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SkyNews
WHERE EARTH MEETS SKY

VOLUME 26, ISSUE 3 · SEPTEMBER/OCTOBER 2020

Chasing tail

Comet NEOWISE (C/2020 F3) doesn't visit often. But the naked-eye wanderer stopped over in our skies in July, becoming the object of astrophotographers' affections across Canada.

08

DEPARTMENTS

FEATURES

ON THE COVER

"With only five minutes to image this comet between clouds," Tim Doucette captured Comet NEOWISE (C/2020 F3) on July 15, 2020 from his Deep Sky Eye Observatory in Quinan, Nova Scotia. Doucette said he used a ZWO ASI2600MC Pro and a Celestron 14 Edge HD and Hyperstar lens. The focal ratio was 684mm at f/1.9, and he took 17 exposures at 15 seconds each, processing the image in PixInsight and Photoshop.

By Allendria Brunjes

Michael Watson photographed Comet NEOWISE (C/2020 F3) from Algonquin Provincial Park in Ontario just after 11 p.m. on July 17, 2020.

Education and evolution

In the middle of July, I went out to Georgian Bay and paddled around Philip Edward Island, near Ontario's beautiful Killarney Provincial Park. Though I love kayaking and I've been doing it for years, I have tended to shy away from open, windy waters.

Not this time. I was out in the waves, edging, bracing and using knowledge and muscles I have built over the years but rarely tested. It was scary for me, paddling alone without a soul in sight, but I did fine. One of the reasons I went was to see Comet C/2020 F3 NEOWISE in a dark sky, which I'm told all true visual astronomers should see.

I wouldn't say I'm a "true visual astronomer," though. I was hired as managing editor of *SkyNews* for my abilities in the publishing industry. Though I have always loved reading about space science and astronomy, at this time last year I did not know who Charles Messier was. I had never heard of a GoTo system. I wouldn't have really known that a comet was passing through our Solar System, nor would I have taken binoculars into a dark area to watch its passage through our skies.

As such, since taking this position, I have been going through a steep, well-loved learning process.

Learning can be a scary endeavour. It involves opening yourself up to the fact that you could be so very wrong about that which you think you know. It requires listening, vulnerability and asking questions. Even though I've had some wonderful help and brilliant teachers, this job has at times felt like a scary solo paddle off unknown shores.

We have all been tested in strange waters over these past few months. From countries' COVID-19 reactions to the #BlackLivesMatter and #ShutdownSTEM movements, many of us are facing new realities that, though they existed, were never perhaps in our fields of view.

Many people are facing their changing worlds with grace and calm, open to education and evolution. They are wearing masks and washing hands, working to create inclusive spaces and tearing down structures that hold up racism and race-based violence.

The struggles to bring awareness to these issues are everywhere. They are within the astronomy and science communities, and it is our duty to learn what they are.

Perhaps you are not part of a population at risk of catching COVID-19. Maybe you have never felt the sting of racism keeping you from doing something you love. It doesn't mean these things don't exist. It doesn't mean that this magazine should turn a blind eye to the world around us and how it affects the people reading these pages.

I'll repeat myself — learning can be a scary endeavour. It involves opening yourself up to the fact that you could be so very wrong about that which you think you know. It requires listening, vulnerability and asking questions.

The astronomy community is made of people who have these strengths when targeting the skies. Let's remember to harness those skills when we shift the focus back down here to Earth. ✶

SkyNews

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Elizabeth Howell, PhD, is a Canadian space journalist. She writes books, teaches technical writing and publishes space-related articles in Canadian and American publications.

Nicole Mortillaro can be found looking up at the night sky appreciating the marvels of our universe. She is the editor of the Journal of the Royal Astronomical Society of Canada and the author of several books.

Chris Vaughan is a planetarium presenter and an astronomy public outreach and education specialist at AstroGeo, and an operator of the historic 74-inch David Dunlap Observatory telescope.

Brian Ventrudo is a writer and long-time amateur astronomer. An erstwhile laser physicist, he now writes about astronomy and stargazing at his blog CosmicPursuits.com.

I noticed an error in the May/June 2020 issue of *SkyNews* and would like to mention it.

On Page 11 in the section "It's not Mars" of the Beginner Sky article, the author notes that Antares lies in the "tail" of Scorpius. As you know Antares is actually found in the 'heart' of Scorpius. Indeed, both the Arabic and Latin names for Antares translate to 'heart of the scorpion.'

I am a little behind on my reading and expect someone else has already caught this, but I thought I would mention it, just in case.

Traci H. Guiler
Delhi, Ontario

You are indeed correct. Thank you for pointing it out, and we apologize for the error. — AB

I thoroughly enjoyed reading the July/August edition of *SkyNews*. The article by Chris Gainor on "Lessons learned" from an earlier pandemic is of course very timely.

However, the date associated with the photo attached to the article is incorrect. This photo was actually taken on October 21, 1916. The majestic 72-inch telescope had just been completed except for the mirrors. John Stanley Plaskett wanted to show off the magnificent telescope and invited members and friends of the Victoria Chapter of The RASC to watch as the great machine was put through its paces.

The gentleman in uniform at the bottom centre of the photograph is John Alexander Douglas McCurdy who went on to become the Lt. Governor of Nova Scotia (1947-1952). He was the son of Arthur McCurdy, a founding member of the Victoria Chapter who is standing to the right of his son.

Dennis Crabtree
Dominion Astrophysical Observatory
National Research Council
Victoria, British Columbia

Thank you for the correction and extra information. We apologize for the error. — AB

I love the magazine, so nice to still get a glossy magazine: great pictures, well-written articles and lots of ads for buying stuff for astronomy. I am still a novice I think, but the magazine is helping me learn more all the time.

Al Vinni
Fort McMurray, Alberta

As fascinating as the pictures coming from Bennu are, the obligatory expressions of hope on the cover and echoed in the article that 'an asteroid could change our understanding of life's origins' are beginning to sound more like a Freudian fixation than a scientific quest. In light of the numerous failed searches of the past, how many more, I'm wondering, will it take for scientists to accept the possibility that the 'absence of evidence' is becoming 'evidence of absence'?

Harry Kort
Beamsville, Ontario

I've been meaning to write for some time, then in your July/August edition I saw John Gillies comments and they fell right in with my disheartened sentiments on astronomy and *SkyNews* magazine.

