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THE HEART OF THE SUMMER MILKY WAY BY DARREN FOLTINEK

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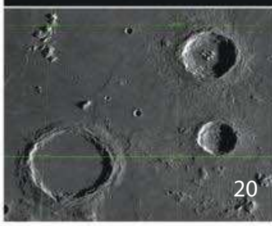
CONTENTS



DEPARTMENTS

FEATURES

COVER: Getting away from it all to soak up the starlight is every astronomy enthusiast's dream. You can camp on your own or attend one of the star parties listed on page 42. Darren Foltinek of Calgary, Alberta, made this evocative self-portrait while on a camping trip at Gooseberry Mesa, Utah.

VISIT US AT **skynews.ca**

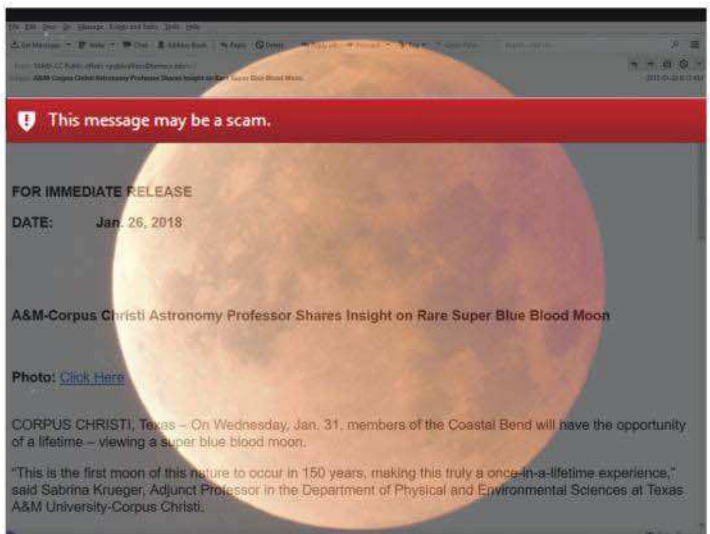
by GARY SERONIK

SHOOTING THE MESSENGER

There's a fine line between enthusiasm and hype

"THIS MESSAGE may be a scam," my computer warned me when an e-mail from Texas A&M University-Corpus Christi arrived. The press release proclaimed the January 31 total lunar eclipse as a "once-in-a-lifetime experience" because it occurred when the Moon was both "blue" and "super" at the same time, yielding a "super, blue, blood Moon." Wow!

Sadly, Texas A&M wasn't the only source hyping the eclipse. Even NASA got in on the "super, blood, blue Moon" game. And once credible organizations join the hype brigade, it's game over. The sensationalism is repeated and amplified downstream by media outlets that get their astronomy information secondhand. The hyperbole is baked in, along with whatever errors happen to creep into the mix. One "fact" I saw repeated over and over was that a "supermoon" is 14 percent larger than usual. It's not true. Owing to our satellite's elliptical orbit, the Moon is 14 percent larger at perigee than at apogee, when it's smallest. Since the Moon usually isn't at one of these extremes, the difference between a supermoon and an average one is at best around 7 percent. Indeed, for all of 2018, the difference spans just 6 percent. Not that exciting in either case.



SUPER, BLOODY AND BLUE The hype surrounding the recent total lunar eclipse threatened to eclipse the event itself. This press release was typical of the coverage. BACKGROUND PHOTO BY GARY SERONIK

Even the "once-in-a-lifetime" aspect of this eclipse was built on a foundation of Jell-O. A "blue moon" is usually thought of as the second full Moon in a calendar month, though this is actually a misunderstanding of the original (admittedly convoluted) definition from *The Old Farmer's Almanac*, Maine Edition, 1937. The definition of "supermoon" is even less solid. Broadly, it refers to the Moon being full while it's also at perigee, which is why the term "perigean" full Moon is more accurate. However, the amount of time that can pass between these two specific events for a Moon to still be considered "super" is elastic, to say the least. Indeed, for the January 31 full Moon (and eclipse), perigee occurred more than 27½ hours earlier. If your definition is generous enough, you could describe half the full Moons in a year as "super."

Within the parameters set out in its press release, Texas A&M's description of a "once-in-a-lifetime" lunar eclipse wasn't exactly wrong, but it also wasn't right. Every single day, each of us does trivial things that could be described as "once in a lifetime," yet we tend not to take note of them. In other words, a rare event isn't necessarily an important one. The crux of the matter regarding last winter's eclipse concerns whether the two secondary factors resulted in something not only unusual but significant in some way.

Don't get me wrong—I think lunar eclipses are simply amazing. They're always visually arresting and a wonder to behold, particularly when we consider the celestial mechanics behind them. Isn't that enough? Was the experience of watching the January 31 eclipse greatly enhanced because the Moon happened to be full for the second time that month or because the Moon was slightly closer than usual the day before? Not to my eye. The whole business brought to mind last August's stunning total solar eclipse—another "once-in-a-lifetime" event needlessly hyped. According to a report I read, the property owners at one observing site set off fireworks during totality—as if the most stunning sight in all of nature needed a little jazzing up.

So why does any of this matter? Anyone familiar with the fable of the boy who cried wolf (or, the astronomical version, The Boy Who Cried Kohoutek) knows the answer. It's understandable that as astronomy enthusiasts, we want to share our sense of wonder and excitement with others. It's fun and often very rewarding. And the universe undeniably *is* amazing. But when people's expectations fall out of sync with reality, everyone loses. We in the astro community lose credibility, and the public becomes incrementally more cynical not just about space science but about science in general. When observable reality and "this message may be a scam" become indistinguishable, trouble follows. We live in a time when more people need to become engaged with science so that we can properly grapple with the many complex environmental challenges that confront us. While overselling a lunar eclipse isn't going to lead directly to an existential crisis, it's one more straw on the proverbial camel's poor aching back. ✦

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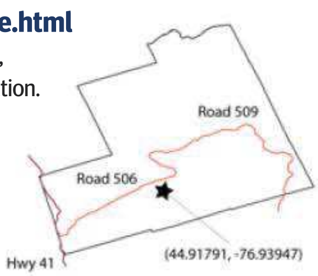
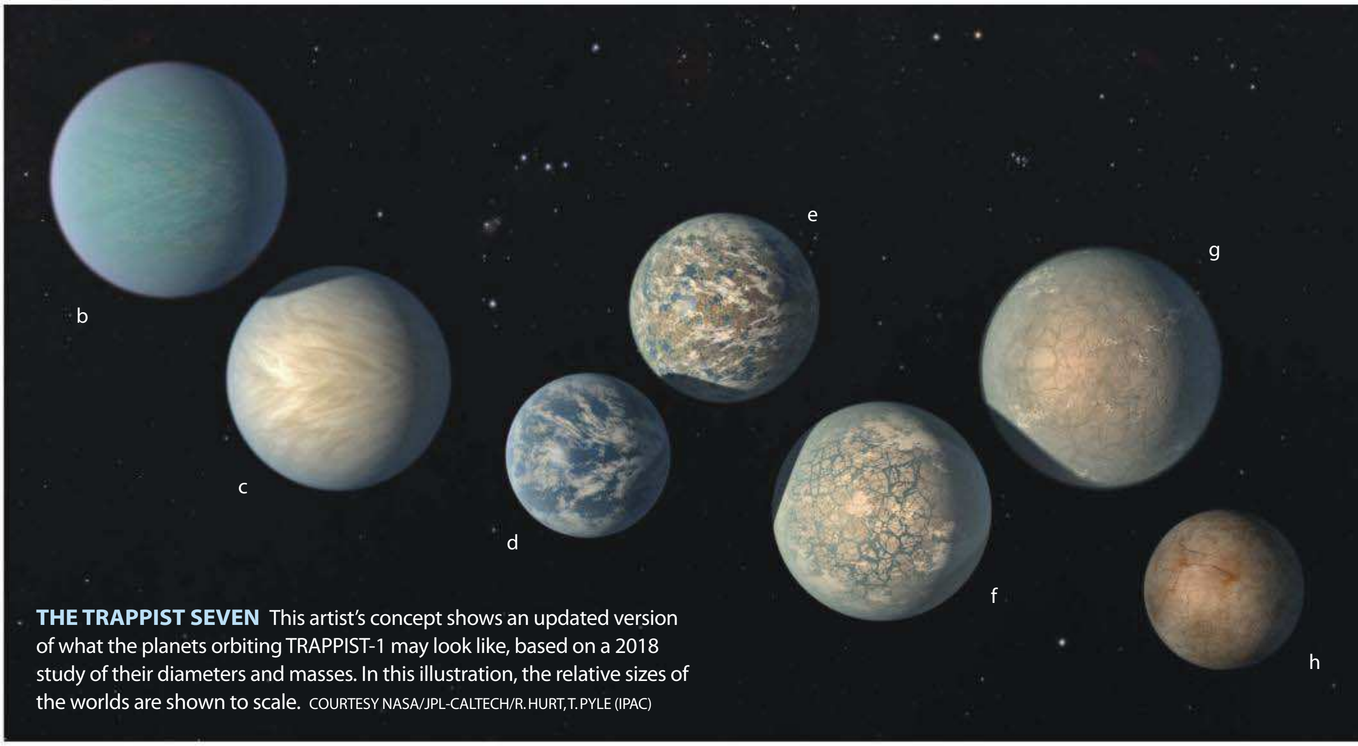




THE TRAPPIST SEVEN This artist's concept shows an updated version of what the planets orbiting TRAPPIST-1 may look like, based on a 2018 study of their diameters and masses. In this illustration, the relative sizes of the worlds are shown to scale. COURTESY NASA/JPL-CALTECH/R. HURT, T. PYLE (IPAC)

A PLANETARY GOLD MINE

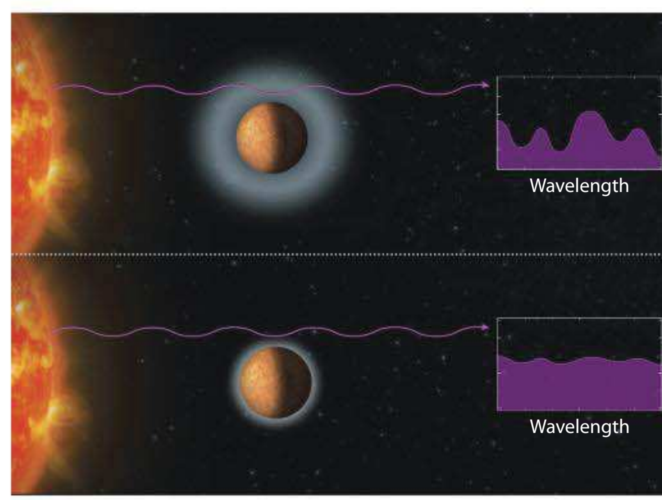
A MERE 40 LIGHT-YEARS AWAY, seven planets the size of Earth orbit a red dwarf star called TRAPPIST-1. "No one ever would have expected to find a system like this," says Hannah Wakeford of the Space Telescope Science Institute. "It's a gold mine for the characterization of Earth-sized worlds."

As part of a team led by Julien de Wit of the Massachusetts Institute of Technology, Wakeford used the Hubble Space Telescope to probe the atmospheres of TRAPPIST-1d, e, f and g—planets orbiting in or near the star's habitable zone (a region around a star where surface water can exist as a liquid). The data obtained rule out hydrogen-rich atmospheres for three of the planets, but the results for TRAPPIST-1g were inconclusive.

"One of these four could be a water world," explains Wakeford. "One could be an exo-Venus, and another an exo-Mars. It's interesting because we have four planets that are at different distances from the star. We can learn a little bit more about our own solar system because we're learning about how the TRAPPIST star has impacted its array of planets."

In a separate study, Simon Grimm of the University of Bern and his team applied computer modelling to all the available data to better establish the densities of the seven TRAPPIST-1 planets. Their data, combined with composition models, strongly suggest that these are not barren rocky worlds; rather, they seem to contain significant amounts of volatile material (possibly water)—in some cases, amounting to nearly five percent of the planet's mass. By comparison, the Earth's volatile water content (atmosphere, oceans, ice) comprises less than 0.1 percent of our planet's mass.

Surprisingly, TRAPPIST-1e, orbiting just inside the outer edge of the habitable zone, is the only planet slightly denser than Earth. This suggests it might have an iron core and may lack a thick atmosphere, ocean or ice layer. In terms of size, density and the amount of radiation it receives from its sun, TRAPPIST-1e is the planet most similar to Earth. Yet it's a puzzle as to why it's denser, by a significant margin, than its siblings.



GOT ATMOSPHERE? Using the Hubble Space Telescope, researchers analyzed light from the star TRAPPIST-1 as it passed through the atmospheres of four Earth-sized planets. The top graphic shows an expected model spectrum if the exoplanets' atmospheres were puffy and dominated by hydrogen. The flat spectrum, above, resembles what Hubble actually observed. The researchers concluded that the planets' atmospheres consist of heavier elements residing at much lower altitudes than could be measured by Hubble. COURTESY NASA/ESA/Z. LEVY (STScI)

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by PAUL DEANS

BURSTS OF MYSTERY

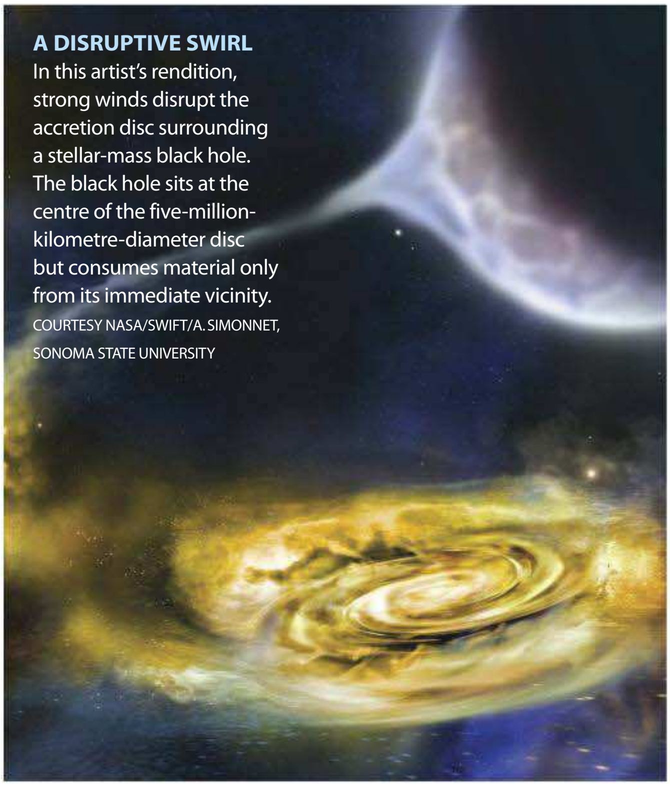
FAST RADIO BURSTS (FRBs) are brief blasts of radio waves originating far beyond our galaxy. Two dozen FRBs are known, and all but one of them are single-burst events. In November 2015, while reviewing archival data from the Arecibo radio telescope, astronomer Paul Scholz of McGill University found 10 repeat signals from FRB 121102. The repetition helped pinpoint its location—a star-forming region in a dwarf galaxy three billion light-years away. However, the source, which releases as much energy in a single millisecond as the Sun does in an entire day, remains mysterious.

New studies reveal that the radio bursts from FRB 121102 are extremely short and highly polarized. When polarized radio waves pass through a magnetic field, the polarization is "twisted" by an effect known as Faraday rotation. The stronger the magnetic field, the greater the twisting. The amount of twisting observed in FRB 121102's bursts is among the largest ever measured in a radio source. "I could not believe my eyes when my colleagues e-mailed their results," says Victoria Kaspi, director of Montreal's McGill Space Institute. "This enormous Faraday rotation is extremely rare and is a huge clue about where this bizarre source resides." Possibly, FRB 121102 lives near a massive black hole in its host galaxy, while another hypothesis has the FRB located inside a powerful nebula.

As for the source itself, the shortness of the bursts—as brief as 30 microseconds—indicates it could be as small as 10 kilometres across, the typical size of a neutron star. If so, FRB 121102 might be a highly magnetized rotating neutron star—a *magnetar*.

FRB 121102 is the only burst repeater, which raises the question: Is its origin different from other FRBs? Several wide-field radio telescopes will soon become operational, including Canada's CHIME radio telescope near Penticton, British Columbia. Once on-line, CHIME is expected to detect upwards of several dozen FRBs daily.

A BLAST FROM BEYOND This composite illustration shows the 100-metre Green Bank Telescope, in West Virginia, receiving a burst of radio waves from FRB 121102. The signal has a complicated structure, with multiple bright peaks that may be created by the emission process.
COURTESY SETI INSTITUTE/ DANIELLE FUTSELAAR



A DISRUPTIVE SWIRL
In this artist's rendition, strong winds disrupt the accretion disc surrounding a stellar-mass black hole. The black hole sits at the centre of the five-million-kilometre-diameter disc but consumes material only from its immediate vicinity.
COURTESY NASA/SWIFT/A. SIMONNET, SONOMA STATE UNIVERSITY

A MIGHTY WIND

WHY DON'T BLACK HOLES consume absolutely everything in their immediate environment? Perhaps, as Bob Dylan sang, the answer is blowin' in the wind. "Winds must blow away a large fraction of the matter a black hole could eat," says Bailey Tetarenko, a University of Alberta PhD student. "In one of our models, the winds removed 80 percent of the black hole's potential meal."

Led by Tetarenko, an international team examined 20 years of data from five satellites. Using new statistical techniques to study outbursts from stellar-mass black holes in X-ray binary systems, the researchers saw evidence of consistent and strong winds surrounding the black holes throughout their outbursts. "We use the X-rays to trace what's going on," explains University of Alberta's Greg Sivakoff. "We were surprised to see the accretion discs [surrounding the black holes] evolving more rapidly than we thought they should. The X-ray emissions were dropping too quickly."

Sivakoff and his colleagues concluded that mass and energy were being carried away from the disc by some kind of wind—a process occurring throughout a black hole's life. They wonder whether the objects feed much more slowly than previously thought and speculate that perhaps not everything in the accretion disc is doomed to fall into the black hole.

For now, the cause of these winds remains a mystery. "We think magnetic fields play a key role," suggests team member Craig Heinke of the University of Alberta, "but we'll need to do a great deal more investigating." ✦

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PRIMARY ATTRACTION J. S. Plaskett (front row, second from left, hat in hand) brought more than 100 guests to the observatory for a preview of the partially completed telescope on October 21, 1916. Many attendees were members of the Victoria Centre of The Royal Astronomical Society of Canada. Facing page: One hundred years after it saw first light, the 72-inch reflector housed in this dome situated on Little Saanich Mountain, north of Victoria, British Columbia, is still helping unravel the mysteries of the universe. The 72-inch was officially named the Plaskett Telescope in 1993.

THIS PAGE: COURTESY NRC HAA. FACING PAGE, LEFT: DENNIS R. CRABTREE; FACING PAGE, RIGHT: GARY SERONIK

100 YEARS OF CANADIAN STAR

How the Dominion Astrophysical Observatory became a young nation's pride and joy by JIM FAILES

LIGHT

TO 21ST-CENTURY EYES, black and white photos of the great machine seem extracted from some strange steampunk fantasy. But when the Dominion Astrophysical Observatory (DAO) opened near Victoria, British Columbia, 100 years ago, its new 72-inch telescope was impressively high-tech and very real.

