fellow Kenzie Nimmo, looked at how the light twinkled as it moved through the interstellar medium of the host galaxy and of our own galaxy. Radio waves scatter as they move through these turbulent media, leaving an imprint in both the time and frequency response astronomers see. Working back, the team found the scattering must come from a region within about 10,000 km of the source object, a size within the magnetosphere of a neutron star. This only strengthened the magnetized neutron star origin found in the Mckinven study.

The second pair of results, then, were all the more confounding. McGill doctoral student Vishwangi Shah led a study showing a collection of bursts from FRB 20240209A detected both from CHIME (22 times) and from a new CHIME outrigger k'ni?atn k'l_stk'masqt outrigger (KKO; 6 times), located 66 km from CHIME. The outrigger is a companion telescope allowing for better localization of objects in the sky using very long baseline interferometry (VLBI; JRASC June 2017). With interferometry, multiple antennae are connected to act as a single instrument, achieving a resolution related to the maximum distance—the biggest baseline—separating the antennae. The interferometric array mimics a single dish the size of the array. In the "very long" case, the telescopes used in the array aren't physically connected and can be thousands of kilometres apart. This allowed the pinpointing of this FRB to a cluster of old, dead stars orbiting a distant galaxy.

The galaxy was found to be a quiescent 11.3-billion-year-old galaxy in a companion study led by Tarraneh Eftekhari, a postdoctoral fellow at Northwestern University's Center for Interdisciplinary Exploration and Research in Astrophysics. This pair of results is unheard of for FRBs. It's the first time an FRB has been located outside a galaxy not forming stars and the farthest an FRB has been seen from a host galaxy. While astronomers suppose FRBs may come from diverse environments, this pair of results challenges the current idea that FRBs are connected to star-forming galaxies.

This connection relates to the magnetar origin of FRBs. A magnetar is thought to be a young stage of a neutron star since the magnetic field decays after about 10,000 years. It becomes inactive relatively shortly after the neutron star forms. Therefore, a magnetar wouldn't survive long, and especially wouldn't be found in a dead galaxy. Shah and Eftekhari's results produce another question, could there be a way to

Figure 1 — CHIME at night, near Penticton, British Columbia. The Canadian Hydrogen Intensity Mapping Experiment telescope in the Okanagan Valley, British Columbia, is a forefront instrument in fast radio burst science as it passively scans the Northern Hemisphere sky every day. Image credit Andre Renard, Dunlap Institute for Astronomy & Astrophysics, University of Toronto.

explain the presence of a magnetar near a dead galaxy? If magnetars could form through other mechanisms, such as a neutron star merger or the collapse of a white dwarf, they may not be isolated in young, active galaxies. There is nothing ruling out diverse sources of FRBs, either.

CHIME has propelled FRB research since it came online in 2018 through the detection of thousands of FRBs. That's 95 percent of all FRBs known. CHIME now has a total of three new outriggers, with KKO as well as outriggers in Green Bank Observatory, West Virginia, and Hat Creek Radio Observatory, California. The large distances between these outriggers will allow astronomers to localize FRBs with a precision of tens of milliarcseconds. They compare it to pinpointing an area in the sky the size of a quarter 40 km away. CHIME will be able to find, daily, exact galaxies where FRBs originate, ushering in a new era of fast-radio-burst science. The complete origin story of FRBs only remains mysterious for now. ✶

Read more on FRB 20221022A:

https://arxiv.org/abs/2402.09304
https://arxiv.org/abs/2406.11053

on FRB 20240209A:

https://arxiv.org/abs/2410.23374
https://arxiv.org/abs/2410.23336

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.

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Astronomical Art & Artifact

Léon-Charles Bienvenu's 1872 Satire on Urbain Le Verrier; Touchatout Mocks the Planet-Finder

by R.A. Rosenfeld, FRASC
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Abstract

This paper presents the first translation into English of a satire on Urbain Le Verrier, the discoverer of Neptune, by his contemporary "Touchatout" (Léon-Charles Bienvenu), a major satirist of the time. It testifies to both the cultural prominence astronomers could attain, and the bitter opprobrium they could attract (some of it well justified).

Not a Nice Man

Urbain-Jean-Joseph Le Verrier (1811–1877, Figure 1), co-discoverer of Neptune, was fortunate to have lived when he did. Celestial mechanics could offer the promise of ever better modelling of theory to match observation, positional astronomy could aspire to provide a sufficiency of dependable observations, and precision instruments to capture those observations had been developed. Le Verrier, mathematically gifted, dogged, and ambitious made the most of the opportunity, and caught a planet through the power of numbers.