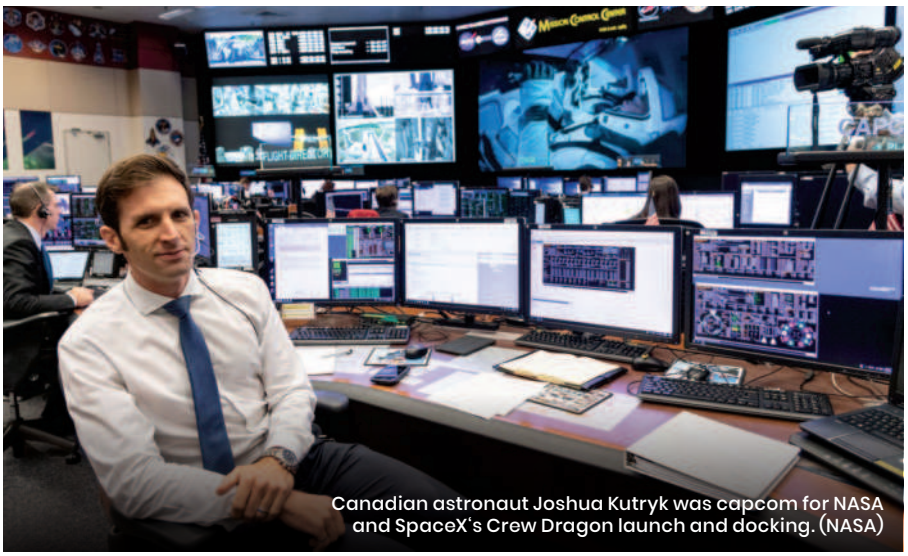
Firstly, I'm a long-time novice skywatcher (age 79). Ever since my teen years — when I was the first person to report the passing of Sputnik over the city of Drumheller, Alberta and to report it to our local radio station CJDV — I've spent endless nights at a campfire looking up to the twinkling "Milky Way" with just my eyes, and wondering.

This was followed by augmenting my vision with hunting binoculars and wondering, then with 20x80 Cabela's binoculars on a tripod, and I studied Jupiter and its moons and continued wondering. One day I was gifted a Walmart Special telescope for kids — and my God! — there was Saturn and its rings in view and the sight nearly made me dizzy.

John Gillies certainly made his point, and mine — I've never found a "nebula." I look in *SkyNews* and see incredible photos full of vivid colors. However, in reality after viewing Andromeda Galaxy, it's obvious there is no "colour" other than an "icky green." Such a sad state of affairs! I'm thinking along with John that there should be a "reality" photo to accompany those "technicolor masterpieces" of timelapse works of art. There should also be an explanation occasionally as to the confusing issue that astronomical telescopes rendering a view which is inverted.

So it all boils down to the fact that if there's a desire to promote astronomy as a viable, thrilling recreation among the younger generation it behooves *SkyNews* to provide some of the very basics, which will lead an enthusiastic young (even old) guy to take that step beyond bare eyesight, and reach out to the stars. Not everyone is an expert!

Wayne F. Brown
Twinkling Star, Saskatchewan
(Northward from Lloydminster, Alberta/Saskatchewan)



Canadian astronaut Joshua Kutryk was capcom for NASA and SpaceX's Crew Dragon launch and docking. (NASA)

Canadian astronaut capcoms Dragon mission

When Doug Hurley and Bob Behnken rocketed to space Saturday, May 30 in the first human SpaceX Crew Dragon mission, Canadian astronaut Joshua Kutryk helped guide them.

The Crew Dragon spacecraft is the first of a set of American commercial crew vehicles that will largely serve to replace astronauts' rides to space aboard the Russian Soyuz spacecraft.

Kutryk was the voice of "capcom," the "capsule communicator" who is the bridge between the Mission Control Center on Earth and astronauts in space.

Kutryk was capcom during the crucial launch and docking phases of the mission, while the astronauts were on their way to the International Space Station.

Space community supports #BlackLivesMatter movement

On June 10, organizations and people around the world, including Canadians, participated in #ShutDownSTEM and #ShutDownAcademia to take action for Black lives and against discrimination.

Countless scientists, laboratories, scientific societies, technical journals and others recognized, participated in and supported the event. Those who expressed support included *SkyNews*, The Royal Astronomical Society of Canada, the Canadian Astronomical Society, the Canadian Association of Physicists, the Ontario Science Centre, the American Astronomical Association, the American Association for the Advancement of Science, the scientific journal *Nature*, the University of British Columbia, McMaster University and the Massachusetts Institute of Technology.

The #ShutDownSTEM website at shutdownstem.com stated: "As members of the global academic and STEM communities, we have an enormous ethical obligation to stop doing 'business as usual.' No matter where we physically live, we impact and are impacted by this moment in history." ✶

CHASING TAIL

After other early 2020 comets fizzled, the Northern Hemisphere received an icy gift from the heavens.

Discovered March 27, 2020, bright-eyed and bushy-tailed Comet NEOWISE (C/2020 F3) became a naked-eye object in our evening and early morning skies through July.

The comet made its closest approach to the Sun — perihelion — on July 3, at 43 million kilometres (0.29 of an Astronomical Unit) away from our central star. The comet was closest to Earth July 23 at 1:09 UT, passing the planet at a distance of 103 million kilometres (0.69 of an Astronomical Unit).

NASA's Near-Earth Object Wide-field Infrared Survey Explorer (NEOWISE) mission discovered the comet using its two infrared channels, which were sensitive to the heat signatures given off by the object as the Sun warmed it.

Slingshotting back into space, Comet NEOWISE won't be back in our vicinity for another 6,800 years.

But while it was here, astrophotographers around Canada took some spectacular shots of its brief moment in our spotlight. ✳

Above: Siv Heang took this shot of Comet NEOWISE visible through Northern Lights on July 14 in Bragg Creek, Alberta. The image was made of 32 six-second exposures stitched together. The exposures were shot with a Nikon D500 and Sigma Art 20mm lens at 30mm. The aperture was set at f/2.2 with ISO 3200.