The DAO was conceived in an era in which the nation's roads saw more horses than automobiles. During the facility's design and construction phases, World War I consumed most of the country's political energy, much of its industry and tens of thousands of its young adults. In the face of such challenges, how could Canada's first big science project possibly come to fruition?

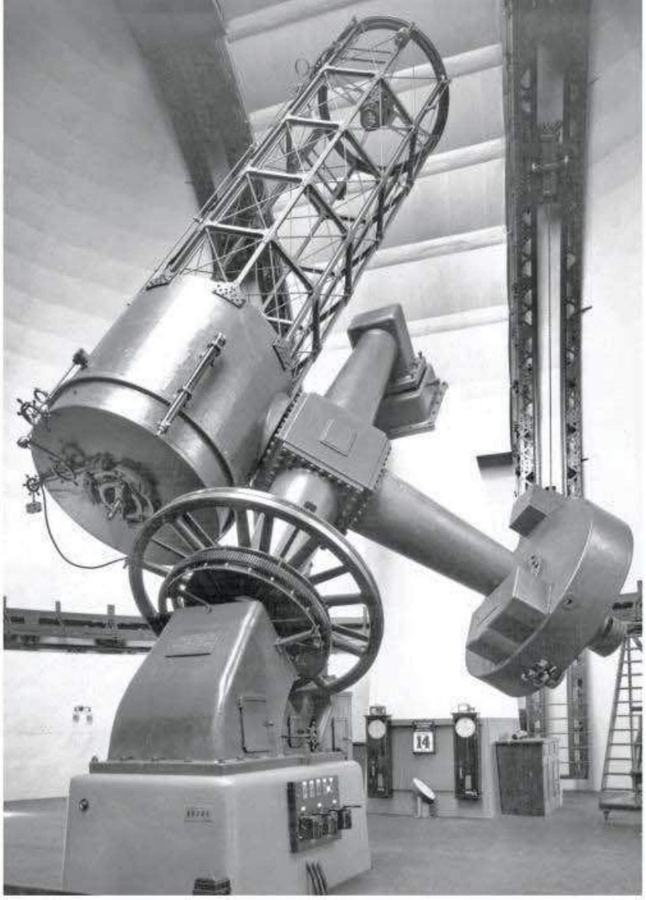
PRIME MOVER

The secret to success lay in the vitality of an extraordinary technician-turned-astronomer, John Stanley Plaskett. Plaskett dreamed far beyond the capabilities of the 15-inch refractor at Ottawa's Dominion Observatory, which he and others had already pushed to its limits. Inspired in 1910 by a visit to the 60-inch telescope (then the world's largest) atop California's Mount Wilson, Plaskett returned home to lobby for Canada's participation in the dawning era of great reflectors.

Plaskett understood that inch for inch, mirror-based telescopes were cheaper to produce than refractors, the objective mirror requiring just one precision optical surface made with relatively inexpensive glass. Such mirrors could be supported across the back instead of around the edge, making large apertures feasible. Armed with well-researched arguments and the support of Canada's first chief astronomer, William Frederick King, Plaskett won government approval for a new world-calibre reflector telescope. Next would come the daunting tasks of building such an instrument and selecting a worthy site for the country's premier astronomical facility.

Among the locations tested by Plaskett's colleague William E. Harper were sites in the dry interiors of Alberta and British Columbia. It's perhaps surprising that Victoria's coastal climate won out over such astronomically favourable locations. But in the days before exotic low-expansion glass was used for telescope mirrors, stable air temperature was crucial for minimizing the thermal-expansion effects that distort a big mirror's figure and hobble its optical performance. The moderating influence of the nearby ocean ultimately pushed Victoria to the top of the list.

Building the observatory among the conifer and arbutus trees of southern Vancouver Island consumed a year and a half, as teams of draft horses hauled huge components to the summit of Little Saanich Mountain. Plaskett's uncompromising spirit shows in aspects of the towering mount—an English equatorial design allowing access to nearly the entire sky visible from the site's latitude. The mount's tracking motion is governed by a precision worm gear of remarkable




THE UNIVERSE AWAITS Clockwise from left: Assembled and ready for its optics, the 72-inch telescope posed for a formal portrait in the completed dome on July 14, 1917. A four-horse team carefully hauls the truss tube of the giant reflector up a dirt road to the summit of Little Saanich Mountain in 1916—the conclusion of a trip that began in Cleveland, Ohio, where the telescope was fabricated by the Warner & Swasey Company. John A. Brashear pauses with the 72-inch mirror blank at his Pittsburgh factory. Cast by the Saint-Gobain Glass Company of Charleroi, Belgium, the blank was shipped to America shortly before the outbreak of World War I and was sent, finished, to Victoria, British Columbia, in the spring of 1918. ALL PHOTOS COURTESY NRC HAA

accuracy that still performs superbly today (as Dan Posey reports on page 15).

Finishing the 72-inch telescope became something of an informal race with Mount Wilson's planned 100-inch, both reflectors vying to usurp the 60-inch as the world's largest telescope. The blank for Victoria's primary mirror was cast in Belgium in July 1914. The demanding process of transforming the rough 5,000-pound disc of glass into a working optical component was undertaken by the renowned John A. Brashear Company in Pittsburgh, Pennsylvania. However, the mirror wasn't completed until April 1918, five months after the 100-inch telescope celebrated "first light" on November 1, 1917. The Mount Wilson victory was only partial—structural and tracking issues reduced functionality of the 100-inch during its inaugural year. Meanwhile, Plaskett's scope logged its first scientific observation on May 6, 1918, and could claim a run of roughly six months as the world's largest, fully operational telescope. During this time, it recorded the spectra of an extraordinary nova in the constellation Aquila. A starburst peaking at magnitude –0.5, it remains the brightest nova observed since the first telescope was turned skyward at the start of the 17th century.

SCIENCE AND PSEUDOSCIENCE

What Canada's new observatory boasted in technology, it unfortunately lacked in operating funds. "With the exigencies of the war, money was incredibly tight," notes emeritus director James Hesser. "There were just two astronomers on staff." Yet this didn't keep Plaskett from pursuing spectroscopic binaries, cataloguing hundreds with the assistance of staff astronomer Reynold K. Young. In 1922, inspired by a letter from American astronomer Annie Jump Cannon, Plaskett discovered a sixth-magnitude O-spectrum star in Monoceros, which was soon revealed to be the most massive star known. The binary, whose components each outweigh our Sun dozens of times over, was dubbed "Plaskett's Star." It topped lists of stellar heavyweights until falling to Eta Carinae in 1995.

Plaskett and the DAO acquired considerable notoriety through this discovery, and the observatory prospered as both a research lab and a tourist destination. Early on, Plaskett reserved Saturday nights for public visits. On warm, clear evenings, hundreds of visitors crowded inside the dome. Most left enthused and enlightened on the current state of cosmic knowledge, but not all. According to the observatory's C.S. Beals (later, Canada's Dominion Astronomer), a few sketchy characters inevitably appeared, including "flat-earth men" and "cranks who have solved all of the mysteries of the universe and who want to tell you about it." The resulting disputes left bystanders amused and staff exhausted.

Neither the Great Depression of the 1930s nor World War II significantly interrupted the DAO's astronomical output. Before she became one of Canada's most respected astronomers during her meritorious career at the University of Toronto, Helen Sawyer Hogg and her husband Frank conducted studies using the big scope, while their baby daughter slept soundly in a basket on the spectrograph cabinet.

Unofficial residents came and went too. Beals records that a long-established hermit on the mountain was eventually evicted, at considerable expense. He further comments that young astronomers occasionally allowed their girlfriends to spend the night under the dome of the 72-inch—a romantic practice probably not looked upon favourably by the observatory's director. By day, a less scandalous social atmosphere flourished. Over the years, staff enjoyed animated lunchtime discussions followed by friendly competitions on a woodsy putting course around the office building, a highly popular activity pursued rain or shine.

PUSHING BOUNDARIES

Spectroscopy continued to be the focus of research throughout the 1940s and 1950s. Andrew McKellar, who had started working at the DAO as a graduate student, rose to global prominence for his application of molecular spectroscopy, revealing evidence for the carbon-nitrogen cycle that powers carbon stars, and for determining the temperature of deep space, confirmed later by Arno Penzias and Robert Wilson's chance discovery of the cosmic microwave background radiation "echo" from the Big Bang. Also doing notable science on the hill was the first female astronomer on staff, Vancouver-born Anne Underhill. She worked at the DAO from 1949 to 1962 and became one of the world's leading experts on early-type stars, ultimately publishing over 200 research papers.

In the 1950s, plans advanced for a second telescope, a 48-inch instrument dedicated to spectroscopy and equipped with a room-sized, high-resolution spectrograph. When the instrument became operational in 1962, it was Canada's third largest optical telescope—the University of Toronto's 74-inch at the David Dunlap Observatory having taken top spot in 1935. Ambitions for cutting-edge hardware didn't stop there. A core group of Canadian astronomers believed the time had come for a new national observatory to train the next generation of graduates and to enhance the country's reputation for optical astronomy. Plans for a world-class reflector and ancillary instruments on Mount Kobau, in the dry B.C. Interior, grew under DAO director Robert Petrie. The big eye's 157-inch Corning mirror blank was set to undergo figuring and polishing by a DAO optical team when support for the project crumbled. Its cancellation in 1968 emphasized the difficulty of maintaining scientific and political backing throughout a long, complex undertaking. Mount Kobau National Observatory is now merely a footnote in Canadian astronomical history; happily, the DAO went on to other successes.

The third quarter of the 20th century brought revolutions in technology and a new era of great observatories. The world's premier locations for optical astronomy were identified, and international alliances were struck to facilitate development. Mountain summits in the Andes, South Africa, the Canary Islands and Hawaii saw the construction of sizable reflectors funded by the United States, the United Kingdom, France, Germany, Spain, the Netherlands and Canada. The 3.6-metre Canada-France-Hawaii Telescope (CFHT) on Mauna Kea, which became operational in 1979, was a collaborative effort owing many of its critical technical developments to the DAO. The Mauna Kea mirror was ground and polished in Victoria (along with a replacement

mirror for the Plaskett Telescope). Instrument design and production had come into its own at the DAO. A team under David Crampton built a reputation for equipment engineered to superfine tolerances that worked "straight out of the box." Over time, the DAO has become a world leader in adaptive-optics technology and highly efficient multiobject spectrographs.

Astronomical research continued apace. In the 1980s, a Canadian team led by Bruce Campbell, Gordon Walker and Stephenson Yang used the DAO facilities to pioneer refinement of stellar radial-velocity measurements. Their precision led to the team's groundbreaking detection of a planet beyond the solar system. Although controversial at the time, the finding was confirmed in 2002. In 1988, working at the DAO with data from the CFHT, John Kormendy quantified the compact mass at the heart of the Andromeda Galaxy—an independent detection (coincident with Alan Dressler and Douglas O. Richstone in the United States) of the first supermassive black hole outside the Milky Way Galaxy. And a decades-long program by David Balam that is ongoing today has revealed hundreds of previously undiscovered minor planets, expanding the catalogue of Earth-approaching and potentially hazardous objects.

PICTURE FROM THE PAST This postcard from 1918 suggests the excitement the new Dominion Astrophysical Observatory generated with the general public as Canada entered the big leagues of astronomical research. Readers interested in visiting the observatory during its centennial year, 2018, can contact Friends of the DAO via its website (www.observatoryhill.org) or its Facebook page (www.facebook.com/FriendsDAO/).

The Dominion Astrophysical Observatory's significance to the country was recognized in 2010 with the DAO's inclusion on Canada's list of National Historic Sites. The facility, meanwhile, is as vital as ever, thanks to collaborations with universities, international research groups and space agencies. As its second century begins, the observatory is pursuing research on galaxy clusters, Kuiper belt objects, stellar-debris discs, high-redshift quasars, stellar streams and more.

J. S. Plaskett would surely be pleased. ✦

Jim Failes is cofounder of the annual Mount Kobau Star Party and a freelance writer living in the Okanagan Valley, British Columbia. His lifelong interest in the stars was encouraged by a DAO astronomer in 1973.

A STELLAR CANADIAN

by PETER BROUGHTON

WHO WAS IT THAT, a century ago, relentlessly prodded the Government of Canada to create the biggest and best telescope money could buy? John Stanley Plaskett. The eldest of 10 children, Plaskett was born on a farm near Woodstock, Ontario, in 1865. The rapid industrialization trends of the late-Victorian era led him to apprentice in the mechanical trades at a local foundry and then at the Edison General Electric Company. The skills Plaskett acquired there were just what the University of Toronto's physics department needed when it hired him as a technician in 1890. He was married in 1892 to Reba Hemley, who urged him to complete his high school education and proceed to his BA—Plaskett achieved that in 1899—all the while continuing his work and helping to raise the couple's first son, Harry.

In 1903, although he had no formal training or experience in astronomy, Plaskett combined his practical expertise and his work in colour photography to land a position at Ottawa's Dominion Observatory. His first major task was to organize a solar eclipse expedition to Labrador in 1905. Unfortunately, the eclipse was clouded out, but Plaskett later used the Labrador equipment in Ottawa to pursue solar studies with dogged perseverance, but not much success. Undeterred, he used the observatory's 15-inch refractor to photograph stellar spectra, which he subsequently analyzed to make radial-velocity measurements. Despite the modest equipment available to him, Plaskett earned recognition as Canada's pioneer astrophysicist.

The 72-inch reflector in Victoria, British Columbia, had 23 times the light-gathering power of the Ottawa refractor, allowing Plaskett to obtain spectra of fainter stars—down to magnitude 7.5. He was thus able to measure O- and B-type stars thousands of light-years away, including the very massive sun that came to be known as Plaskett's Star. From the hundreds of spectra he'd acquired, Plaskett was able to show definitively that the stars and interstellar material of our home galaxy revolve about a centre some 32,000 light-years distant. This led him to estimate that the Milky Way contains roughly 165 billion solar masses.

In addition to receiving numerous honorary degrees and medals from the world's most prestigious scientific societies, Plaskett was a Fellow of the Royal Society, an invited lecturer at Oxford University and a Commander of the Order of the British Empire. Since his death in 1941, Plaskett's name has been given to a peak in the Canadian Rockies, a large crater on the Moon, awards and, of course, the telescope that made much of his research possible. ✦

COURTESY RASC ARCHIVES

Peter Broughton is author of Northern Star: J.S. Plaskett, *a biography recently published by the University of Toronto Press.*

A NIGHT WITH THE 72-INCH

by DAN POSEY

After a summer spent guiding thousands of interested visitors on tours of the DAO and showing them celestial objects through the 72-inch reflector, members of the RASC Victoria Centre were rewarded with one evening to use the historic instrument. So, on Saturday, September 23, 2017, we settled in for a night with the Plaskett Telescope.

When it comes to using the 72-inch, preparation is essential. To avoid surprises (or disasters), each target for the night is carefully selected well in advance. There are other big differences from using your own equipment at home. For one thing, you feel intense pressure to make every second count. And there's a control room that is warm and well lit.

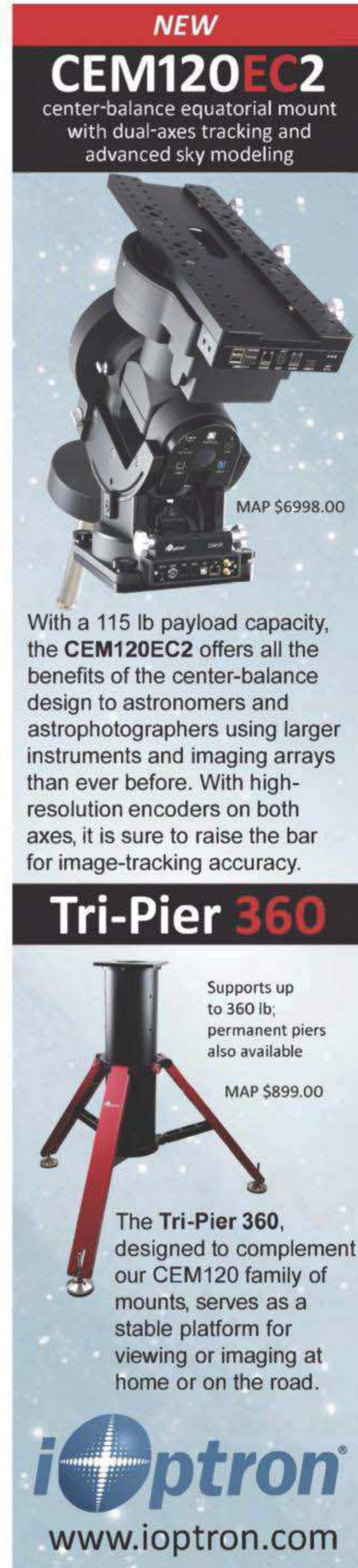
Operating observatory equipment is much more complex, and as a result, it's susceptible to technical glitches. We had an uncooperative telescope control system temporarily, then a guiding issue we were never able to resolve. Consequently, I opted to shoot unguided exposures and was amazed to find that a century after the right ascension gear was installed, it still tracks accurately enough for unguided 3-minute images—remarkable considering the Plaskett's 9,250-millimetre focal length!

The observatory's Teledyne e2v CCD camera is so sensitive that most objects in the Messier catalogue can be cleanly recorded utilizing a single 30-second black and white frame. Due to the large size of the sensor, the field of view with the CCD is still a healthy 23.9 × 10.6 arc minutes, despite the scope's long focal length. By comparison, were it possible to employ a full-frame DSLR camera on the 72-inch, the resulting images would have only half the field size.

Our first object for the evening was NGC7331 (pictured below), a galaxy in Pegasus. Sometimes referred to as the Milky Way's twin, the Pegasus spiral seemed an ideal target for a telescope responsible for redefining our understanding of the Milky Way's rotation and structure. We spent nearly two hours recording imaging data for NGC7331 before slewing to our next object. Clouds moved in at 3:30 a.m., signalling the end of a wonderful night. It was a humbling and exhilarating privilege to work with an instrument boasting such a rich and storied past. ✦

Dan Posey studied the cultural history of the DAO at the University of Victoria, is on the board of the Friends of the DAO and is a member of the RASC Victoria Centre.

A DISTANT MILKY WAY NGC7331, in Pegasus, is on display in this photo taken in September 2017 by Dan Posey using the 72-inch Plaskett Telescope at the Dominion Astrophysical Observatory. The galaxy is thought to share many similarities with our own Milky Way.



TWELVE TILES A dozen individual images were combined in Adobe Photoshop to create this summer Milky Way mosaic (each frame in the final composite is indicated in the inset illustration). Each 2-minute exposure was shot with a Canon 50mm f/1.4 lens (set to f/2.8) mounted on an astro-modified Canon EOS 60D DSLR camera working at ISO 1600. The completed file contains about 200 megapixels and shows incredible detail for such a wide-angle portrait.