He was also unfortunate to have lived during one of the great ages of satire. Arrogant, peremptory, and egotistical, he possessed the sort of unattractive personality attractive to satirists. The title chosen by his best modern biographer for his study of the man succinctly says it all: *Le Verrier: Savant magnifique et détesté* (or in the English edition *Le Verrier—Magnificent and Detestable Astronomer* (Lequeux 2009; 2013). It is an unhappy fact that his first administration of the Paris Observatory saw an extraordinary number of resignations and dismissals among staff at all levels (Lequeux 2013, 135–142). Of course, that is not the entire story. A young Arthur Schuster (1851–1934), charged with leading Lockyer's eclipse expedition to Siam (1875), encountered an unexpectedly helpful and solicitous Le Verrier at the Paris Observatory, when he spent time there to gain experience in handling astronomical instruments (Schuster 1932, 198–201). But on the whole, it would seem more people would have agreed with the physicist Alfred Cornu (1841–1902): "I cannot say whether M. Le Verrier is the most detestable man in Paris, but I do know that he is the most detested man in Paris" (Schuster 1932, 198–199).[1]

Figure 1 — Portrait of Urbain-Jean-Joseph Le Verrier (1811–1877) as he appeared in 1858, from Flammarion 1911, 141. Wood engraving reproduced courtesy of the Specula astronomica minima.

The Satirist

Léon-Charles Bienvenu (1835–1910) was a well-known and prolific literary satirist in Paris of the 1860s–1880s (Larousse 1876, 331). He wrote under the *nom-de-plume* "Touchatout." Less famous now in the English-speaking world than the caricaturists Honoré Daumier (1808–1879) and "Grandville" (the *nom-de-plume* of Jean Ignace Isidore Gérard, 1803–1847), his was an influential voice in his day, particularly as a critic of Napoléon III and his imperial government. Touchatout was not a friend of authoritarian regimes of any sort. Hence Le Verrier, a supporter of the emperor and political beneficiary of his patronage, was a natural target for the satirist.

Touchatout's style of satire was far from the most biting of the period, but it still brought him attention from the state's censors. He would frequently start with some facts about the subject's life, then colour their circumstances toward the absurd, or skew their original significations. He also liked to progressively increase the level of absurdity as his paragraphs

Figure 2 — Caricature of Le Verrier from Touchatout's Trombinoscope 62 (1872 November). Woodcut reproduced courtesy of the Specula astronomica minima.

approached their ends. Aspects of his writing can appear quite opaque now due to their extreme topicality (it is possible that the key to unlocking the identity of some of the figures in his satire of Le Verrier lies in his other satires). The notes to the translation attempt to resolve some of the obscurities and indicate the nature of Touchatout's artful exaggerations.

The first page of the satire is reproduced in James Lequeux's fine biography of Le Verrier, but it is not discussed there (Lequeux 2009, 54, fig. 3.1; Lequeux 2013, 57, fig. 3.1). Unfortunately, it is misidentified as having been published in *Le charivari*¸ one of the leading satirical publications of the time. Touchatout did write for *Le charivari*¸ and Le Verrier was satirized in its pages, but this satire appeared elsewhere, namely in Touchatout's own *Trombinoscope* (Figure 2).

This is the first complete translation of the satire into English. Previously two sentences dealing with the itinerant astronomer of the *Place de la Concorde* appeared in English translation in David Aubin's informative article on street telescopes in 19th-century Paris (Aubin 2017, 137).

This satire can give a taste of how a 19th-century astronomer famous for a sensational discovery was far from popular as a public figure. This was doubtless compounded by the tradition of greater political involvement of astronomers in France (particularly Paris) than elsewhere (think of Bochart de Saron, Jean Sylvain Bailly, and Laplace). The contrast with Le Verrier's earlier and later partial analogues William Herschel and Clyde Tombaugh is striking.[2] No astronomer from our day seems to have attracted such attention from an influential satirist—which may be more a result of lack of cultural significance than anything else. Perhaps that's a good thing.

The Translation

LE VERRIER (Urbain-Jean-Joseph), celebrated French astronomer, born at Saint-Lô (Manche), on the 11th of March 1811.[3]

People say that he demonstrated his astronomical vocation very early. While still in his mother's womb, when she wandered at night by the light of the Moon he stirred so much that he gave her stomach cramps, and, as it caused her to yawn frequently, he took the opportunity to raise his head to comfortably study the stars through the opening which he had caused through malice.

Later, when suckling, he outlined a world map on the breasts of his wet nurse.