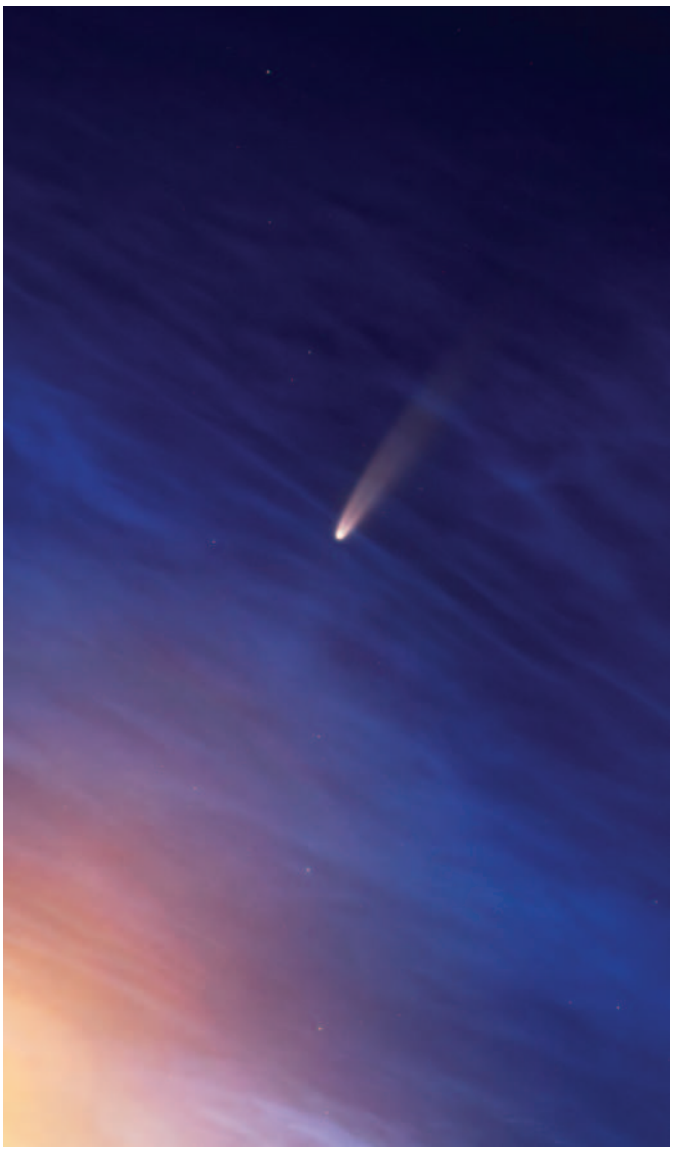
Right, top: Don Hladiuk took this picture of Comet NEOWISE from southern Alberta on July 13 while the Northern Lights were out and noctilucent clouds were on the horizon.

Right, middle: Frederictonian Jeff Beairsto took this image from Oromocto Lake in the reasonably dark skies of southwest New Brunswick on July 15 at 11:46 p.m. He said he used a Nikon D600 mounted on his new birthday present — a Starfield 500mm f/5.5 scope with a 1x field flattener (also Starfield). He said it was a 100-second exposure at ISO 1600, tracked on his CG-5 mount but unguided.

Right, bottom: Tenho Tuomi caught aurora in this 10-second exposure of the comet, taken from a farm 17 miles north of Lucky Lake, Saskatchewan on July 13. Tuomi used a Canon Rebel T5i with a Super-Takumar f/1.8 55mm lens, set to f/2.

Opposite, left: Ian Barredo captured Comet NEOWISE through noctilucent clouds and the glow of a Regina, Saskatchewan streetlight at 3:15 a.m. on July 10. He tracked the comet using a Sky-Watcher EQ6 equatorial mount and his 71mm telescope, with 335mm focal length, paired with a Nikon D5300 and a William Optics 71 lens. The exposure was five seconds.

Opposite, right: Barry Burgess shot this image on July 13 at 10:30 p.m. in Hubbards, Nova Scotia, as the evening view of the comet improved. He said he used a Canon 6D camera at ISO 3200 with a 135mm, f/2.8 adapted Sears lens set to f/4.0. Exposure was four seconds.



By Nicole Mortillaro

SHOW OUR MOON SOME LOVE

1

Nicole Mortillaro

The Crescent Moon

Slipping softly through the sky
Little horned, happy moon,
Can you hear me up so high?
Will you come down soon?

On my nursery window-sill
Will you stay your steady flight?
And then float away with me
Through the summer night?

Brushing over tops of trees,
Playing hide and seek with stars,
Peeping up through shiny clouds
At Jupiter or Mars.

I shall fill my lap with roses
Gathered in the milky way,
All to carry home to mother.
Oh! what will she say!

Little rocking, sailing moon,
Do you hear me shout — Ahoy!
Just a little nearer, moon,
To please a little boy.

—Amy Lowell (1874–1925)

Whether we're casual stargazers, enthusiastic amateurs or professional stargazers, we love the dark. We value it, treasure it. And for that reason, often we shake our fists at our constant companion that lights up the sky, dimming our vision or making it more difficult to catch far-off galaxies or star clusters: the Moon.

However, for almost all of us, the Moon is the first astronomical object in the night sky to which we ever truly paid attention, and it's a shame that it often has to endure the ire of stargazers.

One look through a telescope — or even high-powered binoculars — will transform the Moon from a bright, seemingly flat object to one that reveals peaks and shadows. Often, when I show the Moon to someone through my telescope, there's a gasp followed by an exclamation of awe. It's well deserved. The Moon has a lot to offer.

We take for granted that the Moon is always there, and it's always changing throughout the month. Take a look at it as a crescent, and then again when it's a waning or waxing gibbous, and you will notice the changes. **(Fig. 1)**

The most prominent features on the Moon are the mare, or "seas" — flat, dark plains that are huge basins of lava flows. **(Fig. 4)** There are about 20 major ones. The one people may be most familiar with is Mare Tranquillitatis, or the Sea of Tranquility. That's the landing site of Apollo 11, where humans first set foot on the Moon.

Aside from the misnamed "seas" (there aren't any seas, though there is some water ice on the Moon), the most obvious features are craters.

These craters are believed to have formed during the heavy bombardment of the Solar System's early formation. Leftover pieces of rocks and debris slammed into the Moon as it was forming. In fact, this still goes on, and has even been captured by amateur astronomers. Meteors impact the surface because the Moon doesn't have much of an atmosphere, so there's nothing to burn up debris as it burns in the Earth's atmosphere.

2

NASA/Goddard/Arizona State University

Lunar craters can be a marvellous sight to observe through binoculars or a small telescope. There are two prominent ones: Copernicus and Tycho.

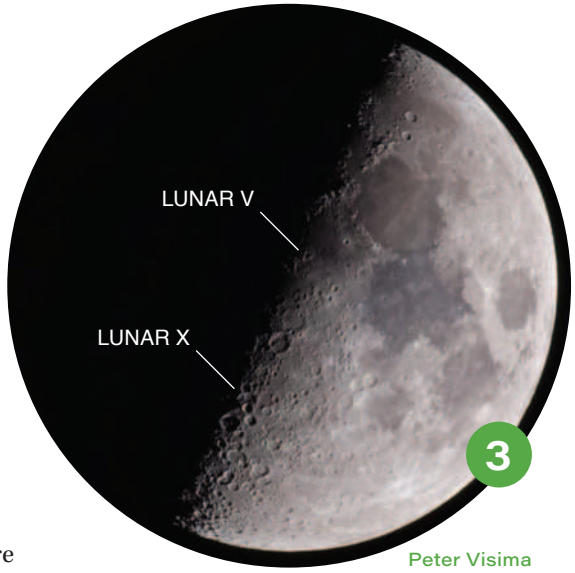
Copernicus can be found just below Mare Imbrium, as a bright white spot.

Tycho, meanwhile, is on the southern part of the Moon and is particularly obvious with its magnificent rays that extend from the crater. **(Fig. 2)** These are a result of material that was ejected after something large impacted the surface. Though bright now, in time the rays will fade.