Text and photography by TONY PUERZER

ENTER THE MATRIX

How to capture impressive high-resolution, wide-angle photos of the night sky

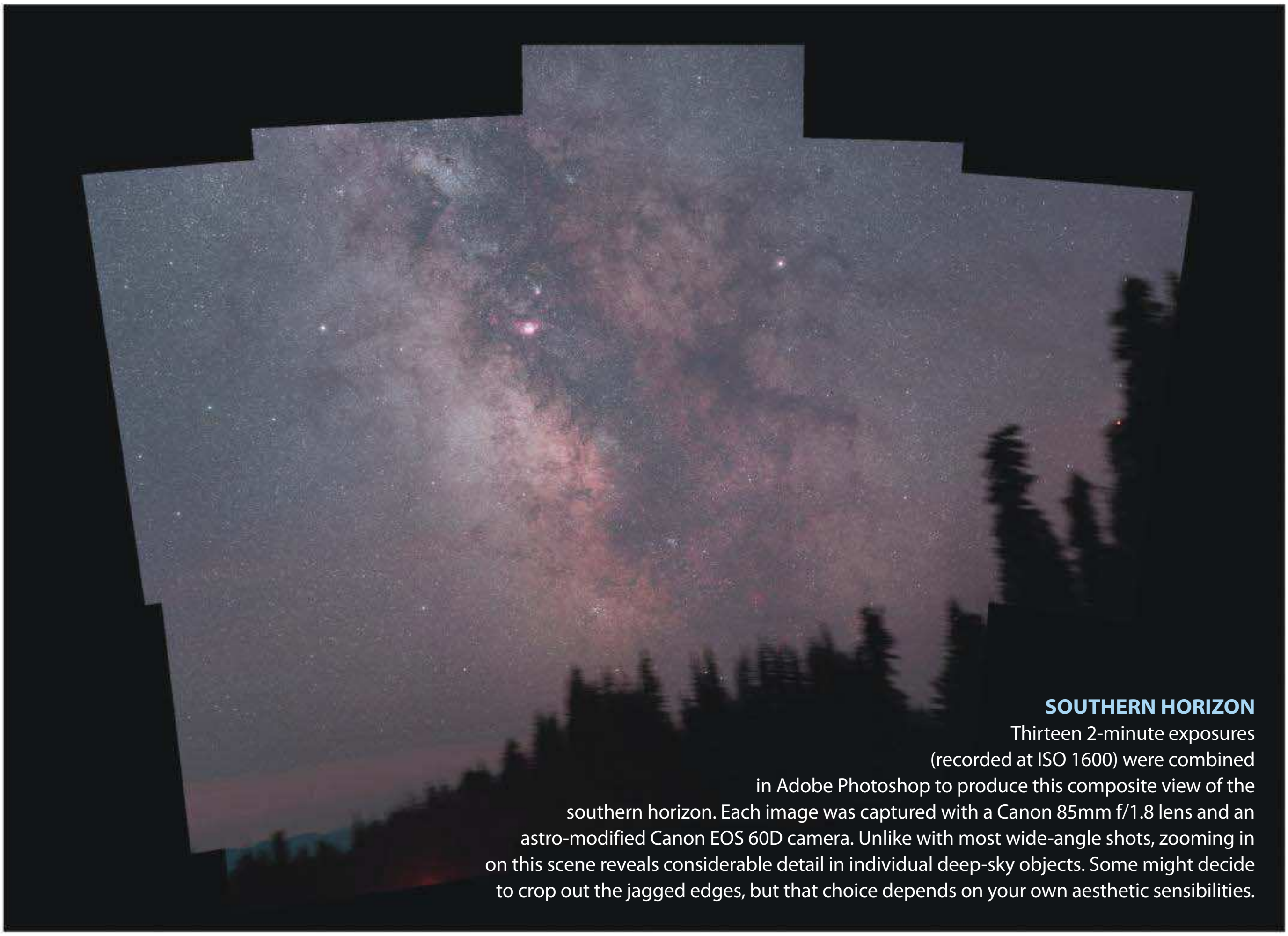
FEW ASTROPHOTOS are as awe-inspiring as a wide-angle view of the Milky Way arching above a dramatic landscape. But the devil is in the details—or lack of details, as is often the case. Zoom in close enough, and you'll usually discover that the myriad deep-sky objects are rendered as little more than indistinct blobs of colour a few pixels wide. Even with the impressive resolution of modern DSLR cameras, wide-angle lenses can't reproduce small features clearly.

But there's a technique that overcomes this problem, allowing you to enjoy the best of both worlds: wide-angle coverage *and* high resolution. Simply switch to a lens with a longer focal length and shoot a matrix of several overlapping frames that you stitch together into a single, expansive, highly detailed shot. Although time-consuming, the results are visually striking and can lead to a newfound appreciation for the intricacy and breathtaking beauty of the night sky.

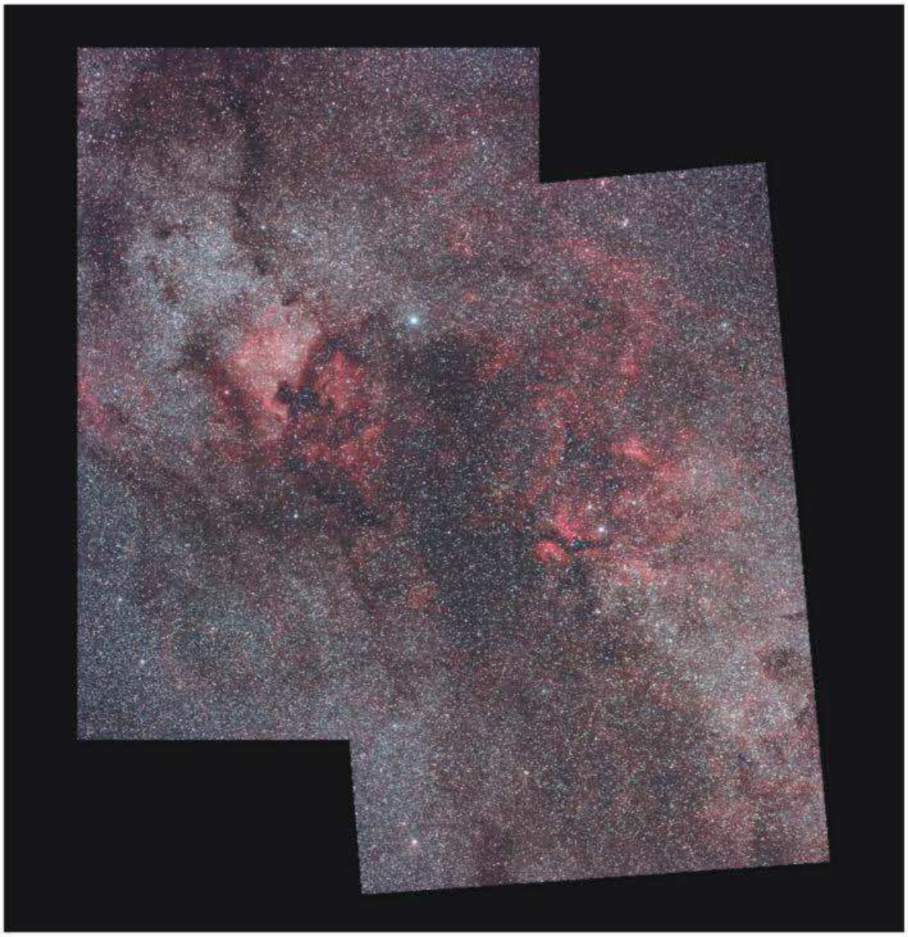
THEN AND NOW

As a teenager, my initial attempt to create a Milky Way mosaic was an epic failure. The plan was to paste together a set of 4×6 prints I'd made using a 35mm film camera and a 50mm lens. Despite allowing a fair bit of overlap between each print, I discovered it wasn't possible to accurately align the photos to match the apparent curvature of the night sky. This, along with the pronounced vignetting in the corners of each picture, made for a pretty sad-looking science project.

Fast-forward 40 years, and astrophotographers are in a totally different universe of possibilities. Thanks to digital technology, it's now a relatively easy task to create the sort of sweeping celestial scenes that defeated my younger self. The key is utilizing the powerful built-in panorama capabilities of Adobe Photoshop and Lightroom, as well as other "stitching" software. These



SOUTHERN HORIZON
Thirteen 2-minute exposures (recorded at ISO 1600) were combined in Adobe Photoshop to produce this composite view of the southern horizon. Each image was captured with a Canon 85mm f/1.8 lens and an astro-modified Canon EOS 60D camera. Unlike with most wide-angle shots, zooming in on this scene reveals considerable detail in individual deep-sky objects. Some might decide to crop out the jagged edges, but that choice depends on your own aesthetic sensibilities.



programs automatically align the individual frames, apply the correct amount of warping and remove vignetting.

To begin creating your matrix masterpiece, set your camera to Manual mode and use exactly the same ISO, aperture and exposure settings for each frame. If working in Raw mode (and you should be), check that you've selected a consistent white-balance setting in postprocessing. These steps will ensure that your frames blend together seamlessly.

Because you're shooting at longer focal lengths, some sort of tracking mount is necessary to avoid star trails. A lightweight model, like the iOptron SkyTracker Pro that I reviewed in the May/June 2017 issue (page 46), is a great option for smaller lenses. However, if you plan to use heavier telephotos, a beefier equatorial mount will likely be required. Although I started out

START SMALL If you're overwhelmed by the thought of combining dozens of individual images into a single mosaic, take heart—you can always start small. This photo of the region that includes the North America Nebula comprises just two 2-minute exposures (at ISO 3200) recorded with a Canon 85mm f/1.8 lens and an astro-modified Canon EOS 60D camera.

WIDER THAN WIDE The author combined half a dozen 2-minute exposures to create this horizon-to-horizon view of the Milky Way. For each image, he used a Canon 15mm f/2.8 fish-eye lens mounted on a crop-sensor Canon EOS 70D camera set to ISO 1600.

with a simple tracking platform, I've been spoiled by the ease of using a computerized GoTo mount, which greatly simplifies repositioning the camera for each exposure in a sequence.

PLAN YOUR SHOTS, SHOOT YOUR PLAN

Careful planning is required for success. You need to execute your shots with a significant amount of overlap between frames to allow the software to perform its digital magic. Desktop planetarium software is indispensable for previsualizing the arrangement of each image tile required for your finished mosaic. Most of these programs can display a graphic overlay indicating the field of view for your specific camera and lens combination.

Each time you record a shot, select a star roughly 30 percent from the edge of the frame to use as a reference point for lining up the edge of the next frame. With a 50mm lens, you can cover wide swaths of sky quite quickly, but as the focal length increases, photographing the same area takes substantially longer, since the field of view is smaller. A mosaic always involves a trade-off between resolution and coverage.

Although you might be tempted to try to get away with using the fewest shots possible, don't skimp on overlap. The last thing you want is to discover gaps in your coverage after you've put away your equipment for the night. Err on the side of too much overlap rather than too little.

When you've imported the images into your computer, it's a simple matter to assemble them using image-editing software. In Adobe Lightroom, select *Photo > Photo Merge > Panorama*. In Photoshop, it's *File > Automate > Photomerge*. Each program also offers a number of different projections to map your flat images onto a hemispherical sky. Experiment to see which one provides the most aesthetically pleasing results.

FINE POINTS

In the northern hemisphere, it's a good idea to begin your sequence with the westernmost frames so that you don't have to worry about that region of sky setting before you're finished. It's also wise to capture at least two exposures for each tile in the matrix in case a passing satellite or aircraft spoils one of your frames.

Although I've used this technique exclusively with camera lenses, there's no reason you can't apply it to telescopic images. After all, a scope is really just a super-telephoto lens. And, depending on the focal length of your instrument, making a mosaic may be your only recourse for big targets such as the Andromeda Galaxy and the North America Nebula.

If the prospect of taking dozens of perfectly overlapped images seems a bit daunting, don't despair—you can start with simple mosaics that combine only two or three images until you're comfortable with the technique. Once you get the hang of it, you'll happily enter the astrophoto matrix. ✦

Tony Puerzer is a full-time professional photographer and part-time amateur astronomer living in Nanaimo, British Columbia.

by GARY SERONIK

A LUNAR OBSERVER'S TOOL KIT

Having the right stuff can make your Moon gazing more enjoyable and rewarding

LATE SPRING is a great time of year for Moon observers. Evenings are relatively mild, and the waxing lunar crescent is nicely positioned high in the twilight sky. Although you can enjoy a spur-of-the-moment look at the Moon with modest equipment (or even none at all), I find that a few resources really enhance the experience and lead to a more satisfying observing session. Here are my current favourite picks.

BEST GUIDEBOOK

There are a large number of books about our nearest solar system neighbour, but not many are as rich with insight and detail as *The Modern Moon* by Charles A. Wood. Full disclosure: I served as the book's editor, but I try not to let that influence my perspective. What Chuck has accomplished is remarkable. He combines a deep understanding of lunar geology with a backyard astronomer's enthusiasm. I also appreciate the region-by-region approach he takes—it's logical, and it allows him to describe surface formations in the context in which they appear. If you want to know what details to look for and why they appear the way they do, this book is your guide.

BEST MAP

Here, again, I have to come clean—my pick is another item I had a hand in producing. The finest lunar map for use at the eyepiece is *Sky & Telescope's Field Map of the Moon*. This large-format, laminated chart features the skilled cartography of the late Antonín Rükl. It's available in a "normal" correct-reading version as well as a "mirror-reversed" edition suitable for use with instruments that have a mirror diagonal, such as refractors and Schmidt-Cassegrain telescopes. One of the map's unique aspects is that each 30-by-30-centimetre (12-by-12-inch) quadrant can be viewed individually, or the map can be opened to show any two adjacent panels or all four at once.

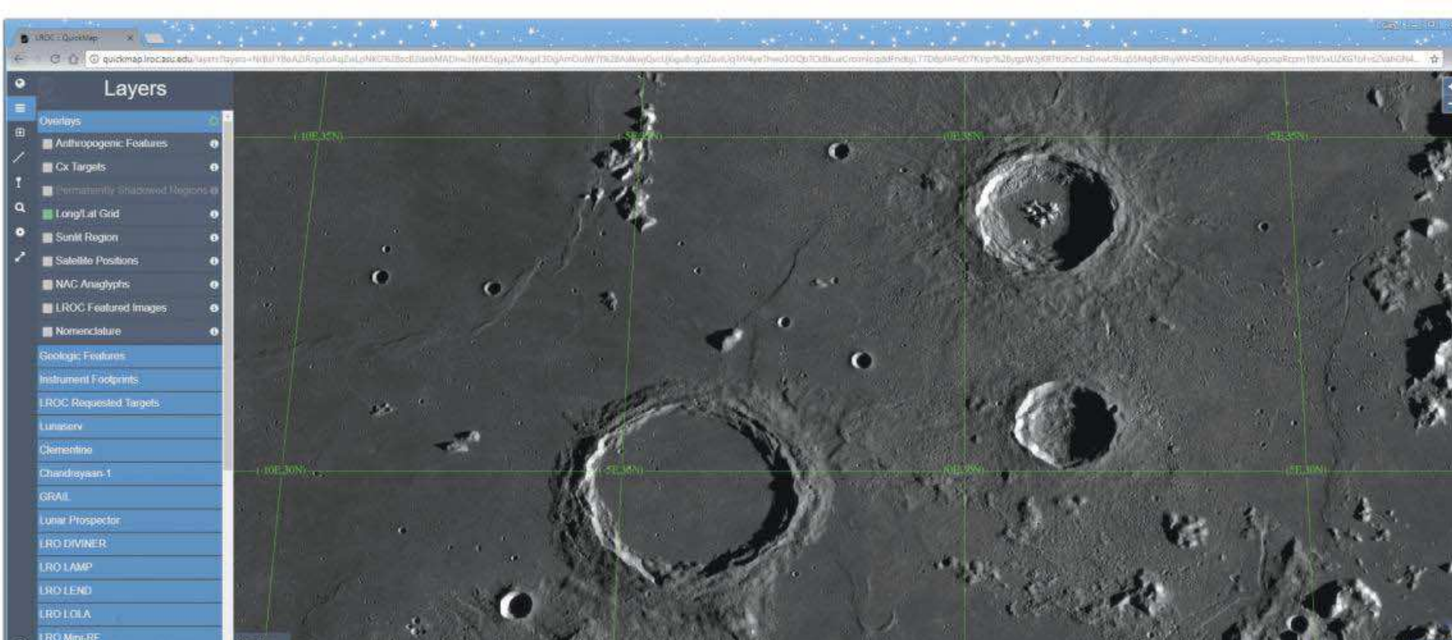
BEST ATLAS

Until recently, Antonín Rükl's *Atlas of the Moon* was, hands down, the best—and it is still a fine choice. But now that it's out of print, used copies command stratospheric prices on the Internet. An arguably better choice is *21st Century Atlas of the Moon* by Charles A. Wood and Maurice J. S. Collins. Although not as comprehensively labelled as the Rükl volume, this new atlas makes use of Lunar Reconnaissance Orbiter (LRO) images to present the entire Earth-facing disc of the Moon in 28 individual charts. The spiral binding enhances the book's utility at the telescope as well. *21st Century Atlas of the Moon* isn't perfect (I wish there were some overlap between charts and more of the descriptive text), but it's very, very good.

BEST SOFTWARE

While most desktop planetarium programs show the Moon's current phase and libration, none take the deep dive that Virtual

DESKTOP MOON Explore the lunar surface using your computer simply by visiting the LROC QuickMap webpage (http://quickmap.lroc.asu.edu/) and delving into the imagery captured by the Lunar Reconnaissance Orbiter Camera. The site is an excellent resource for identifying features you see in your telescope or for planning observing sessions.

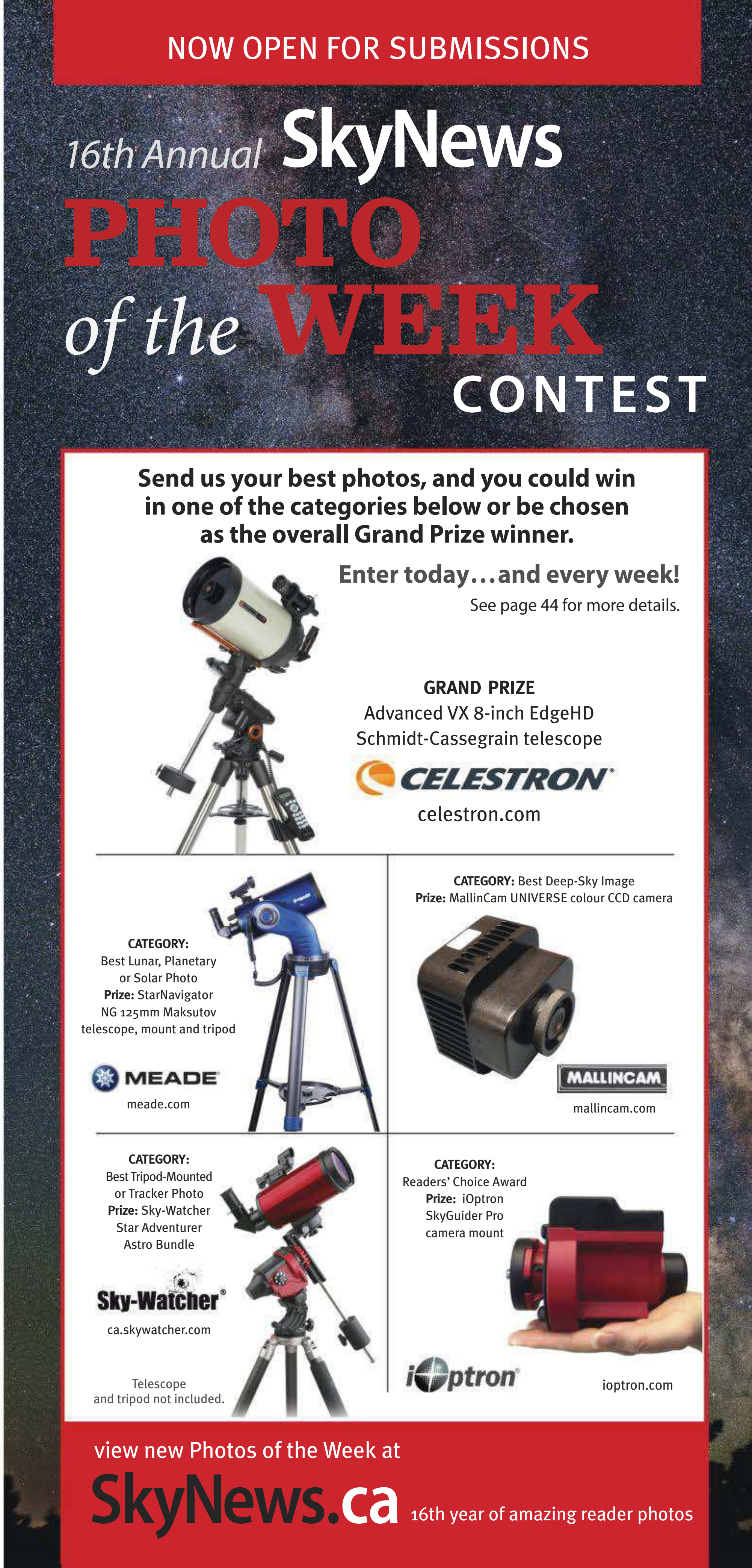


Moon Atlas (VMA) does. Simply put, the software authored by Christian Legrand and Patrick Chevalley is a must-have if you enjoy exploring the nooks and crannies of the lunar surface. When I want to know the name of some tiny impact pit I've chanced upon with my scope, I fire up VMA to get the answer. The program presents a complete zoomable Moon map—all you have to do is click on the feature you're interested in to get its identification, its size and a wealth of additional information. VMA is especially useful in crowded crater fields, where the labels on some printed charts can be ambiguous. You can even choose which surface "texture" is applied, including one utilizing LRO image data. Oh, and VMA is free. It's hard to beat that.