In 1833 he left the École Polytechnique with high standing, which enabled him to have his choice of employment in the public service; yet what was the astonishment of his parents when he chose the administration of tobacco.[4]

M. Le Verrier had his plan—he wanted to remain in Paris to devote himself with more ease to the study of the sciences. The night he wandered onto the *Place de la Concorde* he had telescope orgies in the open air. The fellow who hired out his instrument to passersby had dreadful quarrels daily with the young savant, who asserted that for his two sous he had the right to monopolize the refractor for three hours.[5] Even then he had the amiable character of a man who has walked six leagues without sitting down, in boots that are too tight. When the old man who owned the telescope begged him to withdraw to give other clients their turn, he clouted him with his umbrella, saying: "Leave me be! Have I not payed you for the lease of your glass trombone?"[6]

Afterwards he was engaged in astronomical problems, addressing several memoirs to the Académie des sciences, proving that the course of the planets was assured indefinitely, contrary to other scientists who had calculated only as a result of the deviations of several stars (*notable merchants*), the 22nd of March 9875, at forty-two minutes past one in the morning, the inhabitants on the block of the *Châtelet* would awake with Jupiter on his stomach, while Saturn and Uranus, piling up with the Earth at the height of the Place des Ké-tad-Krétins in Peking [=Beijing], which would flatten our globe to the point of making it look like Mademoiselle Sarah Bernhardt.[7]

The debtors, who had reckoned on the end of the world freeing them from their creditors, were dismayed at the discovery by M. Le Verrier; and if the *Tintamarre* is to be believed, an hunchback offed himself, preferring to leave the Earth since he no longer had hope that an impact would flatten the poles for him.[8]

He twice presented to the Académie des sciences a memoir which indicated nearly to the second the moment when the comets of 1770 and 1843 would appear again.[9] This new success earned him nomination to the Académie; yet a disgrace arose in the midst of his triumphs. He received the following letter from a stranger: "Monsieur…you who know how to pronounce to the second when a comet will touch some spot, tell me, then, the mere trifle when I myself will touch the first dividend of my galleons from Vigo?"[10]

A *tour de force* of M. Le Verrier was to define exactly the course of the planet Mercury and that of the planet Uranus.[11] He showed their itineraries in a marvellous manner. It was almost as if he were leading them with his finger.[12] Besides, he joined a monstrous modesty to his immense talent. One day someone pointed out to him a wholly trivial deviation between the real course of Uranus and the itinerary which he had pronounced. He did not hesitate to respond: "What does that prove? It is Uranus which has gone off course!"[13] But a success important in a rather different way awaited M. Le Verrier, although he was not called upon to lower the rate of rents. For some time the illustrious astronomer suspected that a till-then-unknown planet existed. After numberless calculations he succeeded in determining its course, and he affirmed without hesitation that on the 1st of January next this planet would come within our reach, by attending a dinner put on by one of her sisters-in-law. Real observations were arranged. At all the points of the globe astronomers directed their telescopes, after having been careful to disguise themselves as ticket agents, so as not to frighten-off the planet while awaiting its passage. The poor little thing which had travelled without suspicion through the vastness, and hardly suspecting that she was being tailed, was discovered at the corner of a cloud on the 23rd of September, 1847, by M. Galle, a German astronomer.[14] She was immediately baptized with the name Neptune, without anyone having taken the time to throw the lightest of veils over her charms. It is not gallant, when old men conceal themselves like this to watch scarcely clothed planets.[15]

At word of the discovery of a new planet the excitement in Europe was immeasurable. M. Le Verrier was decorated with the *Légion d' honneur*.

The priority of his discovery was contested, however. It was established that M. Adams, a young English savant, had pointed out the existence of Neptune as early as 1841.[16] This gave rise to sharp contention on the topic, and opinion was very divisive. At one time it seemed as if the two astronomers would wager Neptune, drawing straws to settle the disagreement; but M. Le Verrier, whose character became more and more incorrigible, refused outright, saying: "When M. Adams saw me look into the sky, he should have said to me "Share and share alike!," as is done with ten sous pieces found on the footpath."

In 1848 M. Le Verrier detached himself from the things above, and harboured a desire for a role in politics. A *department* returned him to the legislative assembly.[17]

It is scarcely necessary to say that M. Le Verrier showed himself to be all that is inimical to the Republic. On the one hand his despotic character portrays him as both selfish and egotistical; on the other hand the Republic was a star whose advent he had not reckoned, and, as an acutely self-respecting savant, M. Le Verrier would rather be eviscerated than admit that something had come to pass which he had failed to predict.

When the conflict arose between the President and the Assembly, M. Le Verrier decidedly placed himself on the side of the *Elysée*, and after the *coup d'Etat* he was among the first promoted, being named a senator.[18] This coincided with François Arago's refusal to take an oath to the Empire. It seems that there are savants, and there are savants; there are the Aragos who honour their oaths, and there are the Le Verriers, who are corrupted by being made senators. The latter, when their sovereign demands to know at what hour an eclipse will start, answer: "Sire, it merely awaits your command!"[19]

Upon the death of Arago, M. Le Verrier was selected to replace him. During fifteen years as Director of the Observatory he fulfilled his duties with the amiability of a bulldog, in conformity with his character.