As a side note, Tycho is probably most notably remembered in pop culture for being the location of the Monolith in *2001: A Space Odyssey.*

Due to something called tidal locking, we always see the same face of the Moon. (By the way, don't call the far side of the Moon the "dark side" of the Moon, no matter what Pink Floyd says; it does receive sunlight, just not that we can see.) However, from our point of view, the Moon "wobbles" from side to side. This wobbling means that sometimes we see just a little bit more of the Moon than other times. This can be fun (and a challenge!) to capture yourself, but if you stick with it and look at the full Moon over an extended period of time, you will certainly notice.

The Sun and Moon also move, causing illumination of the Moon in different ways. Lighting changes can lead to some interesting visual phenomena, most notably the "Lunar X." **(Fig. 3)**



Peter Visima

The Lunar X can be seen with binoculars (though, unless you know what you're looking for, it can be tricky) or small telescopes. It only occurs in the hours before the Moon's first quarter phase and lies along the shadow line between lunar day and night. Visible a little longer than the Lunar X, the Lunar V is a similar feature visible north of the X.

One other thing I'd like to address here is the "Supermoon." This term was coined by American astrologer (not an astronomer), Richard Nolle in 1979 to describe a new and full Moon occurring near perigee, when the Moon is closest to Earth in its monthly orbit. It's important to note that Nolle believed a Supermoon would cause increased earthquakes and severe weather, which is not true.

The term has become more popular over the last decade or so, with people claiming to see the Moon larger than it normally is during this time. The truth is that it's difficult to notice this phenomenon, where it is roughly 10 per cent larger and 20 per cent brighter. And here's an exercise to prove it. If you take an Aspirin pill (not a capsule) and hold it at arm's length when the Moon is up, and then again when it's a Supermoon, you will see that they're roughly the same size.

Usually, people who claim to see the larger Supermoon see it when it's on the horizon, and that's a result of our brains tricking us, something that was noticed as far back as the 11th century. Try the pill experiment again, once while the Moon is at the horizon and again when it's higher up in the sky. You'll see that they are the same size.

The point is, the Moon is marvellous no matter what, and it's easy to enjoy. Go ahead. Stop shaking your fist at it and enjoy it instead. ✳

NASA's Goddard Space Flight Center Scientific Visualization Studio

COSMOS FROM THE CLASSROOM

By Elizabeth Howell

(Nathan Dumlao/Unsplash)

Right: Life in the undergrad room. This image of Harrison Souchereau was submitted with a note that he could go down in history as one of astronomy's brilliant minds, and that it "would make a great find for future historians." Souchereau is a Saint Mary's University astrophysics graduate who won a full scholarship to Yale this year for a PhD.

A good introduction to astronomy can open a universe of opportunity. In Canada, the options are endless.

What is the value of astronomy in the world today?

It might seem esoteric. Many of the other sciences are focused on more practical aspects of our lives, such as engineering for safer machines and structures, or trying to create a vaccine that could address the novel coronavirus.

Even so, thousands of people take astronomy courses at Canadian universities each year, and thousands more participate in the field as amateur visual astronomers through groups and clubs like The Royal Astronomical Society of Canada.

Educators in astronomy say that whatever your background — whether you are skilled in physics or an astute observer in general — astronomy builds up experience that is useful both in science and in life.

You'll also gain an appreciation for history and culture, as Indigenous peoples and other societies have their own sky stories to share alongside the 88 constellations used by the International Astronomical Union. Amateurs thus can gain a lot from pursuing astronomy and related fields, and those seeking a professional experience will pick up other skills.

"For all that astronomy involves looking at things other than Earth, it can teach us a lot about Earth. Physics is the same everywhere — we think — and by studying astronomy we can learn how the same physics acts in different contexts," said Christa Van Laerhoven, a teacher candidate at the University of British Columbia who holds a PhD in planetary sciences.

"The same electromagnetic forces that are involved in powering your computer are also relevant for energy transport within the Sun. The gravity that pulls your water glass to the floor after the cat has knocked it over is the same as what makes moons orbit planets and planets orbit suns ... We can use the extreme environments we find in astronomy to test our understanding of how things work."

Paul Delaney, the Allan I. Carswell Chair for the Public Understanding of Astronomy at York University, pointed to benefits from astronomy for amateurs and professionals alike.

"Astronomy is visually appealing and can be discovered at some level in your own backyard without resorting to expensive equipment or advanced degrees. Its lure – The Force! – is strong," he said.

"However, those students who study astronomy at university are rewarded in very practical ways. To complete an astronomy degree requires a thorough understanding of physics, which in turn necessitates strong mathematical and computing skills. Physics, mathematics and computing — especially programming — are a winning trifecta for problem-solving in any field."

> "PHYSICS, MATHEMATICS AND COMPUTING – ESPECIALLY PROGRAMMING – ARE A WINNING TRIFECTA FOR PROBLEM-SOLVING IN ANY FIELD."
>
> – Paul Delaney, the Allan I. Carswell Chair for the Public Understanding of Astronomy at York University

A good course — and good mentor — can really help bring a person into the astronomical fold. Karim Jaffer is a professor at John Abbott College, a CEGEP in Montreal.

He has been teaching a standalone astronomy class at the school, an independent study course that includes optional observing nights with RASC's Montreal Centre.

"Our approach at John Abbott College is a novel approach that puts the direction and depth of the content covered into the students' control, while incorporating the offerings of our local RASC Montreal Centre to motivate and mentor the students in actual observing experiences and methods for practicing astronomical analysis," he said.

Jaffer said the course has been a launch pad for students (for a word from them, flip to Page 40). Some students asked to continue research after the course, and he has set them up with Quebec universities, giving them extra work that has included exoplanet research and telescope coding.

"The dynamic connection these students form to astronomy activities (and to RASC Montreal Centre), and their successes after completing the course, highlights the effectiveness of this self-directed, mentored approach to intro astronomy," he said.

That good intro to astronomy course can stay with a person for a lifetime. In an email, amateur astronomy enthusiast Bruce Allison said he was a math major when he signed up for a two-semester course in college in 1967. The science elective covered the Solar System, stars and galaxies, and there were many hands-on activities.

"My astronomy instructor was also my calculus instructor (Mr. Dixon), but his first love was astronomy," Allison said. "He invited students from his classes to his house for star parties. As I remember, he had a rather large telescope in an outside viewing building that had a sliding roof. He was one of my best instructors in all of my university studies."

Allison's professional career concentrated on food security issues under less than desirable environments, he said, noting he focused on things like water scarcity, extreme weather and wind and water erosion. He added that his academic background paralleled many aspects of astronomy he enjoys.

"At this juncture of my life, I am a little saddened I let astronomy sit in the background for so long," he said. "Sometimes, life just gets in the way. Being retired, I now have time to enjoy astronomy and more."