BEST WEBSITE

There are quite a few on-line resources for Moon enthusiasts, but the one that I use the most is the LROC QuickMap (http://quickmap.lroc.asu.edu/). This handy webpage elegantly presents LRO image data as a zoomable map. If that sounds a lot like VMA, it is, but QuickMap offers much greater detail. At its highest zoom setting, QuickMap has enough resolution to show hardware left behind by the Apollo astronauts! You can also select from several different data sets and overlays to enhance your understanding of lunar geology. In addition, the site has a number of useful tools. One that's particularly handy allows you to trace a chord across a stretch of terrain, then generate a topographic profile. It's a very powerful way to get the "lay of the land," as it were. You can spend hours playing astronaut with QuickMap. Indeed, QuickMap's one notable downside is that it's far too easy to become engrossed in and let an entire afternoon slip away! But that'd be a good afternoon. ✦

Gary Seronik is a dedicated lunaphile and this magazine's editor.



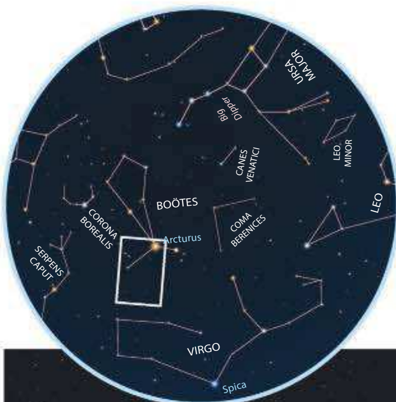
AMBLING AROUND ARCTURUS

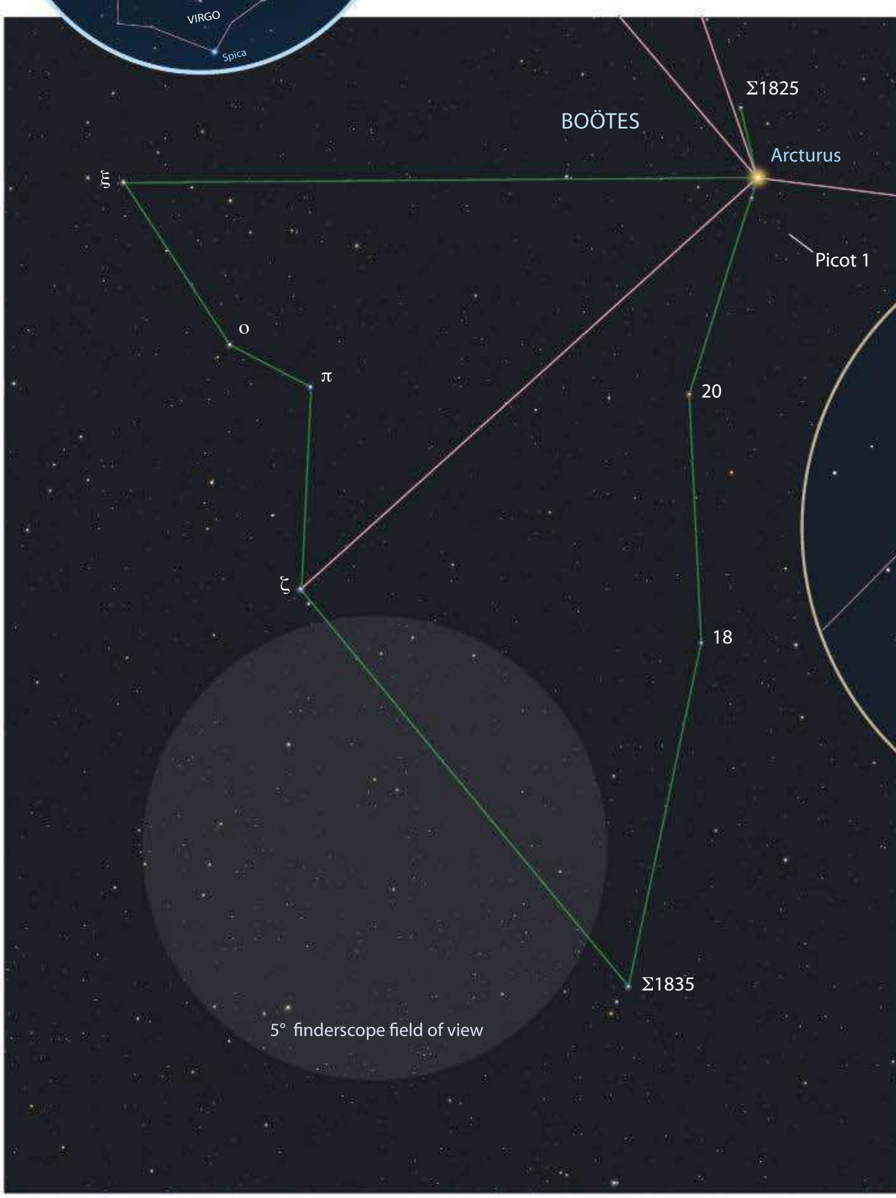
Nightfall in late spring is a perfect time for seeing double in southern Boötes

THE DOMINANT STAR high up these nights is zero-magnitude Alpha (α) Boötis, better known as **Arcturus**. Only 37 light-years away, the amber-hued star is the leading light of Boötes the herdsman. Big Boötes contains no deep-sky showpieces, but it's loaded with double stars.

Recently, I observed a trio of petite pairs south and east of Arcturus using my 4¼-inch (108mm) f/6 Newtonian reflector. All three resolved nicely in a 9mm eyepiece yielding 72×. A fourth duo just north of Alpha was more challenging.

Let's begin by sweeping 11 degrees south of brilliant Arcturus, past fifth-magnitude 20 and 18 Boötis, to a short row of three stars slanting northwestward. Uppermost and brightest in the row is the double star **Struve 1835** (Σ1835). Its yellowish primary component is magnitude 5.0; the pale blue secondary sun, 6.2 arc seconds away, is magnitude 6.8. Lower magnification might





A QUARTET OF DOUBLES The four binary stars labelled on the chart at left all lie within 10 degrees of brilliant Arcturus. The author's looping tour begins with a hop southward to Struve 1835. That star and the other main stars identified en route are visible without optical aid under moderately light-polluted skies. LEFT, TOP AND BOTTOM: CHARTS BY GLENN LEDREW; ABOVE: *SKYNEWS* ILLUSTRATION resolve this unequal set, but I needed 72× for a clean split.

Next, we travel northeastward seven degrees to fourth-magnitude **Zeta (ζ) Boötis**, then turn north a little less than three degrees to fifth-magnitude **Pi (π) Boötis**. Don't confuse Pi with its similarly bright neighbour Omicron (ο) Boötis, nearby to the east. Pretty Pi consists of pure white 4.9- and 5.8-magnitude stars 5.5 arc seconds apart—a compact, attractive pairing and my favourite of the tour.

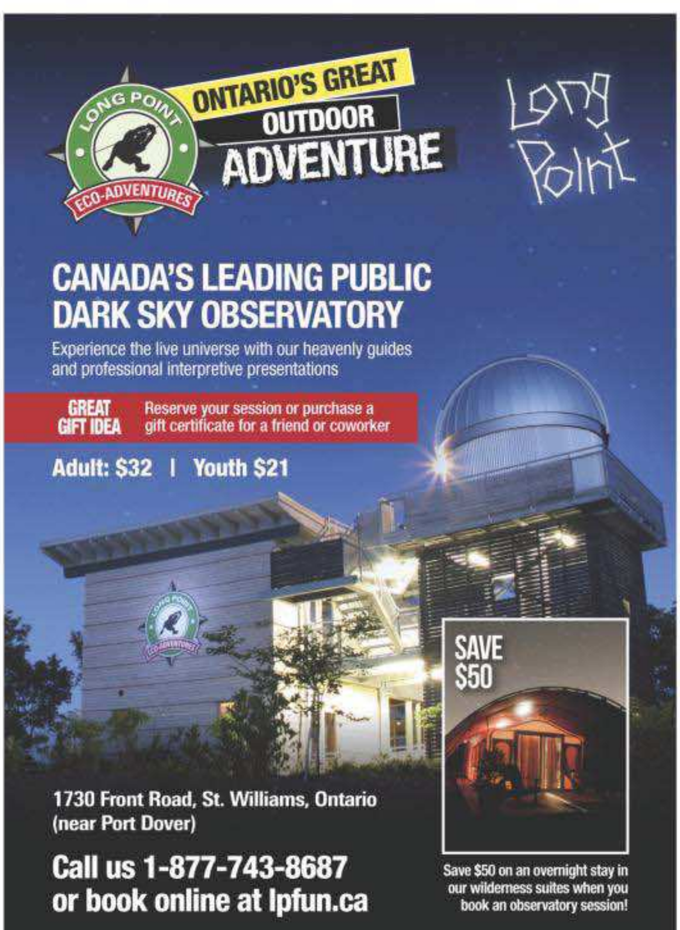
From Pi, we head eastward to the above-mentioned Omicron, then we veer northeastward 2½ degrees to 4.8-magnitude **Xi (ξ) Boötis**. Xi is a strongly unequal binary, but its 7.0-magnitude attendant is easy to spot 6.3 arc seconds away. As you inspect this unbalanced system, consider that Xi itself is a garden-variety yellow star 40 percent nearer than Arcturus yet almost five magnitudes dimmer than the luminous orange giant. Xi's faint companion is an orange dwarf significantly smaller than our Sun.

Now for the challenge. One degree north-northeast of Arcturus is a "double trouble" binary. The 6.5- and 8.4-magnitude components of **Struve 1825** are unevenly bright and closely spaced, a mere 4.4 arc seconds apart. My little reflector barely separated them at 97×. During rare moments of steady seeing, the result was much better at 150×. Give Σ1825 a try, and don't be afraid to pile on the power.

We'll finish off with something a bit different. If you place dazzling Arcturus at the north edge of a low-power field, then look a bit more than ½ degree southward and slightly westward, you should see a curvy asterism 20 arc minutes in length formed by seven stars ranging in magnitude from 9.4 to 10.6. Called **Picot 1**, it's also known as Napoleon's Hat, but I think the sinuous pattern more closely resembles a caterpillar, humped up in mid crawl.

Despite Arcturus blazing in the same view, I recognized Picot 1 at 27×. However, if your telescope is smaller than mine, you might need extra magnification to detect the 10.6-magnitude star at the top of the hump. If you still can't recognize the figure, shove that Arcturian "streetlight" outside your eyepiece field, and—presto!—the cosmic caterpillar appears. ✦

Associate editor Ken Hewitt-White observes double stars and other telescopic targets from his suburban backyard in Chilliwack, British Columbia.



OUR CHART SHOWS the major stars, planets and constellations visible from Canada and the northern United States within one hour of these times:

EARLY MAY: 11:30 P.M.; LATE MAY: 11 P.M.
EARLY JUNE: 10 P.M.; LATE JUNE: 9 P.M.

THE EDGE OF THE CHART represents the horizon; the overhead point is at centre. The faintest stars depicted shine at magnitude 5.0—a little brighter than what you can see under ideal conditions. On a moonless night in the country, you will see more stars than are shown here; deep in the city, you will see fewer. (The planets, when visible, are plotted for the middle of the date range covered by the chart.)

USING THE STAR CHART OUTDOORS: The chart is most effective when you use about one-quarter of it at a time, which roughly equals a comfortable field of view in a given direction. Outdoors, match the horizon compass direction on the chart with the actual direction you are facing. Don't be confused by the east and west points on the chart lying opposite their location on a map of Earth. When the chart is held up to match the sky, with the direction you are facing at the bottom, the chart directions match the compass points. For best results when reading the chart outdoors, use a small flashlight heavily dimmed with red plastic or layers of brown paper. Unfiltered lights greatly reduce night-vision sensitivity.

CELESTIAL CALENDAR

MAY 5 Eta Aquariid meteor shower peaks in predawn sky; waning gibbous Moon 5° from Saturn in early morning

MAY 6 Moon less than 2° from Mars in predawn sky (see page 27)

MAY 7 Last-quarter Moon

MAY 8 Jupiter at opposition (see page 27)

MAY 15 New Moon, 7:48 a.m., EDT

MAY 17 Thin crescent Moon 6° from Venus low in evening twilight (see page 28)

MAY 21 First-quarter Moon; Moon ½° north of Regulus in evening sky (see page 29)

MAY 23 Spring begins in the Martian southern hemisphere, now tilted toward Earth

MAY 27 Waxing gibbous Moon 5° east of Jupiter in evening sky

MAY 29 Full Moon, 10:20 a.m., EDT

MAY 31 Waning gibbous Moon 2° from Saturn in late evening

JUNE 3 Waning gibbous Moon 2½° north of Mars at dawn; Jupiter less than 1° north of Zubenelgenubi (Alpha Librae)

JUNE 6 Last-quarter Moon

JUNE 13 New Moon, 3:43 p.m., EDT

JUNE 15 Thin crescent Moon 7° below Venus at dusk

JUNE 17 Waxing crescent Moon 4° west of Regulus in evening sky

JUNE 19 Venus ½° from Beehive star cluster (M44) low in evening twilight (see page 29); asteroid Vesta at opposition

JUNE 20 First-quarter Moon

JUNE 21 Solstice at 6:07 a.m., EDT (summer officially begins in northern hemisphere)

JUNE 23 Waxing gibbous Moon 4° northeast of Jupiter in evening sky

JUNE 27 Saturn at opposition; full Moon less than 1° from Saturn and rising together at sunset (see page 30); Mercury 7° left of Pollux, low in west-northwest at dusk

JUNE 28 Full Moon, 12:53 a.m., EDT; most southerly full Moon of 2018; Mars begins retrograde motion

Impressive or relatively rare astronomical event

THE PLANETS

MERCURY remains too close to the Sun to observe until the end of June, when the innermost planet emerges at dusk. On June 27, Mercury is 7° to the left of Pollux and shines at magnitude –0.3 low in the northwest during twilight.

VENUS gleams at magnitude –3.9 in the west and is prominent as the evening "star" throughout spring and summer. In early June, Venus appears at its highest for 2018. Look for a thin crescent Moon 6° to the left of Venus on May 17, then 7° below the planet on June 15.

MARS is visible in early May as a bright, orange-tinted object rising in the southeast around 2 a.m. By late June, it clears the horizon shortly after 11 p.m. During this time, the planet brightens from magnitude –0.4 to –2.2, and its disc nearly doubles in size, from 11 arc seconds to 21. In mid-May, Mars moves eastward from Sagittarius into Capricornus. It begins to retrograde westward on June 28.

JUPITER reaches opposition on May 8, when it's brightest for 2018—a beacon shining at magnitude –2.5 amid the dim stars of Libra. At opposition time, Jupiter rises at sunset, but by the end of June, it transits the meridian in twilight. The waxing gibbous Moon appears 5° east of Jupiter on May 27 and 4° northeast of the planet on June 23.

SATURN is at opposition on June 27, when it's brightest for 2018 (magnitude 0.1) and visible all night. Unfortunately, Saturn is in Sagittarius and nearly as far south on the ecliptic as it can appear. This results in the planet being unfavourably low for observers at Canadian latitudes. Saturn rises around 1:30 a.m. in late May and at sunset as summer begins. The planet's famous rings are tilted at an angle of 26°—just 1° shy of the maximum possible. The full Moon sits less than 1° north of Saturn on opposition night.

URANUS is lost in the glare of morning twilight until early June, when it emerges in the dawn sky. It shines at magnitude 5.8 on the Pisces/Aries border.

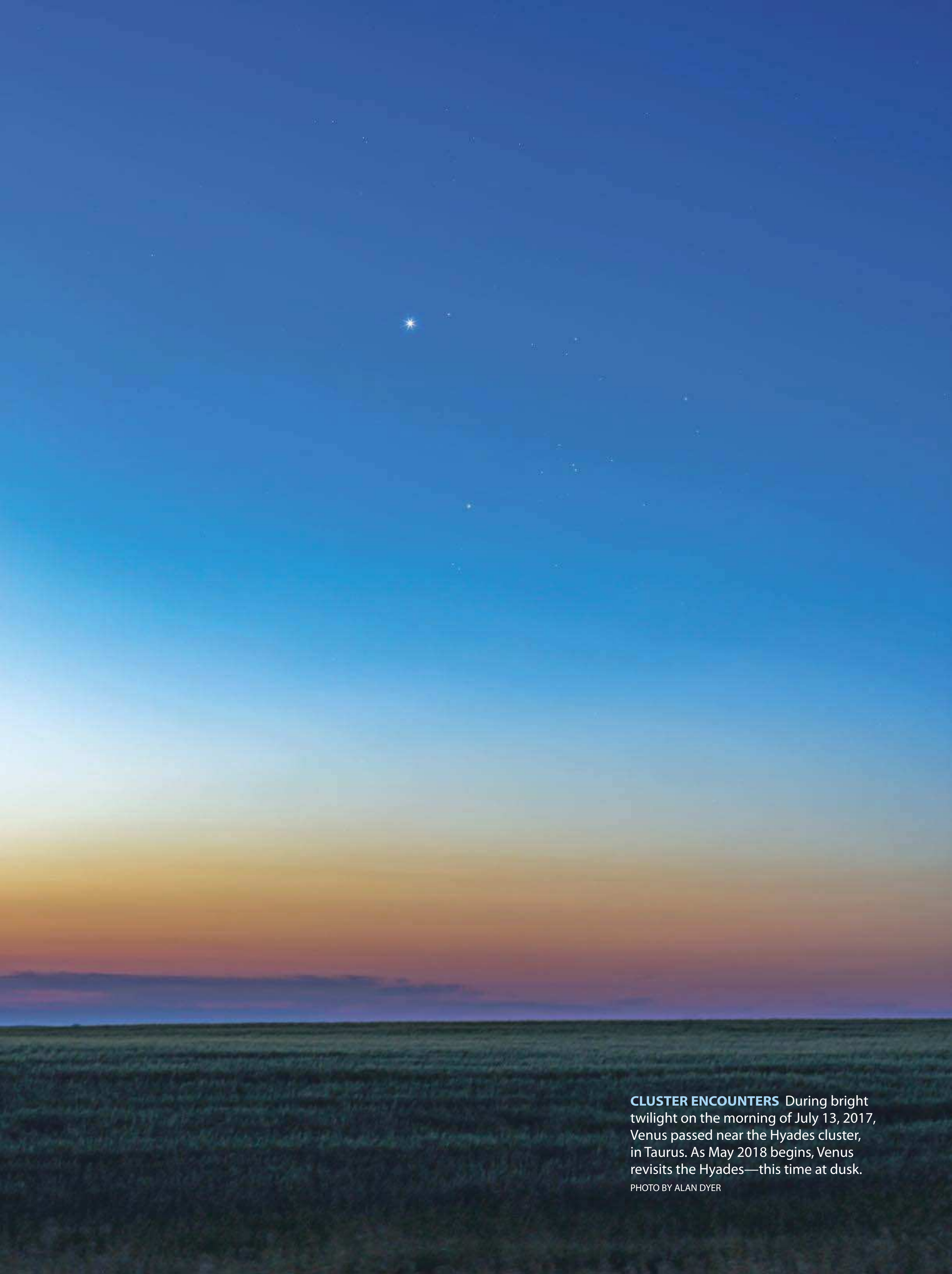
NEPTUNE is a predawn target glowing dimly at magnitude 7.9, roughly 1° west of 4.2-magnitude Phi Aquarii.