Every day witnessed excessively lively scenes between him and those in his vicinity. The press felt obliged to become involved in an attempt to bring the savant to his senses. He constantly had the air of someone who believed the world was out to steal his planet out from under him. In sum, the *Tintamarre* published the following reflection: "It is always easier for M. Le Verrier to observe the stars than to observe proprieties."

Finally, the protests became so universal that M. Le Verrier was removed from office at the beginning of 1870—after having been promoted to Grand Officer of the *Légion d'honneur*.[20] Since that time he has been very miserable, not having anyone on hand but his *concierge* on whom to regularly unleash his ill-temper.

As to appearance, M. Le Verrier is as unpleasant as one can imagine. Likewise, in the moments when he assumes the look of someone who is most amiable, he has the sweet expression of a man who has happened to swallow 30-grams of oil of ricin, with some remaining between his teeth.[21]

Being contemplated every day by a so ungraceful a face, Neptune must have the patience of an angel not to stick out his tongue.

November, 1872.

SUPPLEMENTARY NOTE

—dates to be filled in by the collectors of the *Trombinoscope*—

M. Le Verrier continues to study the stars. The Moon, impatient with his increasingly sullen expression, opted in the end to turn her back on him nightly, which annoyed the mayor of Nanterre, who used to count on her so that he could avoid turning the gas on eight days out of every month.

Finally, the… 19… M. Le Verrier died of grief when he learned that there was a man named M. Baze, whose reputation as a grump threatened to diminish his own. ✶

Acknowledgements

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Endnotes

1 "*Je ne sais pas si M. Leverrier* [sic] *est l'homme le plus détestable à Paris, mais je sais que c'est l'homme le plus détesté.*"

2 Herschel was subject to some satire, but most of it was by figures of little influence; Cunningham 2018, 337–345.

3 In Le Verrier's day Saint-Lô was the prefecture of the department of Manche in north-west Normandy. His family is occasionally said to have belonged to the lower reaches of the *petit noblesse*; his father's employment was in estate management; Aubin 2014, 1315; Lequeux 2013, 2. No ancestor appears to have distinguished himself in science.

4 Le Verrier was first refused entrance to this *grande école* in 1830 despite his perceived brilliance, but he was successful the following year. At graduation he achieved high, though not stellar standing; Lequeux 2013, 2. It is worth noting that Touchatout did not make use of these facts as fodder for his satire, but perhaps he already had a treasure trove with which to work. Missing from Touchatout's account is any mention that Le Verrier's particular training was in chemistry, and that he'd graduated from the *Polytechnique* as a member of the *corps des ingénieurs des Tabacs*; Lequeux 2009, 2. Le Verrier's

early professional interest in chemistry might bring to mind John Herschel's life-long affinity with the subject, although the comparison cannot be perfect as Herschel never had to work as a professional in chemistry, and Le Verrier's interest seems to have withered when he took up celestial mechanics; Wilder 2024, 160–164.

5 The *sou* was the common name for a fairly low denomination coin, worth 5 centimes. A contemporary cultural equivalent would be the shilling in the United Kingdom (though it was worth comparatively more than the *sou*), and a present-day cultural equivalent would be the Canadian nickel, or even the penny (as in Québec); Amandry et al. 2001, 557. Camille Flammarion provides some interesting details on the itinerant street astronomers of 19th-century Paris—apparently they had their own corporation! Anon. 1980, 13. The itinerant astronomer of the Place de la Concorde, who went by the name "Rigal," was quite well-known, and there was a story, probably apocryphal, that Le Verrier took Otto Struve to look through Rigal's telescope; Aubin 2017, 137–138. Flammarion had fond memories of Rigal and his telescope; Flammarion 1911, 160.

6 Le Verrier's insult to the street astronomer's instrument, calling it a "glass trombone," is a play on the name of Touchatout's periodical, the "Trombinoscope."

7 Le Verrier's early publications on the stability of the solar system led him to exactly the opposite conclusion for the inner planets; Lequeux 2013, 8. It is hard to unravel the meaning of this paragraph, which becomes more absurdist as it proceeds. To knowing contemporaries it may well have conveyed thinly veiled topical satire, but for us, the passage of time has shifted it to the opaque end of the spectrum of intelligibility. Who are the "several stars (*notable merchants*)"? "The inhabitants on the block of the Châtelet" could refer to the Palais de Justice. As for Sarah Bernhardt (1844–1923), she was one of the most famous actors of the day. Bernhardt appears to have had no particular interest in astronomy, and no astronomer of note seems to have experienced a social periastron close to her circle; Bernhardt 1999; Gottleib 2010. It is possible that Touchatout is alluding to her reputation for being thin(!); Bernhardt 1999, vii, ix, 174, 234.