The following pages include a list of astronomy-related programs at Canadian universities, giving a slim sense of what is available in English. Even so, a university course is not the be-all-end-all of an education. There are courses and mentors everywhere in Canada, and a lot of learning in astronomy comes from the simple act of looking up and being open to lessons of the universe. →

— With files from Allendria Brunjes

Athabasca University
Athabasca, Alberta

Featured degree:
- Bachelor of Science

Sample courses:
- Universe – The Ultimate Frontier
- Planetary Science

Bishop's University
Sherbrooke, Quebec

Featured degrees:
- Bachelor or Master of Science: Physics

Sample courses:
- Physics of Everyday Phenomena
- Introduction to Astronomy
- Astronomy & Astrophysics

Brandon University
Brandon, Manitoba

Featured degree:
- Bachelor of Science: Physics & Astronomy

Sample courses:
- Solar System Astronomy
- The Galaxy & the Universe
- Stellar & Galactic Astrophysics
- Elementary Astronomy

McGill University
Montreal, Quebec

Featured degrees:
- Bachelor of Science: Physics
- Master of Science or Doctorate: Earth & Planetary Sciences, Physics
- Master of Laws or Doctor of Laws: Air & Space Law

Sample courses:
- Electromagnetism & Optics
- The Earth System
- Elementary Earth Physics

McMaster University
Hamilton, Ontario

Featured degrees:
- Bachelor of Science: Physics, Astrophysics
- Master of Science or Doctorate: Physics & Astronomy

Sample courses:
- Introductory Physics
- Introduction to Astronomy & Astrophysics

Memorial University
Corner Brook, Newfoundland

Featured degree:
- Bachelor of Science: Physics

Sample courses:
- General Physics I: Mathematics
- Stellar Astrophysics

Mount Allison University
Sackville, New Brunswick

Featured degrees:
- Bachelor of Science: Physics, Mathematics & Physics, Astronomy minor

Sample courses:
- General Physics I
- Solar System Astronomy

Queen's University
Kingston, Ontario

Featured degrees:
- Bachelor of Science: Physics, Astrophysics, or Mathematical Physics
- Master of Science or Doctorate: Physics

Sample course:
- Astronomy I: The Solar System

Royal Military College
Kingston, Ontario

Featured degrees:
- Bachelor of Science: Physics, Space Science

Sample courses:
- Introduction to Space Science
- Spacecraft Mission Analysis & Design

Saint Mary's University
Halifax, Nova Scotia

Featured degrees:
- Bachelor of Science: Physics, Astrophysics
- Master of Science or Doctorate: Astronomy

Sample courses:
- The Sky & Planets
- Physics of Stars

Trent University
Peterborough, Ontario

Featured degrees:
- Bachelor of Science: Physics, Mathematical Physics

Sample course:
- Introductory Astronomy I

University of Alberta
Edmonton, Alberta

Featured degrees:
- Bachelor of Science: Astrophysics
- Master of Science or Doctorate: Space Physics, or Planetary Sciences

Sample courses:
- Particles & Waves
- Astronomy of the Solar System

University of British Columbia
Vancouver, British Columbia

Featured degrees:
- Bachelor of Science: Physics, Astronomy, or Physics & Astronomy
- Master of Science or Doctorate: Astronomy

Sample courses:
- Exoplanets & Astrobiology
- Exploring the Universe: Stars & Galaxies
- Planetary Science
- Frontiers of Astrophysics

University of Calgary
Calgary, Alberta

Featured degrees:
- Bachelor of Science: Physics, Astrophysics
- Master of Science or Doctorate: Astrophysics

Sample courses:
- Introduction to Astronomy I
- Introduction to Astrophysics
- Gravitation

University of Guelph
Guelph, Ontario

Featured degrees:
- Bachelor of Science: Physics, Theoretical Physics
- Masters of Science or Doctorate: Physics

Sample courses:
- Integrated Mathematics & Physics I
- Contemporary Astronomy

University of Lethbridge
Lethbridge, Alberta

Featured degree:
- Bachelor of Science: Physics

Sample courses:
- Introduction to Physics
- Modern Astronomy
- Introduction to Cosmology
- The Solar System

University of Manitoba
Winnipeg, Manitoba

Featured degrees:
- Bachelor of Science, Master of Science or Doctorate: Physics & Astronomy

Sample courses:
- General Astronomy
- Observational Astronomy
- Phenomenology of Galaxies
- Stars

University of Ottawa
Ottawa, Ontario

Featured degree:
- Bachelor of Science: Physics

Sample courses:
- Modern Physics
- Waves & Optics
- Thermodynamics

University of Regina
Regina, Saskatchewan

Featured degree:
- Bachelor of Science: Pure & Applied Physics

Sample courses:
- Introduction to General Relativity
- From Quarks to the Cosmos
- Stellar Structure & Evolution

University of Saskatchewan
Saskatoon, Saskatchewan

Featured degree:
- Bachelor of Science: Physics, optional Astronomy minor

Sample courses:
- Introduction to Galaxies & Cosmology
- Astronomical Photometry
- Astronomical Spectroscopy

University of Toronto
Toronto, Ontario

Featured degrees:
- Bachelor of Science: Astronomy & Physics, Astronomy, Planetary Science
- Doctorate: Astronomy & Astrophysics

Sample courses:
- Origin & Evolution of the Universe
- Introduction to Astrophysics
- Great Astronomical Issues
- Stars & Galaxies
- Life on Other Worlds

University of Victoria
Victoria, British Columbia

Featured degrees:
- Bachelor of Science: Astronomy, or Physics & Astronomy
- Master of Science or Doctorate: Astronomy

Sample courses:
- Concepts in Modern Astronomy
- Exploring the Night Sky
- Exploring the Cosmos

University of Waterloo
Waterloo, Ontario

Featured degree:
- Bachelor of Science: Astrophysics

Sample courses:
- Introduction to the Universe
- Astronomical Observations, Instrumentation & Data Analysis Laboratory
- Stars

University of Western Ontario
London, Ontario

Featured degrees:
- Bachelor of Science: Physics, Astrophysics, optional Conceptual Astro minor
- Master of Science or Doctorate: Astronomy

Sample courses:
- Introductory Physics I
- General Astronomy

University of Winnipeg
Winnipeg, Manitoba

Featured degrees:
- Bachelor of Science: Computational Physics, or Mathematical Physics