For additional details or late-breaking information, visit our website (skynews.ca). Also consult the *Observer's Handbook*, published by The Royal Astronomical Society of Canada (www.rasc.ca or 888-924-7272).

ROTATING NIGHT SKY: During the night, the Earth's rotation on its axis slowly shifts the entire sky. This is the same motion that swings the Sun on its daily east-to-west trek. The rotational hub is Polaris, the North Star, located almost exactly above the Earth's North Pole. Everything majestically marches counterclockwise around it, a motion that becomes evident after about half an hour.

CONSTELLATIONS: The star groups linked by lines are the constellations created by our ancestors thousands of years ago as a way of mapping the night sky. Modern astronomers still use the traditional names, which give today's stargazers a permanent link to the sky myths and legends of the past.

Cartography by Glenn LeDrew

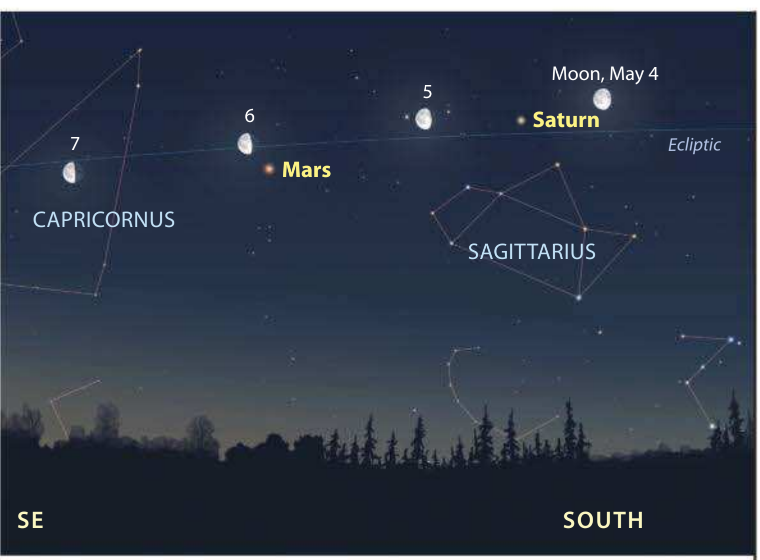


CLUSTER ENCOUNTERS During bright twilight on the morning of July 13, 2017, Venus passed near the Hyades cluster, in Taurus. As May 2018 begins, Venus revisits the Hyades—this time at dusk.
PHOTO BY ALAN DYER

GIANT PLANETS AT THEIR BEST

Jupiter and Saturn are closest and brightest for 2018 by ALAN DYER

ASIDE FROM A BRIEF APPEARANCE by Mercury, Venus has been the sole evening planet so far this year. However, its solo show wraps up when it's joined by Jupiter and Saturn. In mid-May, both gas giants rise well before midnight, followed by a rapidly brightening Mars.



DATE: **SUNDAY, MAY 6**
TIME: **PREDAWN**
TYPE: **CONJUNCTION**
VIEW: **BINOCULARS**

THE MOON AND MARS TOGETHER

In early May, Mars, Saturn and Jupiter are strung out across the southern predawn sky. The waning Moon passes each planet in turn, nearing Jupiter on April 30 and May 1, then Saturn on May 4 and 5. But the Moon's conjunction with Mars is by far the closest. At dawn on May 6, the lunar disc is positioned less than two degrees north of the red planet, which is shining at magnitude –0.5. This means the objects are close enough to easily fit in the field of view of binoculars or even a small telescope used at low power. The pairing is almost due south by the time bright twilight arrives and the stars fade from view.

CHARTS BY GLENN LEDREW

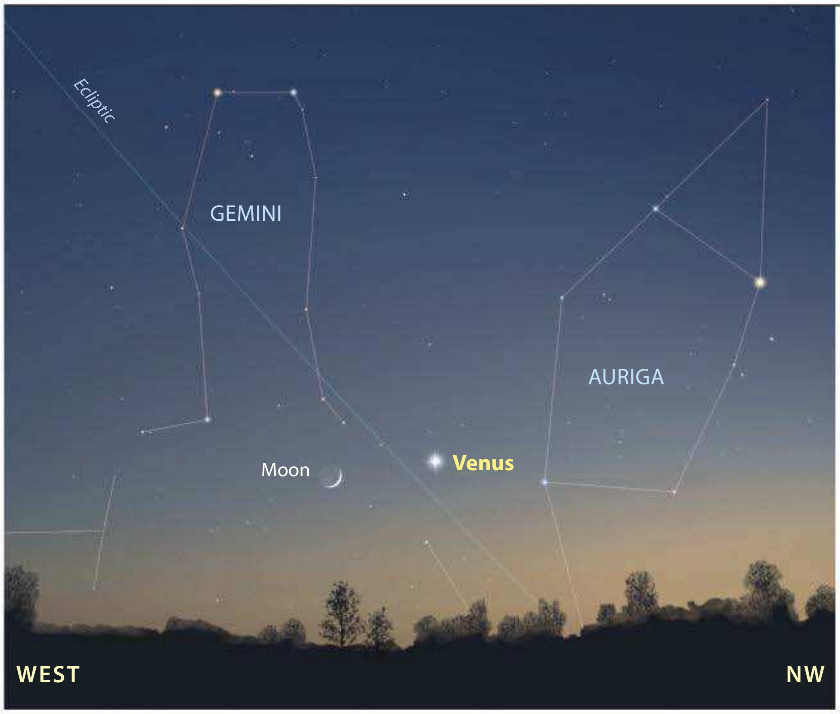
DATE: **TUESDAY, MAY 8**
TIME: **ALL NIGHT**
TYPE: **OPPOSITION**
VIEW: **NAKED EYE, TELESCOPE**

JUPITER AT OPPOSITION

Jupiter reaches opposition on May 8, when it rises at sunset and dominates the south in the middle of the night. At magnitude –2.5, Big Jove is at its most luminous for the year—second only to Venus. Jupiter's disc is at its maximum size as well, spanning 44.8 arc seconds. That makes early May the ideal time to pick out the prominent dark belts and Great Red Spot (GRS) on the Jovian disc. The GRS is located on the southern edge of the south equatorial belt and can be detected on nights when the planet's rotation carries it around to Jupiter's Earth-facing side.

Jupiter is slowly retrograding westward during spring, approaching 2.7-magnitude Alpha Librae, also known as Zubenelgenubi. On June 3, the planet passes less than one degree north of this wide, binocular double star.

PEAK JUPITER This nicely detailed Jovian portrait was captured in April 2016 (one month after opposition) by Pete Barbaro from his backyard in downtown Windsor, Ontario. He recorded the image data with a Celestron 8-inch Schmidt-Cassegrain telescope (fitted with a Celestron 3× Barlow lens) and an Imaging Source DBK 21 CCD video camera.



DATE: **THURSDAY, MAY 17**

TIME: DUSK | TYPE: CONJUNCTION

VIEW: NAKED EYE

A CRESCENT MOON MEETS VENUS

May is the perfect time to enjoy Venus's 2018 reign as the evening "star." Venus doesn't reach greatest elongation from the Sun until mid-August; however, the ecliptic's shallow angle during summer means that the planet is actually highest in mid-May. At magnitude −3.9, Venus gleams brilliantly in the western twilight after sunset. The waxing crescent Moon approaches Venus once a month throughout spring and summer, and on May 17, it sits five degrees to the left of the starlike beacon. Together, the pair are a lovely naked-eye sight at dusk. (The Moon returns on June 15, but it will be a couple of degrees farther away.)

MARS WATCH 2018: THE RED PLANET RETURNS

May begins with the disc of Mars appearing slightly larger than 10 arc seconds across—the oft-stated minimum size for glimpsing surface detail in a telescope. But the situation improves rapidly. By the end of June, Mars presents a disc greater in diameter than at any time since its favourable 2003 opposition.

Begin your Mars watch as soon as you can. Frequent high-power observing sessions will provide you with valuable experience, which, in turn, will make it easier for you to see fine detail on the Martian surface when the planet is at its best in July and August.

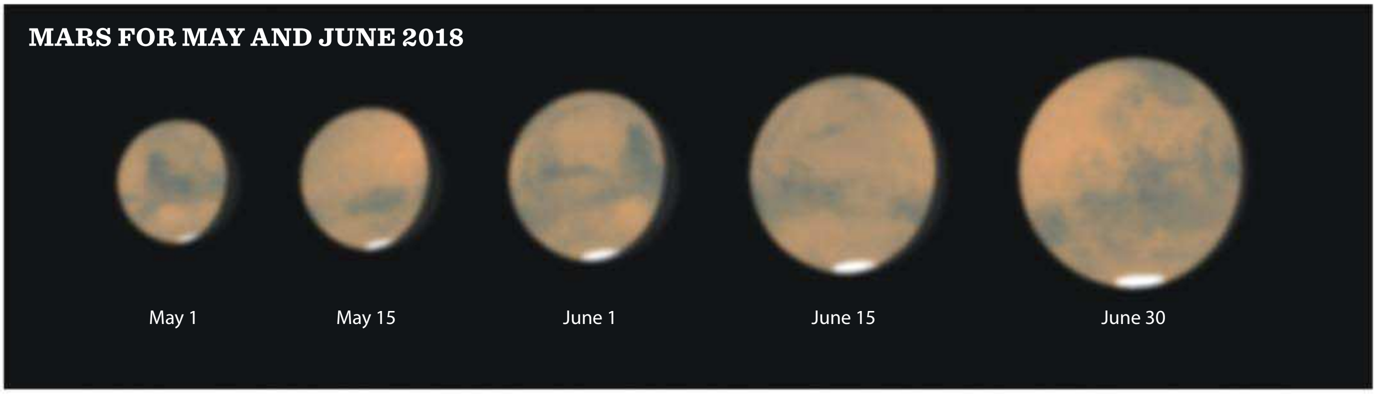
For much of May and June, the best telescopic views of Mars occur in morning twilight. In early June, the most interesting hemisphere of Mars—the side featuring the prominent dark marking Syrtis Major—is ideally positioned for Canadian observers when Mars is due south and highest.

MARS IN MAY AND JUNE 2018

Date	Mag.	Diam.	Transit (EDT)*
May 1	−0.4	11.1"	6:23 a.m.
May 15	−0.7	12.8"	5:55 a.m.
June 1	−1.2	15.4"	5:13 a.m.
June 15	−1.7	17.9"	4:31 a.m.
June 30	−2.1	20.8"	3:36 a.m.

**Transit times (when Mars is highest) are exact for Toronto, Ontario, and approximately correct for local daylight time at all other locations.*

MARS APPROACHES As this series of illustrations shows, the Martian disc grows appreciably in size in May and June. The planet is presented with north up and as it appears at the start of morning twilight in Ontario for the dates shown. *SKYNEWS* ILLUSTRATION

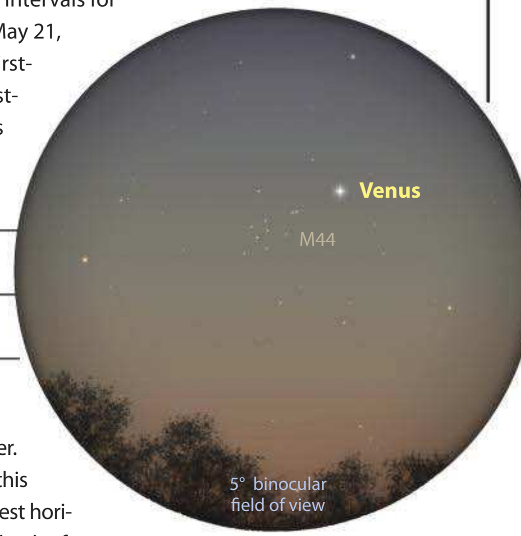


ALL CHARTS BY GLENN LEDREW UNLESS OTHERWISE NOTED

DATE: **MONDAY, MAY 21**	TIME: EVENING
TYPE: CONJUNCTION	VIEW: BINOCULARS

THE MOON ROARS BY REGULUS

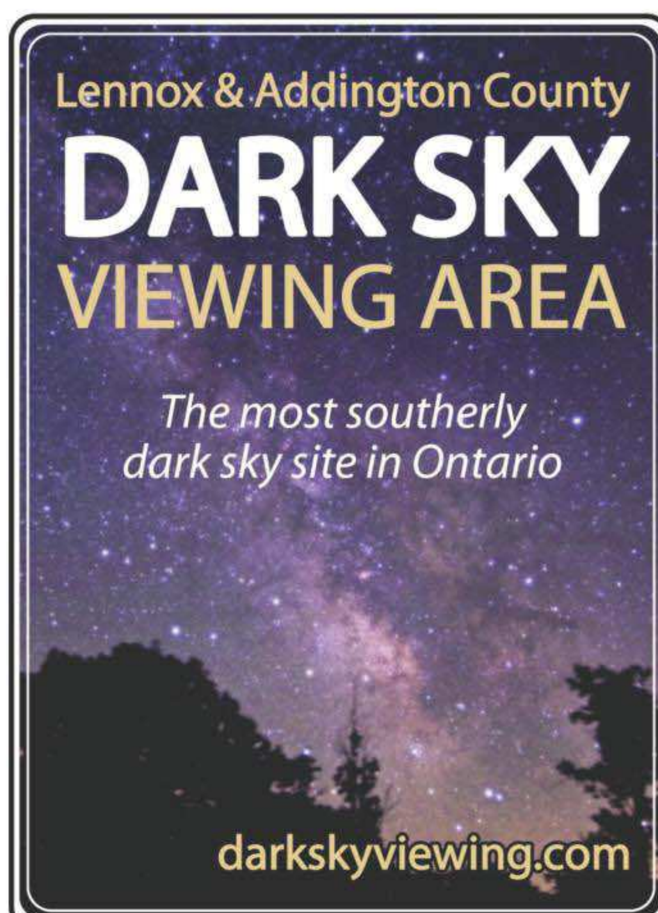
The Moon has been passing close to Regulus at monthly intervals for the past two years—sometimes even eclipsing the star. On May 21, observers in eastern Canada can witness a fine conjunction as the first-quarter Moon stands only one Moon diameter (½ degree) north of Regulus. By nightfall in western Canada, the separation between the objects has doubled to roughly one degree, yet that's still close enough to frame in a small telescope at low power.



DATE: **TUESDAY, JUNE 19**	TIME: DUSK
TYPE: CONJUNCTION	VIEW: BINOCULARS

VENUS BUZZES THE BEEHIVE

On the evening of June 19, Venus grazes the northern edge of the Beehive cluster (M44), in Cancer. The lingering evening twilight of the summer solstice combined with Venus's low altitude make this conjunction a challenging one to observe. But if you have a relatively unobstructed west-northwest horizon, use your binoculars or a low-power telescope to catch brilliant Venus next to this sparkling clutch of stars.



A LOW LUNAR ARC On late-spring and early-summer nights, the full Moon traces a path across the sky similar to the Sun's daily journey in early winter. This composite image from the night of July 9/10, 2017, records the Moon's motion as it rises at sunset (left) and sets at dawn (right). When this year's most southerly full Moon rises on June 27, it will again trace an arc low across the sky from southeast to southwest.
PHOTO BY ALAN DYER

DATE: WEDNESDAY, JUNE 27	TIME: EVENING
TYPE: OPPOSITION & CONJUNCTION	VIEW: NAKED EYE

THE FULL MOON MEETS SATURN AT OPPOSITION

Saturn reaches its annual opposition on June 27, when it appears brightest (zero magnitude) and is visible all night long. By coincidence, the Moon is also at "opposition" this same night. Of course, lunar opposition occurs every time the Moon is full. At dusk on June 27, both objects rise together, with Saturn positioned just one degree south of the Moon. This is the pair's closest conjunction of the year.