8 Two among the possibilities for the identity of the "hunchback" are: 1. Charles-Joseph Traviès' (1804–1859) satirical creation "Mayeux the hunchback;" and 2., Alfred Joseph Naquet (1835–1916), an actual research chemist and politician; Wechsler 1982, 84; Farewell 1989, 149; Portalez 2022. The *Tintamarre* is another one of Touchatout's publications.

9 This paper on cometary orbits was an impressive investigation, but what it didn't do was indicate "nearly to the second the moment when the comets of 1770 and 1843 would appear again"—rather, it established which cometary apparitions could not be identified with those comets, and the role of possible perturbations in altering orbits; Lequeux 2013, 16–18.

10 This may be a reference to the sunk "Silver Fleet" lost by the Spanish to an Anglo-Dutch fleet at the Battle of Vigo Bay 1702 October 23, as part of the War of the Spanish Succession (1701–1714). It functions here as part of a request for a prediction even too difficult for Le Verrier, hence as a mood-spoiler for him. Touchatout seems not to have realized that this serves his purpose poorly, as Le Verrier could easily have modelled a probability in answer to the request!

11 Le Verrier's early work on the theory of Mercury was indeed impressive, but he did not "define exactly the course of the planet;" its value was rather in furthering understanding of the deficiencies in the existing theory and improving its terms and predictive power. He did this several times. Seen in hindsight, his most important contribution was the discovery of the anomalous perihelion advance of the planet, but his proposed Neptune-like cause of the anomaly, the inter-Mercurial planet Vulcan, ultimately proved less happy; Roseveare 1982, 20–37; Baum & Sheehan 1997.

12 This has more than an echo of the elegant words attributed to François Arago, that Le Verrier had discovered the planet "*du bout de sa plume*" ("on the tip of his pen"); Lequeux 2009, 47.

13 One is reminded of Einstein's reply when someone asked him how he would have reacted if the 1919 British eclipse expeditions' value for the deflection of starlight had confirmed the Newtonian figure rather than the one predicted by the General Theory of Relativity: "*Da könnt' mir halt der Hebe Gott leid tun. Die Theorie stimmt doch*" ("Then I would have to pity the dear Lord. The theory is correct anyway"); Pais 2005, 30.

14 Johann Gottfried Galle (1812–1910); Freiesleben 1981.

15 A clear reference to the biblical legend of Susanna and the elders, which would have been well-known to Europeans of the time; Liber Danielis 13: 15-27. And the fluidity in gender when referring to the planet seems to be deliberate on Touchatout's part.

16 For Touchatout, Adams is a handy whip with which to beat Le Verrier on the steps of his club, as it were. Adams did indeed wonder in 1841 whether an undiscovered planet exterior to Uranus might be the cause of the disagreement between the theory of its motion and observations, but that is not the same thing as his having "pointed out the existence of Neptune," for at that time he had yet to perform the mathematical analysis in support of a prediction leading to discovery; Sheehan 2021, 119–122.

17 His election as one of the deputies for La Manche took place in 1849, rather than in 1848; Lequeux 2013, 69.

18 This happened early in 1852, and he served as a senator until the fall of Napoléon III's reign in 1870. This was nearly concurrent with his first Directorship of the Paris Observatory 1854–1870; Lequeux 2013, 71. On the *coup d'état* see Lagoueyte 2016. The *Elysée* refers to the *Elysée* Palace, the official residence of the President of the Republic, and functions here as a metonym for the government in power.

19 François Arago (1786–1853), Le Verrier's predecessor as Director of the Paris Observatory. The personalities and politics of the two could not have been more different. Arago's refusal to take the oath of allegiance to the usurper Napoléon III, and the clever way he went about it, was lauded by people such as Victor Hugo; Lequeux 2016, 53–54.

20 Lequeux 2013, 173–207. Touchatout's satire was published before Le Verrier was reappointed as observatory director 1873–1877.

21 A powerful toxin found in the seeds of the castor bean plant (*Ricinus communis L.*). The poison features in some classic crime fiction, such as "The House of Lurking Death" in Agatha Christie's *Partners in Crime* (1929). On the toxin see Cherwonogrodzky et al. 2014.

Blast from the Past!

Compiled by James Edgar
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Magnetic Disturbances Recorded at the Agincourt Observatory

By R F. Stupart

A series of magnetic disturbances were recorded at the Agincourt Magnetic Observatory February 6-9, 1907, during which period the sun showed remarkable disturbances as evidenced by spots, and some very beautiful aurorae were observed in various parts of the Dominion.