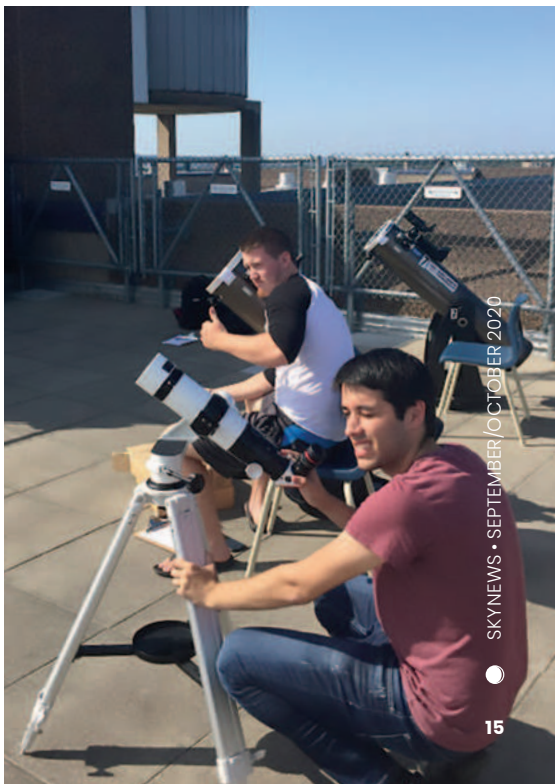
Sample courses:
- Foundations of Physics
- Astronomy

York University
Toronto, Ontario

Featured degrees:
- Bachelor of Science: Physics & Astronomy
- Master of Science or Doctorate: Astronomy & Astrophysics, or Planetary Physics

Sample courses:
- Planets & Planetary Systems
- Physics of the Space Environment
- Radio Science & Techniques for Space Exploration ✶

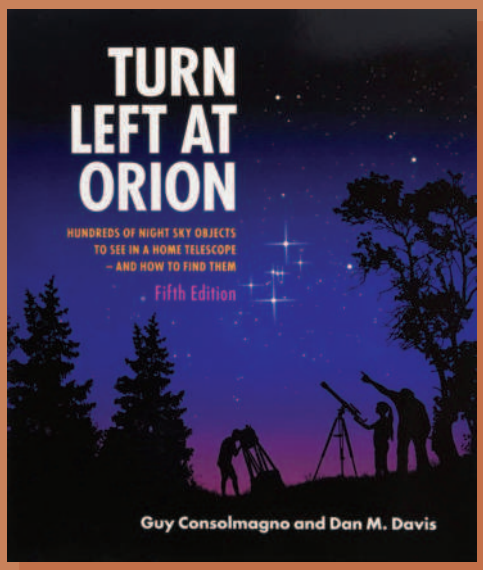
(Top to bottom) Master student Tiffany Fields and undergraduate student John Read set up a solar observing lab at Saint Mary's University. Owen Sharpe, Fields and Read prepare for the 2017 solar eclipse. Astrophysics student Cole Martin gives a thumbs up with fellow student Souchereau.

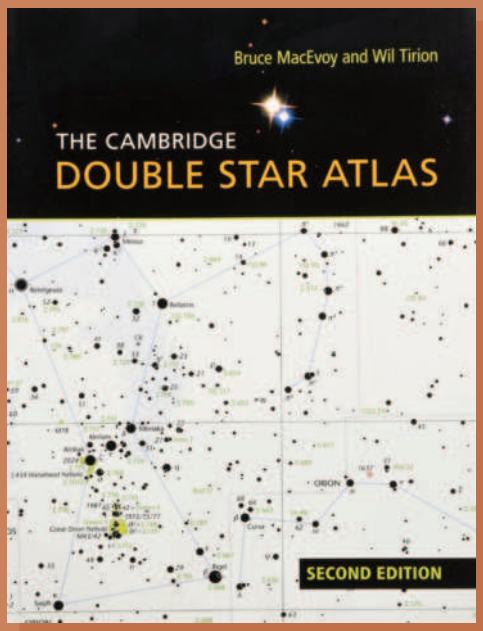


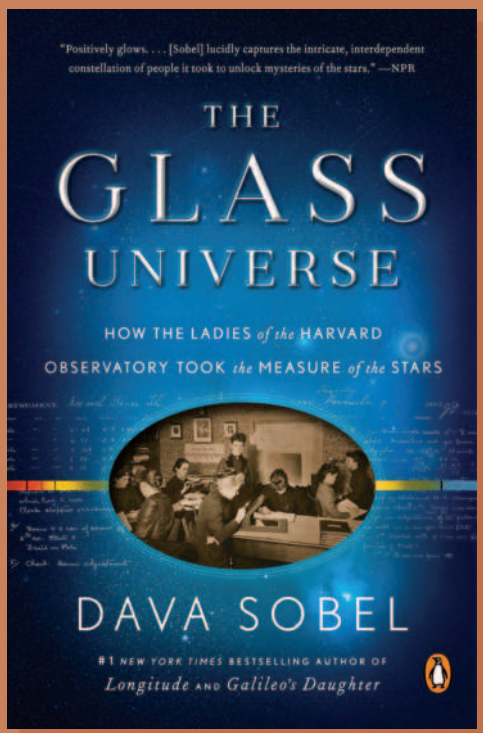
THE astronomer's bookshelf

By Chris Vaughan

Good books add an extra dimension to amateur astronomy — for planning what you'll look at, reading up on what you saw or curling up with a mind-expanding narrative on those nights when it's cloudy. Here are some of my picks. They've been widely available for some time now, many in digital form, but I think it's more fun to unwrap a new book and dive into it.







Before you go observing:

Turn Left at Orion, Fifth Edition
Guy Consolmagno and Dan M. Davis,
2019, Cambridge University Press

Turn Left at Orion is an excellent book for complete beginners and for those who are ready to look at more challenging targets. The large-format, spiral-bound book begins with several chapters covering astronomy basics: finding your way around the sky; selecting, using and caring for your telescope; and more advanced topics such as collimation and telescope-math formulas. Following these is a guide to viewing the Moon, highlighting features visible to unaided eyes, through binoculars and through amateur telescopes, all illustrated with labelled full disk and close-ups of selected areas. Each planet's chapter is loaded with observing tips and tables indicating where to find the planet through 2024.

The rest of the book focuses on the night sky, organized by season. The authors, both veteran visual observers, have chosen the best sights to see during each part of the year. Devoting two to three pages to each target, they provide a wide-field sky chart to orient you, a view of what you'll see in your finderscope (with the major stars labelled) and annotated, hand-drawn sketches showing how the object will appear when viewed through both small and larger telescopes. Those sketches, which account for how your telescope optics flip and/or mirror the view, are extremely helpful for conveying the size, shape and brightness of the objects. The drawings are accompanied by a written description of the object, observing tips and other interesting nearby targets. The authors have included a variety of kinds of objects — double and multiple stars easily viewed from urban locations, open clusters and globular star clusters, and challenging but spectacular nebulas and galaxies that are better viewed under dark skies.

Honourable mention: The everlasting *NightWatch, Fourth Edition* by Terence Dickinson, 2006, Firefly Books

At the eyepiece:

The Cambridge Double Star Atlas, Second Edition
Bruce MacEvoy and Wil Tirion, 2015, Cambridge University Press

A star atlas is an essential tool for finding and viewing targets at the eyepiece. Since you'll be using it under dim light conditions or with a red flashlight, it's important to choose one that is readable. My pick in this category is the *Cambridge Double Star Atlas.* While it is ostensibly for double star enthusiasts, the fully annotated charts in this atlas also display the deep-sky objects of the Messier List, New General Catalog (NGC) and more — by using drawn and shaded outlines or via coloured symbols.