Saturn's low altitude throughout its 2018 apparition makes detailed telescopic views a challenge. However, when the glaring Moon isn't around, you can use binoculars to view golden-hued Saturn slowly drifting against the spectacular backdrop of the Sagittarius Milky Way. Enjoy the sight—Saturn won't return to this star-rich stretch of sky until 2047. ✦

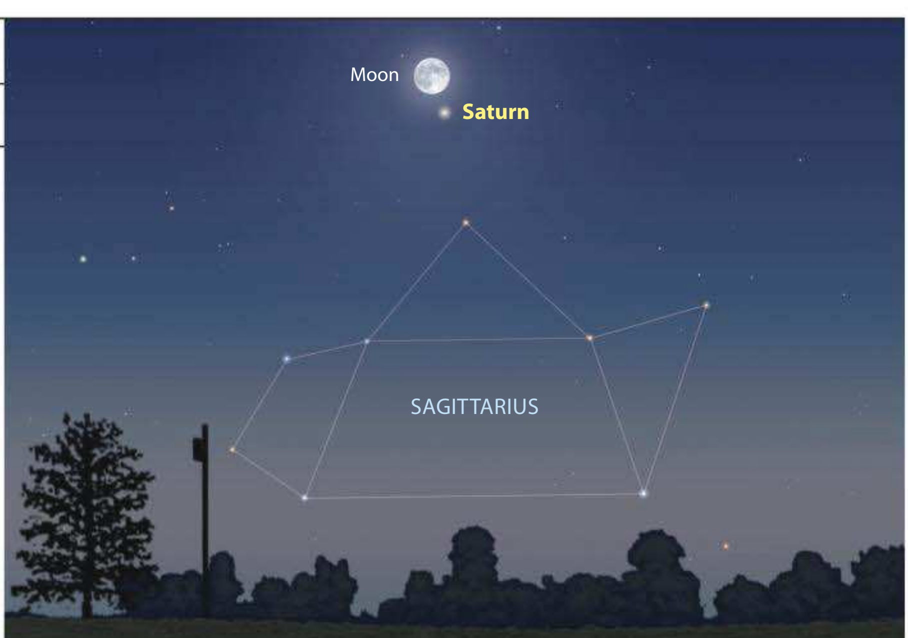
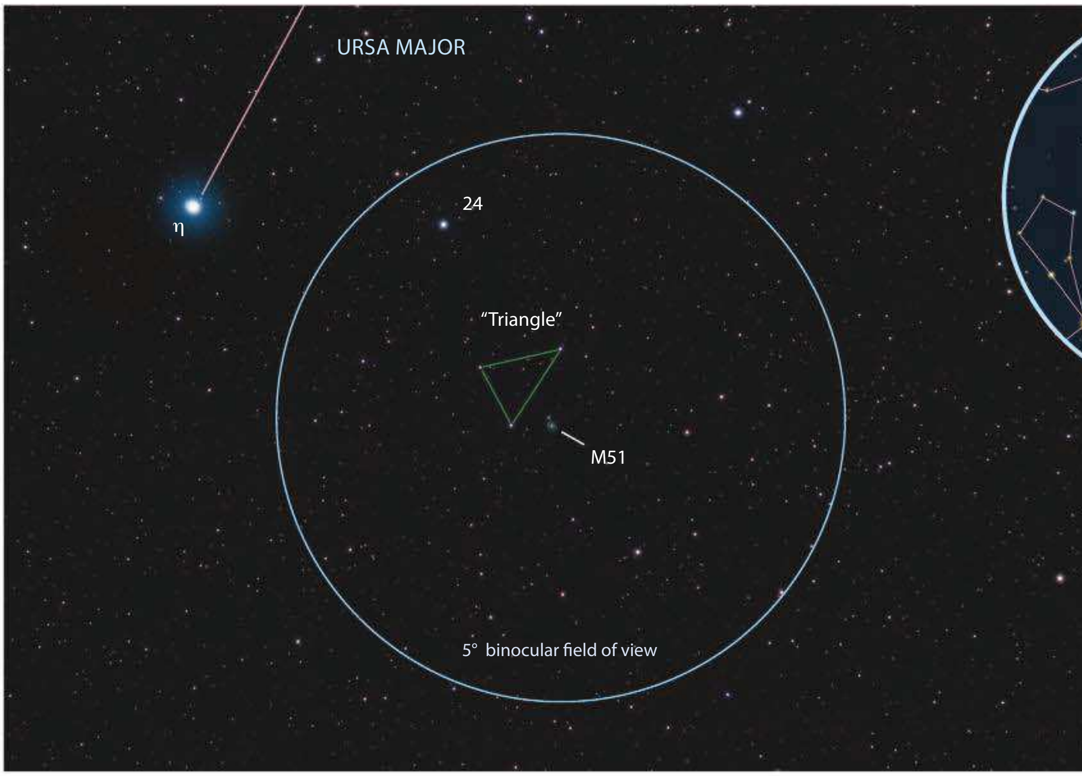


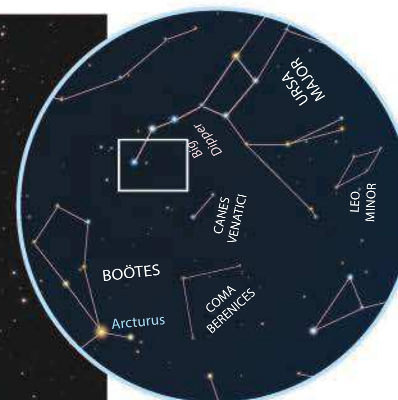
CHART BY GLENN LEDREW

by KEN HEWITT-WHITE

A COSMIC WHIRLPOOL

The handle of the Big Dipper is your gateway to a bino challenge high overhead





FROM HANDLE TO WHIRLPOOL M51 lies close to the Big Dipper. Our star-hop begins at Eta (η) Ursae Majoris, at the end of the Dipper's handle, proceeds westward to dimmer 24 Canum Venaticorum, then turns southward through a triangle of faint stars to the galaxy.
PHOTO BY GARY SERONIK

VETERAN binocular observers will tell you that good galaxies are hard to find. Even so, binos can reveal some of the nearer specimens.

M51, the famous Whirlpool Galaxy, is in the "near" category, measuring roughly 28 million light-years distant. Featuring a classic "grand-design" spiral structure, the Whirlpool is probably the best-known face-on spiral in the heavens. Its long, winding arms are resplendent with pink emission nebulas and blue star clusters, evidence of a fertile galaxy rich with ongoing star formation.

Alas, the observational facts for backyard binoculars are humbling. M51 is an 8.4-magnitude object spanning less than a fifth of a degree. This modest dimension includes a galactic companion, NGC5195, alongside M51. The diameter of the Whirlpool itself is barely one-tenth of a degree, and just the prominent central portion of that wound-up wisp is visible in binoculars. Our challenge is to find it.

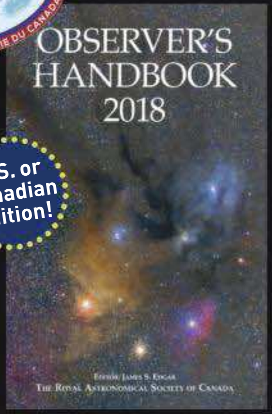
M51 resides in northwestern Canes Venatici, an inconspicuous constellation boasting exactly two stars better than fifth magnitude—neither close to our quarry. Fortunately, M51 is located right next to the Big Dipper. The bright star marking the end of the Dipper's handle, 1.8-magnitude Eta (η) Ursae Majoris, better known as Alkaid, makes a perfect starting point for a short star-hop to M51.

Our star chart for late spring (see page 24) shows the Dipper directly overhead at nightfall. I suggest you lie on the ground or settle into a reclining lawn chair, then aim your binoculars at Alkaid. A bit west of Alkaid is a 4.7-magnitude star named 24 Canum Venaticorum. 24 CVn is plotted on our star chart as a tiny dot beside Alkaid, and it's labelled on the detailed chart above. Your binoculars will show it in the same field as Alkaid. And, crucially, they'll reveal a small triangle of seventh-magnitude stars south of 24 CVn. Do you see a faint, round glow alongside the triangle? That's M51.

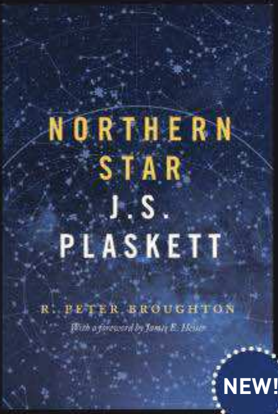
I can detect M51 in 7×50 binoculars from my suburban yard, provided the target is high up in a moonless sky and I'm down low in the shadows, shielded from neighbourhood lights. Using my tripod-mounted 10×50s away from town, I note a distinct spherical haze against the darker sky. Either way, there's not much to see.

There's lots to think about, though. That pale patch at the threshold of your vision represents uncountable billions of suns, not as they are now but as they existed 28 million years ago. The notion of stargazing as a form of time travel is just one imponderable you'll enjoy as you scrutinize a "nearer" galaxy barely close enough to comprehend. ✦

Must-Haves for 2018



U.S. or Canadian edition!



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THE EQ6-R PRO MOUNT FROM SKY-WATCHER

This revamped version of a venerable favourite has a new design and improved features. We take it for a test-drive to see how it handles.

Text and photographs by ALAN DYER

SKY-WATCHER'S EQ6 has long been a popular choice among those desiring a heavy-duty telescope mount. I favourably reviewed the original version in the May/June 2006 *SkyNews*. But 12 years is a long time for telescope gear to go unchanged, so a "refresh" was overdue. We arranged the loan of an early production model of that mount's successor, the EQ6-R Pro, from Pacific Telescope Corp. to find out what's new and noteworthy.

Using the EQ6-R Pro, I noted several worthwhile upgrades that could be described as "evolutionary," rather than "revolutionary." For example, the stated payload capacity of the EQ6-R Pro is 20 kilograms (44 lb)—two kilograms greater than the original. That's welcomed, but it's the ergonomic improvements I enjoyed the most. The hefty handle on the polar axis is a wonderful aid to setup. And in cold winter months particularly, I appreciated the large hand knobs on the tube clamps and the fine-motion adjustments. They're easy to grip even with gloves on.

The heaviest instrument I tried on the EQ6-R Pro was my Celestron C9.25 Schmidt-Cassegrain telescope (SCT), which tips the scales at 10 kilograms (22 lb), well under the mount's 20-kilogram capacity but in keeping with a rule of thumb which states that a telescope's weight shouldn't be more than one-half to two-thirds of the mount's rated payload limit. With the Celestron in place, vibrations damped out in about two seconds. That's as good as, if not better than, what I found with the same tube assembly on the original EQ6.

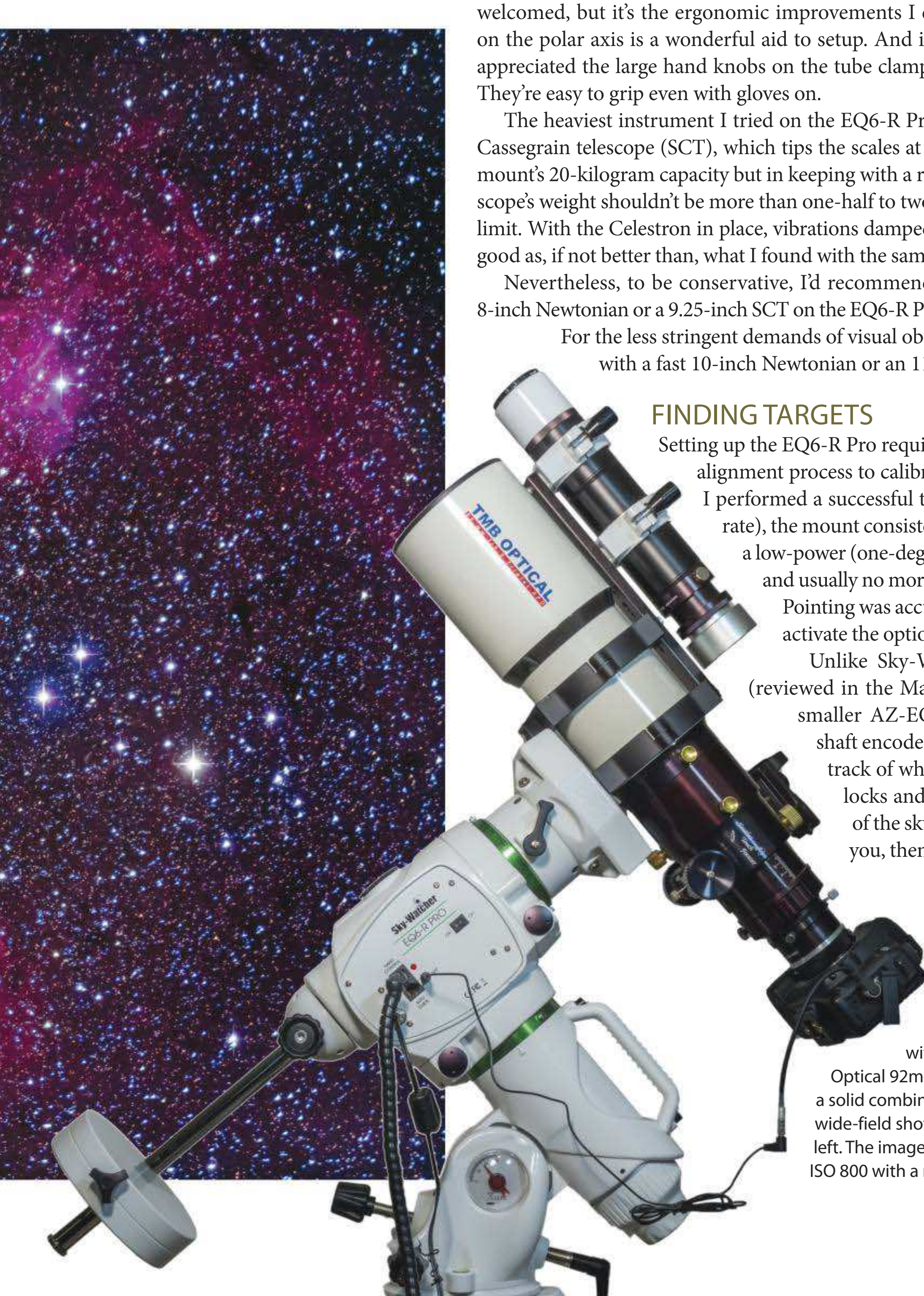
Nevertheless, to be conservative, I'd recommend nothing larger than a short-focus 8-inch Newtonian or a 9.25-inch SCT on the EQ6-R Pro if you plan to do astrophotography. For the less stringent demands of visual observing, the mount should work well with a fast 10-inch Newtonian or an 11-inch SCT.

FINDING TARGETS

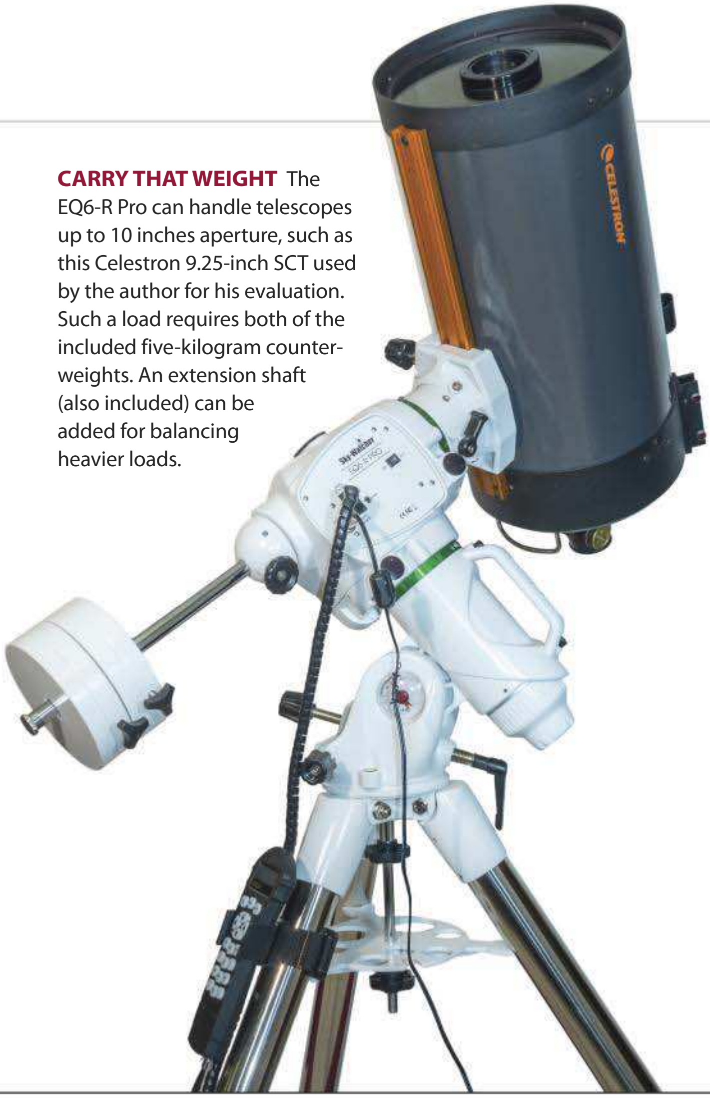
Setting up the EQ6-R Pro requires the usual one-, two- or three-star alignment process to calibrate the GoTo pointing system. After I performed a successful three-star alignment (the most accurate), the mount consistently placed targets near the centre of a low-power (one-degree field) eyepiece—often dead centre and usually no more than halfway to the edge of the field. Pointing was accurate enough that I never bothered to activate the optional "Cone Error" correction routine.

Unlike Sky-Watcher's more expensive AZ-EQ6 (reviewed in the May/June 2013 issue, page 35) and its smaller AZ-EQ5, the EQ6-R Pro doesn't include shaft encoders. Consequently, the mount will lose track of where it's pointed if you loosen the axis locks and swing the scope to some other part of the sky. If manual capability is important to you, then the AZ-EQ6 is likely a better choice.

The EQ6-R Pro includes an auxiliary GPS receiver, which saves you the task of having to manually enter



SOLID FOR IMAGING The new Sky-Watcher EQ6-R Pro mount paired with a small, fast scope, such as this TMB Optical 92mm f/5.5 apochromatic refractor, proved a solid combination, which the author used for this wide-field shot of clusters and nebulosity in Auriga, left. The image is a stack of six 6-minute exposures at ISO 800 with a modified Canon EOS 5D Mark II DSLR.



CARRY THAT WEIGHT The EQ6-R Pro can handle telescopes up to 10 inches aperture, such as this Celestron 9.25-inch SCT used by the author for his evaluation. Such a load requires both of the included five-kilogram counterweights. An extension shaft (also included) can be added for balancing heavier loads.

GLOVE-FRIENDLY The large knobs and spring-loaded latitude adjustment make precise polar alignment easy. The included illuminated polar scope has reticles for both the northern and southern hemispheres. New on the EQ6-R Pro mount is a windowed latitude dial.

MULTIPLATE HEAD The mount accepts both Vixen V-style and Losmandy D-style dovetail plates and utilizes large, secure clamping knobs. The green anodized setting circles, while attractive, appear dark under red light, making them difficult to read.

your location (usually just once) and the current date and time at the start of an observing session. With the little receiver connected to the hand controller, these parameters are entered automatically during start-up. Once you're up and running, you can remove the GPS unit if you wish.

POLAR ALIGNING

For casual visual use, precise polar alignment isn't necessary to locate and track objects. But if you want to take long-exposure photographs, more care is needed. Fortunately, the EQ6-R Pro mount has an excellent polar-alignment scope featuring a dimmable reticle illuminator controlled via the hand unit's "Utility" function. One minor change that I like concerns the polar-scope dustcap, which now snaps into place rather than screwing on, thus eliminating the chance of cross-threading.

The SynScan hand controller I tested (firmware version 4.37) also offers a polar-alignment routine to help you at observing sites where Polaris isn't viewable, perhaps because it's obscured by trees or a building. To take advantage of this handy feature, you first complete a three-star alignment, then enter *Alignment* > *Polar Alignment* mode. The mount slews to where a selected star is expected to be. Next, you use the mount's altitude and azimuth adjustments to centre the target star. While the routine worked, it resulted in a polar-alignment error of roughly 10 arc minutes, as measured by PHD2 Guiding software. Using the built-in polar scope, I was able to align with an error of less than 1.5 arc minutes, so this utility is best reserved for situations where it's definitely needed.

TRACKING THE SKY

A mount intended for astrophotography must be able to follow objects without introducing significant random or periodic error. In my tests, the EQ6-R Pro yielded a very low periodic error of about 15 arc seconds, peak to peak, over approximately eight minutes of tracking. This can be reduced by training the periodic error correction (PEC), but the results are retained only if the mount is "parked" between observing sessions. Unlike Sky-Watcher's two AZ-EQ mounts, the EQ6-R Pro lacks "permanent PEC."

One night, I used my 92mm f/5 refractor to shoot a total of 40, 45-second unguided exposures at ISO 6400. Even without PEC training, the tracking was smooth enough that every frame except one yielded untrailed stars. However, working with instruments of greater focal length and/or shooting longer exposures at lower ISO speeds is more demanding. These situations require auto-guiding—using an auxiliary imager (such as the Orion StarShoot auto-guider I used) and a second "guide" scope—to automatically feed guiding corrections directly to the mount's drive motors. When so equipped, the EQ6-R Pro auto-guided consistently well.

The EQ6-R Pro doesn't have hardware

or software "stops," so it's able to track an object crossing the meridian without interruption—a capability certain to be appreciated by those making long-exposure images. In addition, the mount can be instructed not to "flip" when performing a GoTo move to an object on the other side of the meridian. Bypassing this manoeuvre has its risks (the scope could collide with the mount), yet if executed cautiously, it can be helpful when aiming at a target in the east, then following it across the meridian with no change in the orientation of the scope and camera.