The magnets were somewhat disturbed after 21h February 6, and small movements continued during the night. At 3h 56m on the 7th the declination needle began a westerly movement, and in 21 minutes had passed through an arc of 45′.2. A sharp return movement followed lasting for 29 minutes, when another abrupt westerly movement occurred through an arc of 28', and then a somewhat slower easterly movement, which by 4h 43m gave a declination 10′ east of that recorded at 3h 56m. By 9h 30m the magnet was steady at a nearly normal position.

The movements registered on the evenings of the 7th and 8th were quite remarkable. They had somewhat similar characteristic features, and occurred at approximately the same hour on consecutive days. On the 7th the extreme easterly reading was reached at 20h 29m and the extreme westerly at 20h 35m 7s, and on the following day the extreme easterly at 20h 14.4m and westerly at 20h 30m, a change of 56′ occurring in 14.5 minutes. Several irregular movements of both the declination and the horizontal force magnets occurred during the early hours of the 9th, and then suddenly at 9h 10.5m a disturbance of large dimensions set in. Until about 14h the force was below its normal value and afterward generally above for seven hours, during which interval the bifilar magnet made some eight large excursions, and in five instances the record was beyond the limit of the paper. The largest movement in declination occurred between 20h 43.6m and 21h 0m, when a change of 1° 4′ was recorded.

The changes above described are shown by the accompanying diagrams. ✶

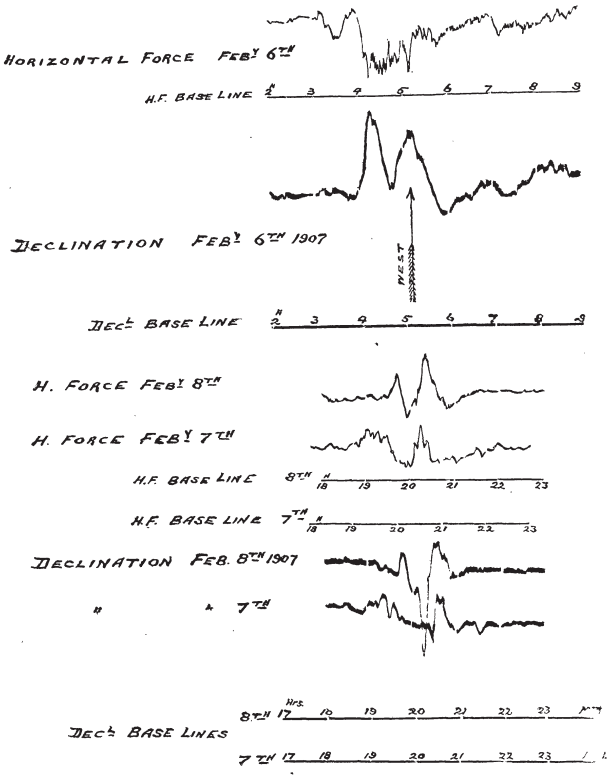


Figure 1 — Disturbed Magnetic Curves, February 6, 7, 8, 1907 Agincourt Station of Toronto Observatory.

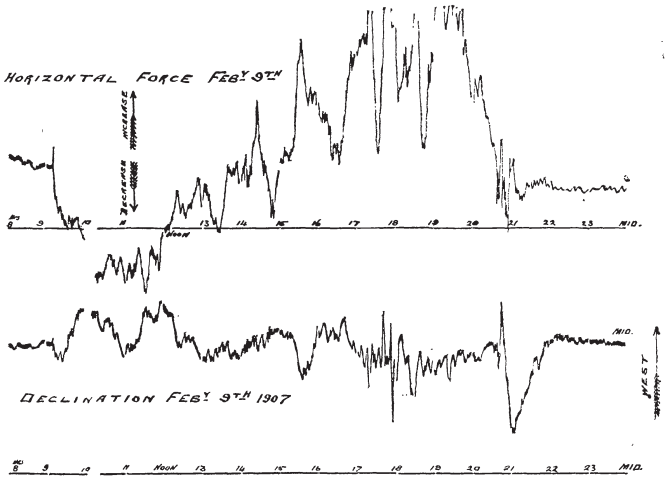


Figure 2 — Horizontal Force and Declination Curves for February 9, 1907. Scale for H.F., 1 mm. = 0·000207 dyne; for Decl., 1 mm. = 5′.88.