I particularly like the large dimensions of the 30 two-page charts. Each single panel covers two hours of right ascension by 40 degrees of declination (except near the poles). And the charts are arranged with plenty of overlap, so there is less need to flip pages to find the patch of sky you are observing. The larger chart size also allowed the authors to plot stars to magnitude 7.5, which is more than the popular *Pocket Sky Atlas*. The book is spiral bound and printed on heavy, glossy paper that holds up well, even on dewy nights.

Double stars are ideal targets for Moon-filled nights, and this atlas will take you far into that interesting topic. Each double or multiple star system is labelled using green text. The second half of the atlas provides a comprehensive database of star systems, arranged by constellation.

Honourable mention: *Pocket Sky Atlas*, by Roger W. Sinnott, 2007, Sky & Telescope

On cloudy nights:

The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars
Dava Sobel, 2016, Viking Press

What's better on a cloudy night than a good book to slake your thirst for knowledge of the universe? In *The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars*, author Dava Sobel weaves the tale of the famed Harvard Observatory and the discoveries made by the many pioneering women astronomers who worked there. The book's title refers to the archive of a half million glass photographic plates taken and preserved by the observatory.

Like all good history books, this one is a page-turner, but I especially appreciated all of the astronomy I learned by reading it. The story begins in the mid-1800s with the founding of the observatory and the remarkable (for its time) decision by enlightened directors to recruit a team of brilliant and hard-working young women "computers" to analyze and catalog the photographic survey of the skies Harvard was compiling.

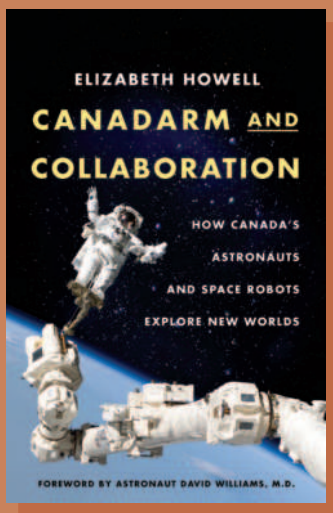
In the 1880s, Mary Anna Palmer Draper, the widow of Henry Draper, became a benefactor of the observatory, funding the collection of stellar spectra on the plates. The new information laid the foundations for our modern astrophysical understanding of stars and stellar evolution. Williamina Fleming developed one of the first classification systems for stars. Annie Jump Cannon became an expert on variable stars and refined Fleming's approach into today's familiar O-B-A-F-G-K-M system. She later established an eponymous award for women astronomers. Henrietta Leavitt discovered the Cepheid variable period-luminosity relationship and began to determine the size of the universe. Cecilia Payne-Gaposchkin became the first woman to earn a PhD in astronomy, from Radcliffe College of Harvard University in 1925.

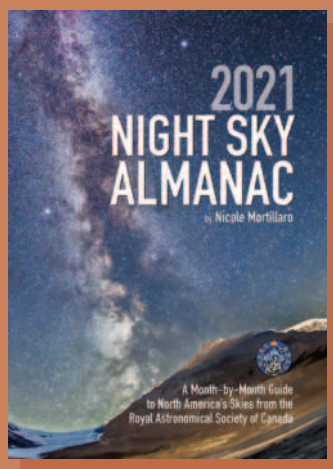
I think you'll find the story of the women of Harvard Observatory inspiring. Their contributions have rippled across the scientific community. Canada benefitted, too — the David Dunlap Observatory's Helen Sawyer Hogg was a Harvard alumnus.

Honourable mention: *Bad Astronomy: Misconceptions and Misuses Revealed, from Astrology to the Moon Landing "Hoax,"* by Philip Plait, 2002, Wiley →

From the *SkyNews* team

A look at the books published by *SkyNews* writers in 2020





Canadarm and Collaboration: How Canada's Astronauts and Space Robots Explore New Worlds

By Elizabeth Howell • October 2020

Canada is a small but mighty power in space exploration. After providing the Canadarm robotic arm for the space shuttle in 1981, Canada received an invitation to start an astronaut program — a program that quickly let its people accumulate skill and prestige. Canadian astronauts have since commanded the International Space Station, flown as co-pilots on spacecraft and even held senior roles within NASA. This book traces how Canada grew from small beginnings into a major player in international space policy. You will hear about Canada's space program from the words of its astronauts, from Canadian celebrity Chris Hadfield to Liberal cabinet minister Marc Garneau to Governor General Julie Payette. You will experience the excitement and challenges of reporting on a rocket launch in Kazakhstan, as Canada sent its latest astronaut to space in preparation for possible Moon missions in the 2020s. And you will learn from the people who work behind the scenes on Canadian space technology and space policy about why we are doing this — and what we plan to do next.

Not Yet Imagined: A Study of Hubble Space Telescope Operations

By Chris Gainor • September 2020

Not Yet Imagined: A Study of Hubble Space Telescope Operations documents the history of HST from its launch through its first 30 years of operation in space. It focuses on the interactions among the general public, astronomers, engineers, government officials and members of Congress during that time. The decision-making behind the changes in Hubble's instrument packages on servicing missions that made HST a model of supranational cooperation among scientists is chronicled, along with HST's contributions to our knowledge about our solar system, our galaxy and our universe. This book also covers the impact of HST and the images it produces on the public's appreciation for the universe, and how HST has changed the ways astronomy is done. Published by the NASA History Division, it will be available for sale from NASA, and it will be available as a free download here: history.nasa.gov/series95.html

2021 Night Sky Almanac: A Month-by-Month Guide to North America's Skies from The Royal Astronomical Society of Canada

By Nicole Mortillaro • October 2020

2021 Night Sky Almanac is the ideal resource for both novice and experienced sky watchers in the United States and Canada, with all of the advice, information and data that enthusiasts need to understand and enjoy the wonders of the night sky. This in-depth guide first introduces readers to the objects in the sky — from stars, to comets, to globular clusters — and then takes them through the cosmic events to look out for each month in 2021, with sky maps, Moon phase charts and information about the planets. The book also features methods for using your hands to measure angles in the sky, information about binoculars and telescopes, histories of constellations including Indigenous history and a glossary of terms. *2021 Night Sky Almanac* is both a comprehensive introduction to astronomy and a quick reference book for more experienced sky watchers who don't want to miss a thing. Its compact size means it's perfect for taking on an "astro-vacation" or simply sky viewing in the backyard. ✶

By Alan Dyer

GEAR REVIEW

TESTING TWO SKY-WATCHER MOUNTS

Two new mounts from Sky-Watcher provide grab-and-go portability — one with no-frills manual controls, the other with computerized GoTo and WiFi.