You can't fault a heavy-duty mount for being heavy, but be warned: The equatorial head of the EQ6-R Pro alone weighs 17 kilograms (37 lb), and heavier tube assemblies require using both included counterweights, which adds another 10 kilograms to the total. In other words, this is not the ideal mount for a spur-of-the-moment viewing session. However, if you're serious about observing and astrophotography with midsized scopes, the new EQ6-R Pro should make your short list. ✦

Alan Dyer is a world-renowned astrophotographer and SkyNews *contributing editor.*

SKY-WATCHER EQ6-R PRO EQUATORIAL MOUNT

Approximate retail price: $2,300

Available from Sky-Watcher dealers across Canada

ca.skywatcher.com

Summary:
A solid and accurate GoTo equatorial mount suitable for scopes up to 10 inches aperture

PLUSES

- Precise and quiet GoTo slewing
- Accurate tracking with low periodic error
- Large glove-friendly adjustment knobs and handle

MINUSES

- Not equipped with encoders to track position when moved manually
- Does not have permanent PEC
- Power cable has only cigarette-lighter plug

GOING WIRELESS

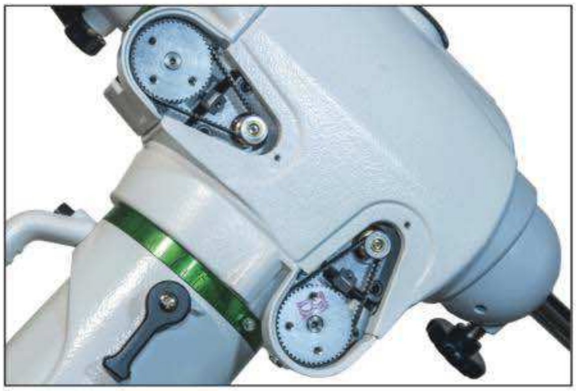
Telescope hand controllers using basic two-line LCD displays are looking a bit old-fashioned in 2018. Thankfully, you can control a Sky-Watcher telescope with your phone or tablet via the company's $75 WiFi adapter.

This little device allows you to perform all the functions of the hand controller —alignment, slewing, GoTo slewing, camera control, PEC training and hibernating— once you've installed the free SynScan app (available for iOS and Android devices). The "3rd Party Connection" feature on the SynScan app also allows the optional planetarium app, SkySafari Pro (US$39.99), to connect to the mount via the adapter for graphics-based pointing capabilities.

I encountered no problems connecting my iPad or iPhone with the WiFi adapter. Even if I quit the SynScan app while the scope was tracking a target, I could reconnect again later without the app losing track of where the telescope was aimed.

ADDING WIFI Sky-Watcher's new WiFi adapter replaces the hand controller and sets up an ad hoc SynScan WiFi network that you connect to your mobile device.

GETTING CONNECTED A power cable connects the EQ6-R Pro to any battery unit equipped with a standard 12-volt cigarette lighter (accessory) plug. The SNAP port allows the hand controller to operate a camera, with up to eight combinations of user-set exposure times and frame counts. However, the included cable is only for Canon cameras with a sub-mini E3 remote jack. Other camera makes require additional cables.



BELT DRIVEN The EQ6-R Pro, like other recent Sky-Watcher mounts, uses belt-driven gears (shown here with covers removed) for smoother tracking. Slewing is fast and quiet, ending with a short slow-speed motion to automatically take out the minimal backlash. The mount worked well even at temperatures as low as –10°C.

FROM SIBERIA TO ANDROMEDA

This collection of superb astrophotos demonstrates that meticulous technique and carefully chosen equipment can overcome suburban light pollution

IMAGER OLEG BOUEVITCH of Nepean, Ontario, has been on quite a journey. "My fascination with astronomy began many years ago, when I was growing up in the former U.S.S.R.," he says. "I was 12 when my dad gave me a copy of H.A. Rey's *The Stars*, translated into Russian. Inspired by Rey's book, I built my first telescope with a cardboard tube, a large lens from a pair of glasses and an old camera objective. I remember using it to observe a lunar eclipse in the midst of a Siberian winter. As I viewed the Moon, my parents were indoors watching me through a window to make sure I didn't freeze."

Bouevitch eventually settled in Canada, and in March 2015, he decided to take up astronomy once again—this time with a camera and a better scope. He ultimately selected an Atik 383L+ CCD camera and a Takahashi FSQ-106EDX III astrographic refractor (often fitted with a 0.73× focal reducer, for a working focal ratio of f/3.65). It's the equipment used for the pictures displayed here, except where noted.

But Bouevitch's continuing journey isn't about the gear or even about the impressive images he captures with it. As he explains, "What got me started—and keeps me going—is a deep-rooted fascination with space. A telescope is a time machine. When you look at remote galaxies, you are, in fact, seeing millions of years back in time. With the right equipment, anyone can take a nice photo, but for me, it's ultimately not about the picture—it's what the picture means that I find interesting."

That Bouevitch has been seriously imaging for only three years and is able to produce such tremendous results under light-polluted skies should offer encouragement and inspiration to anyone at the start of his or her own astrophotographic journey.

◄ **BEAUTY IN BLACK AND WHITE** This striking image of the nebula complex in Monoceros (catalogued as NGC2264) is a study in texture and contrast. Most conspicuous is the little comet-shaped feature, below centre, known as the Cone Nebula. Bouevitch's photo combines 11, 30-minute exposures recorded through an Astrodon H-alpha filter.

▲ **NEBULA FIT FOR A KING** IC1396 is a large patch of nebulosity located in the constellation Cepheus the king. In this photo, the Elephant's Trunk Nebula (sometimes listed as IC1396A) shows as a nebulous protrusion extending from the bottom edge toward the centre of the frame. To capture the scene, Bouevitch acquired a total of nearly eight hours exposure through Astrodon narrowband filters.

◄ **THE SWAN'S CRESCENT** The aptly named Crescent Nebula (NGC6888) is found roughly 2½ degrees southwest of Gamma Cygni, in the constellation Cygnus the swan. At the Crescent's centre is a remarkable 7.5-magnitude Wolf-Rayet star (WR 136) that shines some 250,000 times brighter than our Sun. For this image, Bouevitch used a Celestron EdgeHD 11-inch Schmidt-Cassegrain telescope (fitted with a 0.7× reducer, for a working focal ratio of f/7) to acquire a total of 10½ hours exposure through Astrodon narrowband filters.

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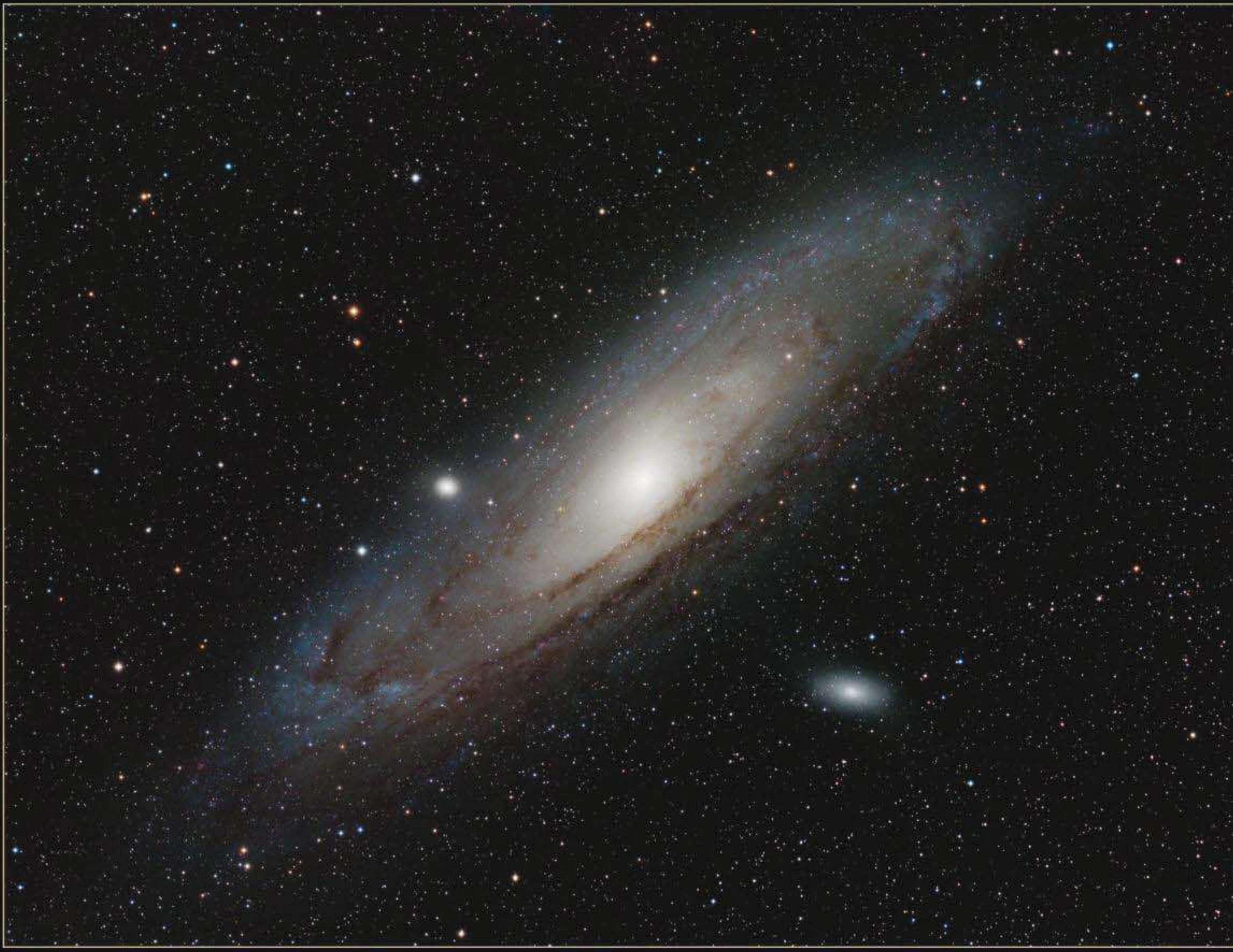
SkyNews
The Canadian Magazine of Astronomy & Stargazing

◀ **CELESTIAL ROSETTE** Arguably one of the finest winter deep-sky objects for photography is the wreathlike Rosette Nebula (catalogued collectively as NGC2237-8/46), in Monoceros. While detecting the large, dim object visually requires a dark rural sky, the associated cluster at its centre (NGC2244) can be viewed in binoculars. This Rosette portrait combines 340 minutes of exposure data shot with Astrodon narrowband filters.

▼ **ANDROMEDA SPIRAL** At a distance of 2.5 million light-years, the Andromeda Galaxy (M31) is the Milky Way's nearest large neighbour and a splendid telescopic sight. It's also a popular target for astrophotographers. This two-panel mosaic was shot through Astrodon red, green and blue filters—the final image utilizing a dozen 15-minute exposures through each filter. Unlike the other photos in this collection, Bouevitch's Andromeda was taken from a rural location in Maynooth, Ontario.



STAR PARTY CALENDAR

Dark night skies, mild weather, telescope viewing sessions, contests and informative talks are featured at summer gatherings across Canada. Contact organizers to confirm details and inquire about registration, accommodations and fees. Compiled by CHRISTINE KULYK

ATLANTIC CANADA

June 15-16
KOUCHIBOUGUAC SPRING STARFEST
Kouchibouguac National Park, New Brunswick
Contact: Paul Owen
Tel: 506-343-7975
E-mail: pacificpaul@msn.com
Website: sjastronomy.ca/star-parties-new-brunswick/kouchibouguac-spring-starfest

July 13-14
MOUNT CARLETON STAR PARTY
Armstrong Campground (in Mount Carleton Provincial Park), New Brunswick
Organizer: RASC New Brunswick Centre
Contact: Paul Owen
Tel: 506-343-7975
E-mail: pacificpaul@msn.com
Website: sjastronomy.ca/star-parties-new-brunswick/mount-carleton-star-party

August 10-12
NOVA EAST STAR PARTY
Smileys Provincial Park (near Newport), Nova Scotia
Organizer: RASC Halifax Centre
Contact: Registrar
E-mail: novaeast2018@halifax.rasc.ca
Website: halifax.rasc.ca/ne

August 10-11
TERRA NOVA PARK NIGHT SKY CELEBRATION
Terra Nova National Park, Newfoundland
Organizer: RASC St. John's Centre
Contact: Randy Dodge
Tel: 709-745-2903
E-mail: info@stjohnsrasc.ca
Website: www.stjohnsrasc.ca

August 17-18
BUTTER POT STAR PARTY
Butter Pot Provincial Park (west of St. John's), Newfoundland
Organizer: RASC St. John's Centre
Contact: Randy Dodge
Tel: 709-745-2903
E-mail: info@stjohnsrasc.ca
Website: www.stjohnsrasc.ca

August 17-19
KEJIMKUJIK DARK SKY WEEKEND
Kejimkujik National Park & National Historic Site, Maitland Bridge, Nova Scotia
Organizers: Parks Canada & RASC Halifax Centre
Contact: Audrey Levesque
Tel: 902-682-2772
E-mail: audrey.levesque@pc.gc.ca
Website: www.pc.gc.ca/keji

August 31-September 1
FUNDY PARK STARGAZE
Chignecto Campground (in Fundy National Park), New Brunswick
Organizer: RASC New Brunswick Centre
Contact: Paul Owen
E-mail: pacificpaul@msn.com
Website: sjastronomy.ca/star-parties-new-brunswick/fundy-park-stargaze

September 14-15
KOUCHIBOUGUAC FALL STARFEST
Kouchibouguac National Park, New Brunswick
Contact: Paul Owen
Tel: 506-343-7975
E-mail: pacificpaul@msn.com
Website: sjastronomy.ca/star-parties-new-brunswick/kouchibouguac-fall-starfest

CENTRAL CANADA

April 20, May 18, June 22, July 20, August 17, September 14, October 12
MILLENNIUM SQUARE STARGAZING NIGHTS
Millennium Square (south end of Liverpool Road), Pickering, Ontario
Organizer: RASC Toronto Centre
Contact: Arnold Brody
Tel: 905-903-2822
E-mail: arnbrody@gmail.com
Website: www.rascto.ca

May 10-13
FROZEN BANANA STAR PARTY
Mew Lake Campground (in Algonquin Provincial Park), Ontario
Organizer: North Bay Astronomy Club
Contact: Bill Montague
E-mail: astronomer123@bell.net
Website: www.gatewaytotheuniverse.org

May 11-14, September 7-10, October 5-8
AURORA BOREALIS WEEKEND
Gordon's Park Dark Sky Preserve (on Manitoulin Island), Ontario
Organizer: Gordon's Park
Contact: Rita Gordon
Tel: 705-859-2470
E-mail: rita@gordonspark.com
Website: www.gordonspark.com

May 11-12, June 8-9, July 6-7, August 3-4, September 14-15
NIGHT SKY STARGAZING TOURS
Lennox & Addington Dark Sky Viewing Area, Erinsville, Ontario
Organizer: Lennox & Addington County
Contact: Rob Plumley
Tel: 613-453-1010
E-mail: stargazing@lennox-addington.on.ca
Website: www.DarkSkyViewing.com

May 12, June 16, July 14, August 11-13, September 1, October 6
FRONTENAC STARGAZING EVENTS
North Frontenac Stargazing Pad, 5816 Road 506 between Plevna and Fernleigh, Ontario
Organizer: Township of North Frontenac
Contact: Corey Klatt
Tel: 613-479-2231, ext. 233
E-mail: recreation@northfrontenac.ca
Website: www.northfrontenac.com/dark-sky-preserve.html

May 19, June 16, July 14, August 11, September 8
ASTROPHOTOGRAPHERS ASSEMBLE
Lennox & Addington Dark Sky Viewing Area, Erinsville, Ontario
Organizer: Lennox & Addington County
Contact: Rob Plumley
Tel: 613-453-1010
E-mail: stargazing@lennox-addington.on.ca
Website: www.DarkSkyViewing.com

June 7-10
NEW MOON IN JUNE
Grundy Lake Provincial Park, Ontario
Organizers: North Bay Astronomy Club & Sudbury Astronomy Club
Contact: Linda Pulliah
Tel: 705-671-8127
E-mail: pulliah@fibreop.ca
Website: www.gatewaytotheuniverse.org

July 5-6
NOCTURNE X: A NIGHT SKY FESTIVAL
Cube Gallery, 1285 Wellington Street W., Ottawa, Ontario
Organizer: Cube Gallery
Contact: Don Monet
Tel: 613-728-1750
E-mail: don@cubegallery.ca
Website: cubegallery.ca

July 12-15
GATEWAY TO THE UNIVERSE
Location details TBA (Ontario)
Organizer: North Bay Astronomy Club
Contact: Bill Montague
E-mail: astronomer123@bell.net
Website: www.gatewaytotheuniverse.org

July 13-15
STARGAZING MANITOULIN: AN INTRODUCTION TO ASTRONOMY
Gordon's Park Dark Sky Preserve (on Manitoulin Island), Ontario
Organizer: Gordon's Park
Contact: Rita Gordon
Tel: 705-859-2470
E-mail: rita@gordonspark.com
Website: www.gordonspark.com

August 1-4
14TH ANNUAL INTERNATIONAL VIDEO ASTRONOMY STAR PARTY
Johnstown, Ontario
Contact: Rock Mallin
E-mail: mallincam@gmail.com
Website: www.mallincam.net/video-star-parties.html

August 9-12
AUGUST STAR PARTY
The Chapmans' observing field, Ontario
Organizer: North Bay Astronomy Club
Contact: Lillian or Robert Chapman
Tel: 705-386-7087
E-mail: bobandlil14@gmail.com
Website: www.gatewaytotheuniverse.org

August 9-12
STARFEST 2018
River Place Park (near Mount Forest), RR#3, Ayton, Ontario
Organizer: North York Astronomical Association
Contact: Ken Knox
Tel: 416-733-2048
E-mail: info@nyaa.ca
Website: www.nyaa.ca

August 10-13
PERSEIDS METEOR PARTY
Gordon's Park Dark Sky Preserve (on Manitoulin Island), Ontario
Organizer: Gordon's Park
Contact: Rita Gordon

SOLAR VIEWING DURING NOVA EAST STAR PARTY. PHOTO BY DON WRIGHT

Tel: 705-859-2470
E-mail: rita@gordonspark.com
Website: www.gordonspark.com

August 12-14
PERSEID METEOR SHOWER
Lennox & Addington Dark Sky Viewing Area, Erinsville, Ontario
Organizer: Lennox & Addington County
Contact: Rob Plumley
Tel: 613-453-1010
E-mail: stargazing@lennox-addington.on.ca
Website: www.DarkSkyViewing.com

August 23-26
HALF THE NIGHT STAR PARTY
Halfway Lake Provincial Park, Ontario
Organizer: Linda Pulliah with the Sudbury Astronomy Club
Contact: Linda Pulliah
Tel: 705-671-8127
E-mail: pulliah@fibreop.ca
Website: www.ogorman.ca

September 6-9
LAST CHANCE STAR PARTY
Group Site #601 in Restoule Provincial Park, Ontario
Organizer: North Bay Astronomy Club
Contact: Lillian or Robert Chapman
Tel: 705-386-7087
E-mail: bobandlil14@gmail.com
Website: www.gatewaytotheuniverse.org