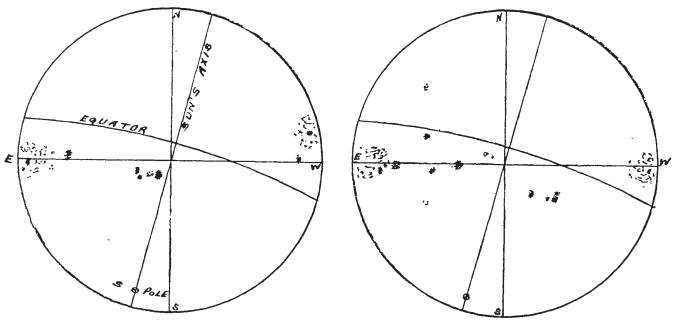
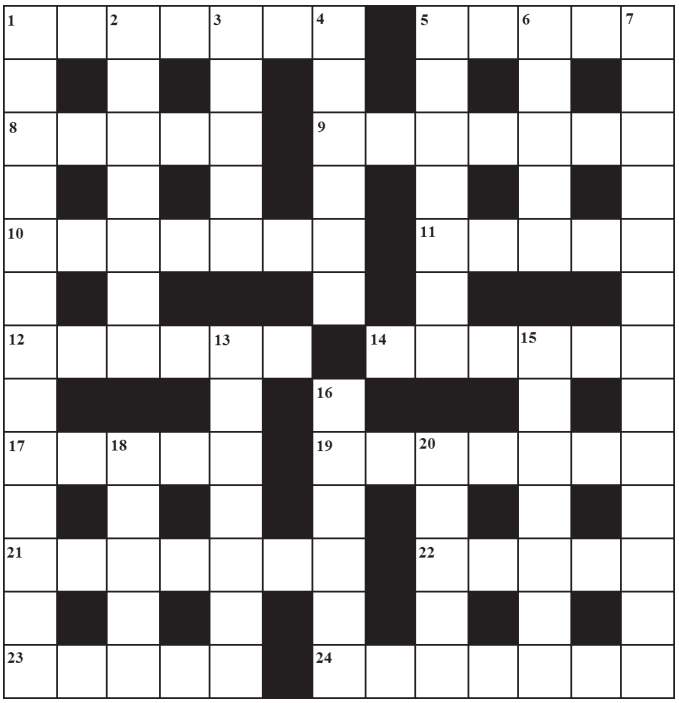


Figure 3 — The Sun's disc as sketched with the 6-inch refractor of the Toronto Observatory.

R.F. Stupart was Director of the Toronto Observatory and Superintendent of the Dominion Meteorological Service (1894–1929) and President of the Society (1902–03).

Astrocryptic

by Curt Nason



ACROSS

1. Apollo's last place near Taurus (7)
5. After time, Ryle turns nominally to Olcott's middle (5)
8. Home of the wonderful star and maybe Jonah (5)
9. Relative humidity leads to great dislike in the periodic table (7)
10. Wise man appeared around a conjunction to assist Hubble (7)
11. Bald flier passes overhead on summer nights (5)
12. Labyrinth escapee fell into near-Earth orbit (6)
14. Radio source from Paul's broken Radiohead tape (6)
17. Table of misspelt names in the Deep South (5)
19. Feel bad returning to lost hope around Uranus (7)
21. Source of grease and fusion in brown dwarfs (7)
22. Bad habit without end tails head of Draco in head of Capricornus (5)
23. An asteroid perhaps dooms this ancient city (5)
24. He found Triton and Ariel in first class elliptical orbits (7)

DOWN

1. Claus: His email lunatic password is Winterlake (5,8)
2. It ain't a spinning comet seen around Uranus (7)
3. Jamaican deist that became a star (5)
4. We're strangely hugging a nurse in a hole near the Lunar X (6)
5. Walden resident has French water after Thursday, nominally (7)
6. In repose, eclipse chaser Alister is seen around the gym (5)
7. Charlize and Erma with a curvy valley north of X (5,8)
13. With 92 at the table it nominally inspired a planet (7)
15. The Sun turns blue when dispersed in water (7)
16. Frenchman left Germany to teach Tycho (6)
18. Recorded observation without help from Theodore (5)
20. Pluto's counterpart hidden in the shade (5)

Answers to previous puzzle

Across: **1** STAR-CROSSED (2 def); **9** AIRGLOW (anag+w); **10** GHOST (2 def); **11** MIZAR (homonym); **12** RITCHEY (R(itch)ey); **13** RADIAL (2 def); **15** BARRED (2 def); **19** ELEMENT (2 def); **21** DYSON (2 def); **22** HAEDI (anag+i); **23** FINDERS (2 def); **24** ORION NEBULA (anag)

Down: **2** TARAZED (rev+a+z+e+d); **3** RULER (anag); **4** REWARD (rev); **5** SAGITTA (rev+Itt+a); **6** EPOCH (re(c)v); **7** BALMER (anag); **8** STAY (2 def); **14** ARECIBO (2 def); **16** RUSSELL (hid); **17** DANISH (2 def); **18** STEFAN (an(TE)ag); **19** ECHO (ec+OH(rev)); **20** EMEER (em+e+ER);

21 DENEB (d(ENE)B)

The Royal Astronomical Society of Canada

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To be Canada's premier organization of amateur and professional astronomers, promoting astronomy to all.