September 7-9
FALL 'N' STARS
Boy Scout Camp (in Vanderwater Conservation Area), Thomasburg, Ontario
Website: rascbelleville.ca/fallnstars

September 7-9
R.O.C. (RENDEZ-VOUS DES OBSERVATEURS DU CIEL)
Saint-Romain, Quebec
Contact: Pierre Tournay
Tel: 450-458-7050
E-mail: PierreT@aei.ca
Website: www.roc-qc.net

September 15 (Rain Date: September 22)
STARS OVER KILLARNEY
Killarney Provincial Park Observatory, Ontario
Organizers: Science North & Sudbury Astronomy Club
Contact: Olathe MacIntyre
Tel: 705-522-3701, ext. 341
E-mail: macintyre@sciencenorth.ca
Website: sciencenorth.ca/starparty

Date TBA
CAFTA 2018
(Concours Annuel de Fabricants de Télescopes d'Amateurs)
Dorval, Quebec
Website: astrosurf.com/cdadfs/cafta.html

SASKATCHEWAN SUMMER STAR PARTY 2017, CYPRESS HILLS INTERPROVINCIAL PARK. PHOTO BY ALAN DYER

WESTERN CANADA

May 19
BEYOND THE BIG DIPPER
Rock Creek Campground in Grasslands National Park (East Block), Saskatchewan
Organizer: Grasslands National Park
Contact: Brenda Peterson
Tel: 306-476-2018
E-mail: grasslands.info@pc.gc.ca
Website: www.pc.gc.ca/grasslands

June 28-July 1
THE ROYAL ASTRONOMICAL SOCIETY OF CANADA GENERAL ASSEMBLY
University of Calgary campus in Calgary, Alberta
Organizer: RASC Calgary Centre
Contact: Robyn Foret
Tel: 403-803-1075
E-mail: arforet@shaw.ca
Website: https://rascga2018.ca

July 13-15
STARBQ
Eccles Ranch Observatory (north of Caroline), Alberta
Organizer: RASC Calgary Centre
Contact: Roland Dechesne
Tel: 403-510-4330
Website: calgary.rasc.ca/starbq2018.htm

July 14 & August 11
BEYOND THE BIG DIPPER
Frenchman Valley Campground in Grasslands National Park (West Block), Saskatchewan
Organizer: Grasslands National Park
Contact: Carmen Hanson
Tel: 306-298-2257
E-mail: grasslands.info@pc.gc.ca
Website: www.pc.gc.ca/grasslands

August 4-12
MOUNT KOBAU STAR PARTY
Summit of Mount Kobau (near Osoyoos), British Columbia
Organizer: Mount Kobau Astronomical Society
Contact: Jim Failes
Tel: 250-763-6962
E-mail: info@mksp.ca
Website: www.mksp.ca

August 8-13
SASKATCHEWAN SUMMER STAR PARTY
Cypress Hills Interprovincial Park (Centre Block), south of Maple Creek, Saskatchewan
Organizers: RASC Saskatoon Centre & RASC Regina Centre
Contact: Richard Huziak
Tel: 306-665-3392
E-mail: sssp.sk@sasktel.net
Website: sssp.saskatoon.rasc.ca

August 10-13
23RD ANNUAL ISLAND STAR PARTY
Bright Angel Park, 4528 Tigwell Road, Duncan, British Columbia
Organizer: Cowichan Valley Starfinders Astronomy Club
Website: starfinders.ca/island-star-party

August 23-26
THEBACHA AND WOOD BUFFALO DARK SKY FESTIVAL
Fort Smith & Wood Buffalo National Park, Northwest Territories
Organizer: Thebacha & Wood Buffalo Astronomical Society
Contact: Mike Couvrette
Tel: 867-872-0243
E-mail: info@tawbas.ca
Website: www.tawbas.ca

August 24-26
YUKON STAR PARTY
Whitehorse, Yukon
Organizer: RASC Yukon Centre
Contact: Viktor Zsohar
Tel: 250-408-4838
E-mail: yukonastronomicalsociety@gmail.com
Website: yukonastronomy.com

September 4-9
NORTHERN PRAIRIE STAR PARTY
Black Nugget Lake Campground (southeast of Tofield), Alberta
Organizer: RASC Edmonton Centre
Contact: Rick Bramm
E-mail: npsp@edmontonrasc.com
Website: edmontonrasc.com/northern-prairie-star-party

September 7-9
ALBERTA STAR PARTY
Starland Recreation Area Campground (north of Drumheller), Alberta
Organizer: RASC Calgary Centre
Contact: Jason Nishiyama
E-mail: albertastarparty@gmail.com
Website: calgary.rasc.ca/asp2018.htm

September 21-22
NORTHERN NIGHTS FESTIVAL
Kathleen Lake Campground (in Kluane National Park and Reserve), near Haines Junction, Yukon
Organizer: Parks Canada
Contact: Jackie Zinger
Tel: 867-634-7250
E-mail: kluane.info@pc.gc.ca
Website: www.pc.gc.ca/en/pn-np/yt/kluane

October 12-21
JASPER DARK SKY FESTIVAL
Jasper townsite & Jasper National Park, Alberta
Organizer: Tourism Jasper
Contact: Myriam Bolduc
Tel: 780-820-2124
E-mail: myriam@jaspercanadianrockies.com
Website: jasperdarksky.travel

Dates TBA
RASCALS STAR PARTY
Vancouver Island, British Columbia
Organizer: RASC Victoria Centre
Contact: Chris Purse, President
E-mail: president@victoria.rasc.ca
Website: victoria.rasc.ca/events/rascals-star-party

SkyNews 16th Annual
PHOTO of the WEEK CONTEST

HOW TO ENTER

Go to **skynews.ca/contest-rules** for contest rules, detailed instructions for submitting your photos and other information.

To be eligible to win, submissions must be received by **June 1, 2018**.

You may enter as often as you wish, but please don't send more than 10 of your best photos per entry.

THIS CONTEST IS OPEN TO RESIDENTS OF CANADA ONLY.

THREE EASY STEPS

Step 1.
Send your best astrophotos via e-mail to **photo@skynews.ca**.

Step 2.
We'll select the best submissions and publish a new photo every week at **skynews.ca**. The images posted on-line are eligible for our Readers' Choice Award.

Step 3.
The year's finest photos and honourable mentions will be published in the Sept./Oct. 2018 issue of *SkyNews*.

RULES AND INSTRUCTIONS

There are no entry fees or entry forms.

SEE PAGE 21 FOR PRIZE DESCRIPTIONS.

Photos previously submitted to the Photo of the Week Gallery, including those not published, are automatically eligible. Do not resubmit photos already sent.

Images should be in JPEG format, 2,400 pixels wide, and should not have text (such as labels, copyright notices or other information) imprinted on them.

Composite images (for example, those with foregrounds added digitally) are not eligible; however, photos consisting of stitched mosaics and panoramas are allowed.

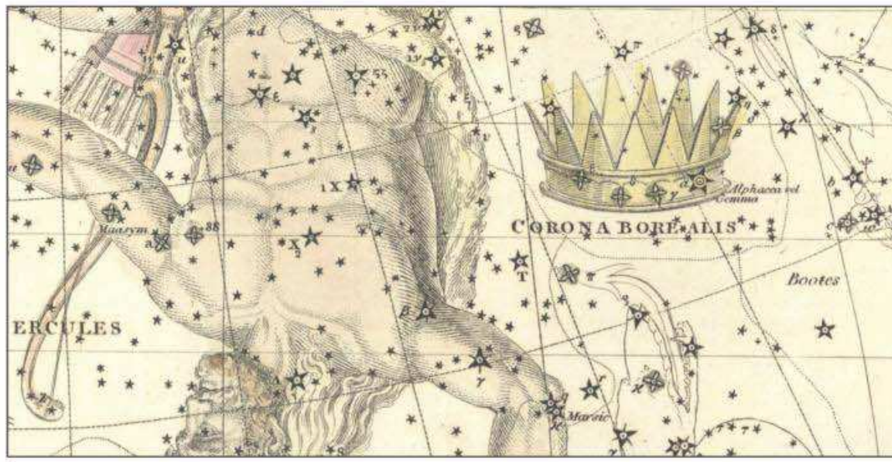
Please include as many of the following details as possible: camera make, lens, focal ratio, exposure time, processing steps, location and date. Put your name, phone number and address in your e-mail.

SkyNews.ca

by KEN HEWITT-WHITE

CORONA BOREALIS

The northern crown is a celestial reminder of a legend about a girl, a guy, a maze and a monster



THE FIFTH SMALLEST constellation of the northern heavens, Corona Borealis is dwarfed by neighbouring Hercules and Boötes. Yet Corona's distinctive semicircle catches the eye of most backyard astronomers. Seven degrees wide, the compact curve is outlined by seven stars ranging from second to fifth magnitude.

Its brightest member—the jewel in the crown—is 2.2-magnitude Alpha Coronae Borealis. Blue-white Alpha boasts two popular monikers. The most common is Alphecca, whose ancient Arabic root means "to separate, to break up," a possible reference to the fact that Corona's alluring asterism forms an incomplete circle. Alpha is also known as Gemma, a more recent Latin name meaning, appropriately, "the Gem."

Legend has it that the crown belonged to Princess Ariadne of Crete. Her father was King Minos, a vengeful man who spent much of his time settling an old score with the Athenians, his archenemies. He captured and fed Athenian youths to his hungry Minotaur, the infamous half-man, half-bull that inhabited the labyrinth in Minos' basement.

Enter Theseus, heir to the Athenian throne. He'll end this nonsense by navigating the maze and slaying the creature. Ariadne falls in love with the handsome lad and aids his cause by giving him a ball of golden yarn. Theseus uses the yarn to mark his path through the labyrinth. Before you know it, the Minotaur is mincemeat and the happy couple has set sail for Greece.

They overnight on the little island of Náxos. The next morning, tricked by the island's sole resident—a certain Mr. Dionysus (a.k.a. Bacchus, the god of wine) —Theseus sails without Ariadne. The scheming deity, who wants Ariadne for himself, convinces her that Theseus won't return anytime soon, then wins her hand by presenting her with his most prized possession: a jewel-studded crown. Dionysus announces his betrothal by tossing the gleaming coronet into the heavens.

There are often several versions of these convoluted mythic soap operas, and I prefer the one in which the princess has her own royal crown when she encounters Theseus. Her heart aflutter, Ariadne offers our hero the dazzling diadem as a kind of headlight for his treacherous journey through the maze. In this variation, the celestial Corona Borealis, illuminating its little corner of the sky, is a more fitting tribute to the loving lady of ancient Crete. ✦

IMAGE FROM ALEXANDER JAMIESON'S 1822 *CELESTIAL ATLAS*

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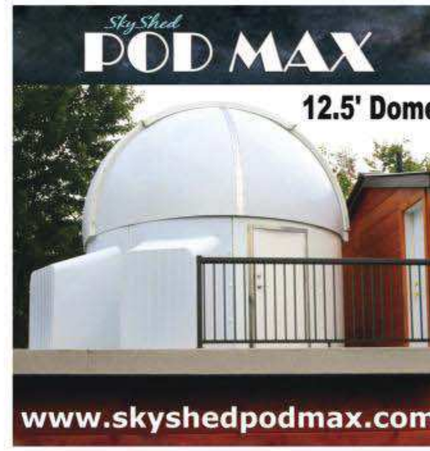

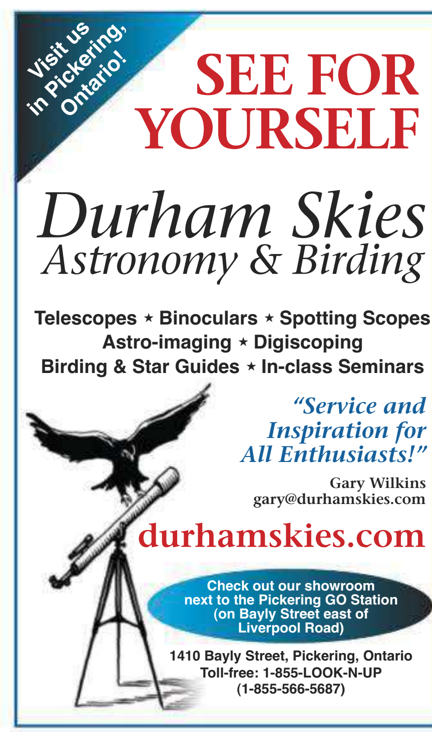

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by TERENCE DICKINSON

DUNLAP OBSERVATORY RECOLLECTIONS

An early spark burst into a brilliant flame after an encounter with a 74-inch telescope

I WAS IN GRADE THREE when I discovered the only children's book on astronomy in my school's library. It was the first time I'd ever encountered any real facts about the stars and planets, and I devoured that book. I'd always had an urge to know what's out there, and now I was able to find answers for some of my questions.

The most amazing thing the book disclosed was that stars are suns—like our Sun—radiating heat and light. Some of these distant suns could have planets, I read, like those in our solar system. This struck me as such a powerful idea that I immediately shared it with my teacher, who seemed markedly less enchanted than I was with the profound implications of this information. Nevertheless, I couldn't wait for the next clear night so that I could gaze at the stars, understanding their true nature for the first time.

A few years later, in 1955, I was still blathering about astronomy—so much so that my dad decided a field trip to the David Dunlap Observatory might help work off some of my youthful enthusiasm. It was a Saturday evening in the summer, and the 74-inch reflector was open to the public. Urban light pollution in the 1950s was so insignificant that from the observatory grounds, just north of Toronto, in Richmond Hill, Ontario, the Milky Way was a distinct powdery ribbon arching above the huge observatory dome.

As we climbed the stairway to the observing level, the giant dome's supporting ribs rose overhead as if reaching to infinity. And there, at the centre of it all, was a telescope almost as big as a school bus!

Motors whirred, the lights dimmed, and two great shutters rumbled open, exposing the starry vault to the giant instrument. The staff astronomer described how the telescope's enormous mirror collected starlight and reflected it to another mirror at the top of the tube, which then focused it into a concentrated cone at the base of the structure. There, an eyepiece was in place for visitors to view celestial treasures.

When it was my turn, I climbed the ladder and peered into the eyepiece. At first, there was nothing but darkness. Then I saw it. Swimming in the black abyss was a swarm of stars, like a pouch of diamonds dumped onto black velvet. This was a star cluster called M13—a collection of 100,000 remote suns. These stars were so far away, the astronomer explained, that their light takes 30,000 years to reach Earth.

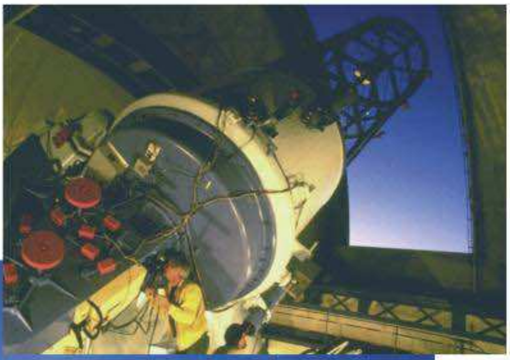
I was awestruck.

We looked at only one object that night in the observatory. But I was not about to leave without talking to the astronomer, the late Jack Heard, a gentle, knowledgeable man who patiently answered my questions about how big and how far. My dad almost had to drag me away.

The epilogue to this little story is that at an RASC meeting 13 years later, Jack Heard introduced me to Henry King, the newly appointed director of the McLaughlin Planetarium, then under construction at the Royal Ontario Museum, in Toronto. Shortly thereafter, I was working full-time at the planetarium, immersed in astronomy on a daily basis—youthful enthusiasm fully intact. ✦

Editor emeritus Terence Dickinson is the author or coauthor of 15 books, including NightWatch *and* The Backyard Astronomer's Guide.

DOME OF DREAMS This view of the dome housing the David Dunlap Observatory's 74-inch telescope, below, was recorded in July 2010 by photographer Christopher Luk of Toronto, Ontario. Right: Terence Dickinson at the eyepiece of the big reflector. The scope looks the same today as it did when this photo was taken in 1985. COURTESY TERENCE DICKINSON



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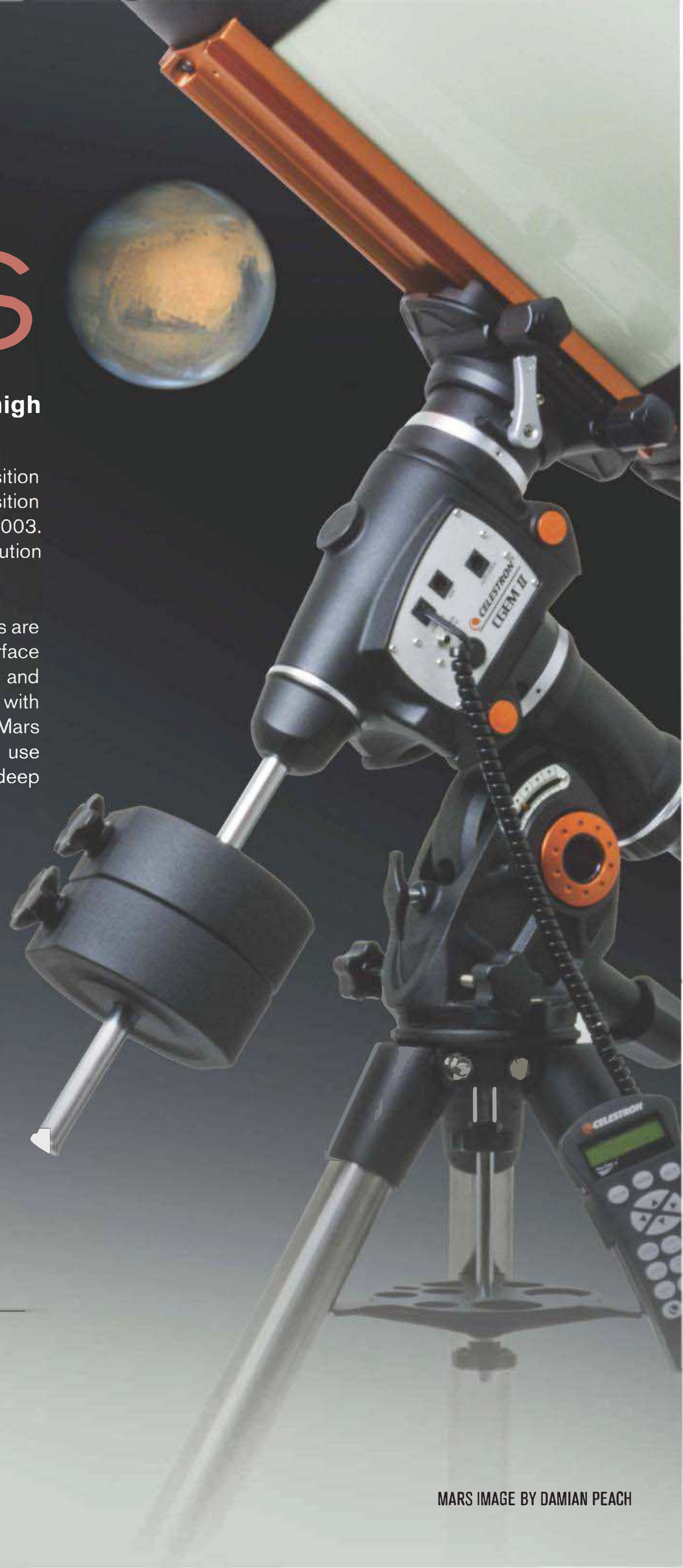

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