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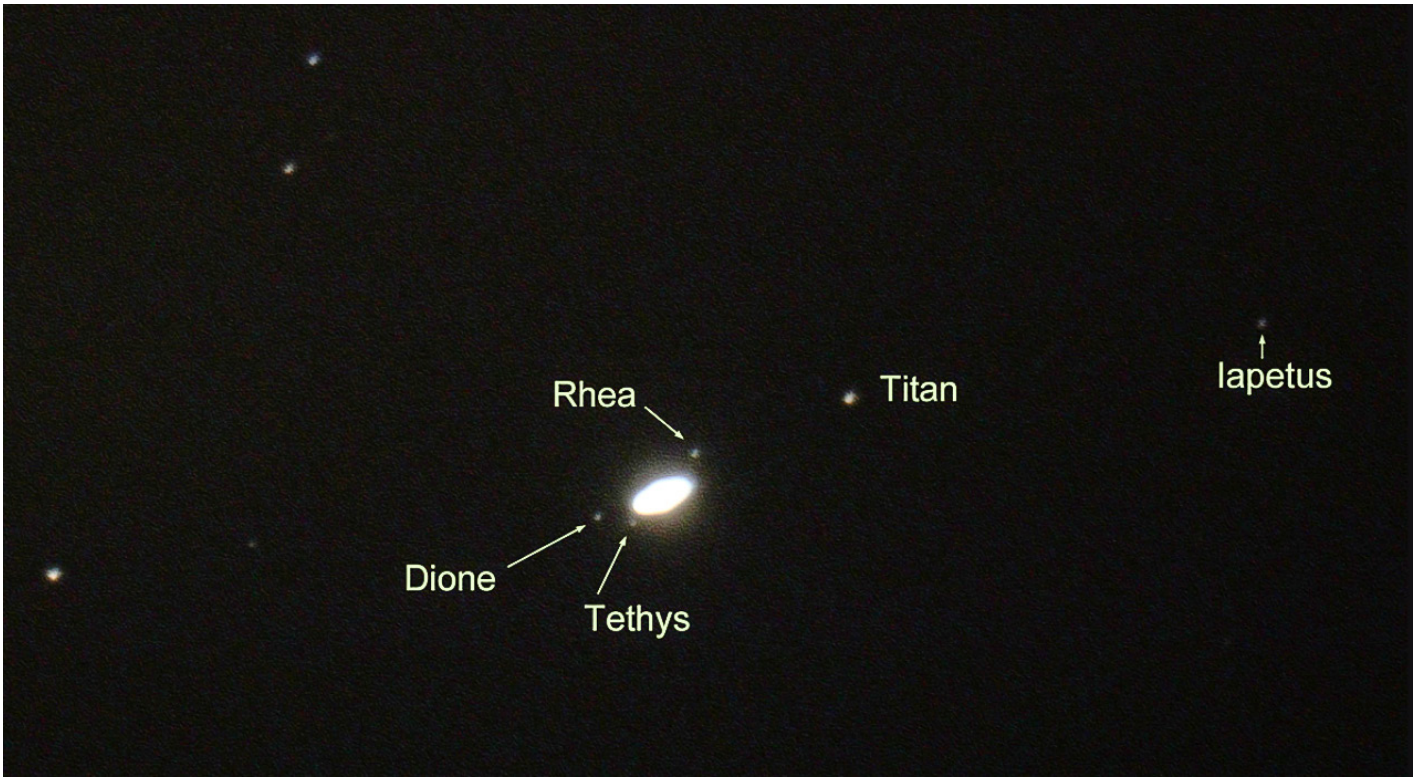
Great Images

By Richard Taylor



Richard Taylor of Ottawa Centre writes: I was pleasantly surprised at how many of Saturn's moons could be captured with the right conditions and post processing. I'm still working on getting a good image of Saturn's rings.
Date: 2021 September 16, 20:08 EDT
Location: Carlington, Ottawa, Ontario
Equipment: B&L 8" SCT, Canon M100 camera, wedge mount with motor
Settings: 2s, ISO-800, single image
Processing: Photoshop Elements for brightening, labelling, and cropping. Stellarium was used to identify the moons.

Journal

NGC 7000—the North America Nebula in the constellation Cygnus, next to the bright star Deneb. Tom Owen of Edmonton Centre writes: My Takahashi was used with focal reduction. Six combined subs with a total exposure of 38 minutes; early in the morning 2017 September 29. I would have liked more, but the balance weight jammed up against a tripod leg and killed the tracking. So it goes. But I do like how the Cygnus Wall is the most intense red in this image.