SkyNews has reviewed many Sky-Watcher mounts over its 25 years. Here we test two of their latest, using units I purchased from random stock at All-Star Telescope.

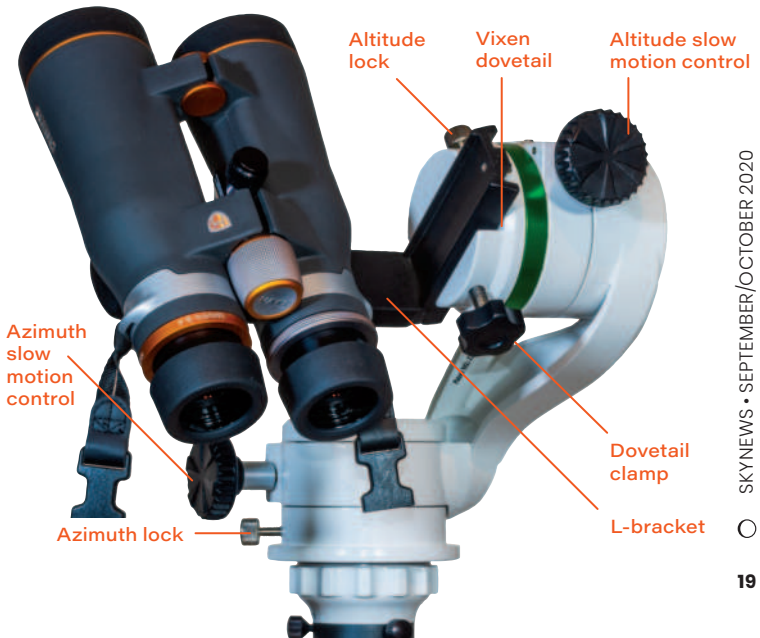
The AZ5 manual mount

The new AZ5 is an alt-azimuth mount for manually scanning around the sky. The mount is ideal for pairing with 80mm or lightweight 100mm refractors, or up to a 127mm Cassegrain telescope. Like the AZ-GTi, it accepts Vixen-standard mounting plates.

The AZ5 is a solid mount. The tripod is the same one used on Sky-Watcher's mid-sized equatorial mounts, so it is sturdy. And hefty! The total weight of the tripod and mount head is 9 kilograms (19.8 pounds). The height to the middle of the head is 120 centimetres (48 inches) with the tripod collapsed, or it can be raised to 155 centimetres (61 inches) with the legs fully extended.

Damping time with the big refractor was two seconds; with my 4.4 kg (9.7 lb) 80mm refractor it was a superb one-second damping. In all, I found the AZ5 a solid alt-azimuth mount for a serious beginner or an experienced observer looking for a grab-and-go package. →

Binocular mounting: With its legs extended, the AZ5 is good for binoculars, using an L-bracket, such as this one from Orion Telescopes. However, any tripod-mounted binocular is best kept to targets below 45° altitude.



18+

WHAT IS AVAXHOME?

AVAXHOME –

the biggest Internet portal, providing you various content: brand new books, trending movies, fresh magazines, hot games, recent software, latest music releases.

Unlimited satisfaction one low price
Cheap constant access to piping hot media
Protect your downloadings from Big brother
Safer, than torrent-trackers

18 years of seamless operation and our users' satisfaction

All languages
Brand new content
One site

AVXLIVE.ICU

AvaxHome - Your End Place

We have everything for all of your needs. Just open https://avxlive.icu

The AZ-GTi GoTo mount

By comparison, this compact computerized mount comes on a smaller tripod that is so light (at 4 kilograms or nearly 9 pounds) the entire assembly can be lifted with one hand. I thought it might be too shaky, but not so. With the 76mm refractor I tested it with, vibrations damped down in just 1.5 seconds. The AZ-GTi is rated to handle up to 5 kilograms (11 pounds), the same as the AZ5. The tripod legs are 69 centimetres (27 inches) long (they'll fit inside a large piece of luggage), but can extend another 53 centimetres (21 inches). The mount head has a standard 3/8-inch bolt hole on the bottom so it can be mounted on any camera tripod.

Though the AZ-GTi can be used with a hand controller (it should be a current SynScan V5 model), the AZ-GTi does not come with one. Instead, it has WiFi built-in to connect to using a mobile device (phone or tablet) and then to control the telescope with the free SynScan Pro app (for Apple iOS and Android). I tested the iOS version. I found it connected quickly and stayed connected reliably.

Finding and tracking objects requires a two- or three-star alignment. With either option, you use the slew buttons to centre the first alignment star. I preferred the North-Level option as it conveniently slewed itself to the first alignment star.

Once aligned, the AZ-GTi found targets reliably, placing all within the field of a medium-power eyepiece, then tracking them for hours. The mount can be hibernated, then woken up later, perhaps to find daytime sky objects without another alignment. (The SolarQuest is a variation of the AZ-GTi just for finding and following the Sun.)

The SynScan Pro app contains all objects from the Messier, NGC, IC and Caldwell deep-sky lists, a good selection of double stars, the planets, as well as comets with entries it can update from a download. Nice! A list of "Tonight's Best" (hidden under the Utilities menu) provides a good tour of two or three dozen deep sky objects and double stars.

While the app works well, it does not provide narration, images or a sky map. For those, you can simultaneously control the AZ-GTi using either the SkySafari or Luminos apps running on the same device by connecting them using the "SynScanLink" choice in their telescope control options. This worked on iOS, despite the app's Help screen claiming it would not.

The AZ-GTi includes Sky-Watcher's "Freedom Find" to manually move the mount without losing its GoTo alignment. But activating that feature requires turning on "Auxiliary Encoders," another hidden setting found under Settings>Advanced. They are always off by default.

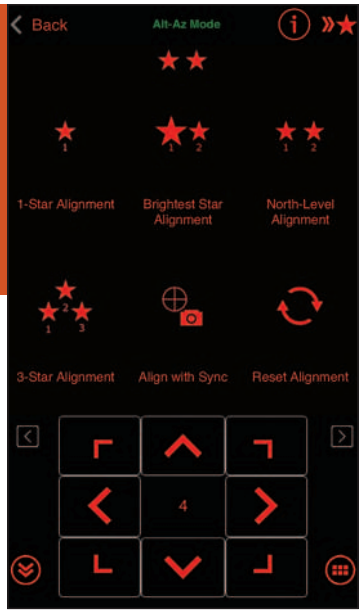
Aim the top of your phone at an area of sky, hit "Point and Go" under Utilities, and the mount will magically slew to where the phone is aimed, handy for major moves to a new region. The app then indicates what's of interest in the area.

Mounts manual and motorized:

While the AZ5 (left) handled the author's 105mm A&M refractor, its 7.6 kg (16.7 pound) mass surpassed the mount's rated capacity. The lighter 76mm SharpStar refractor, shown on the AZ-GTi (right), was an ideal match for either mount.

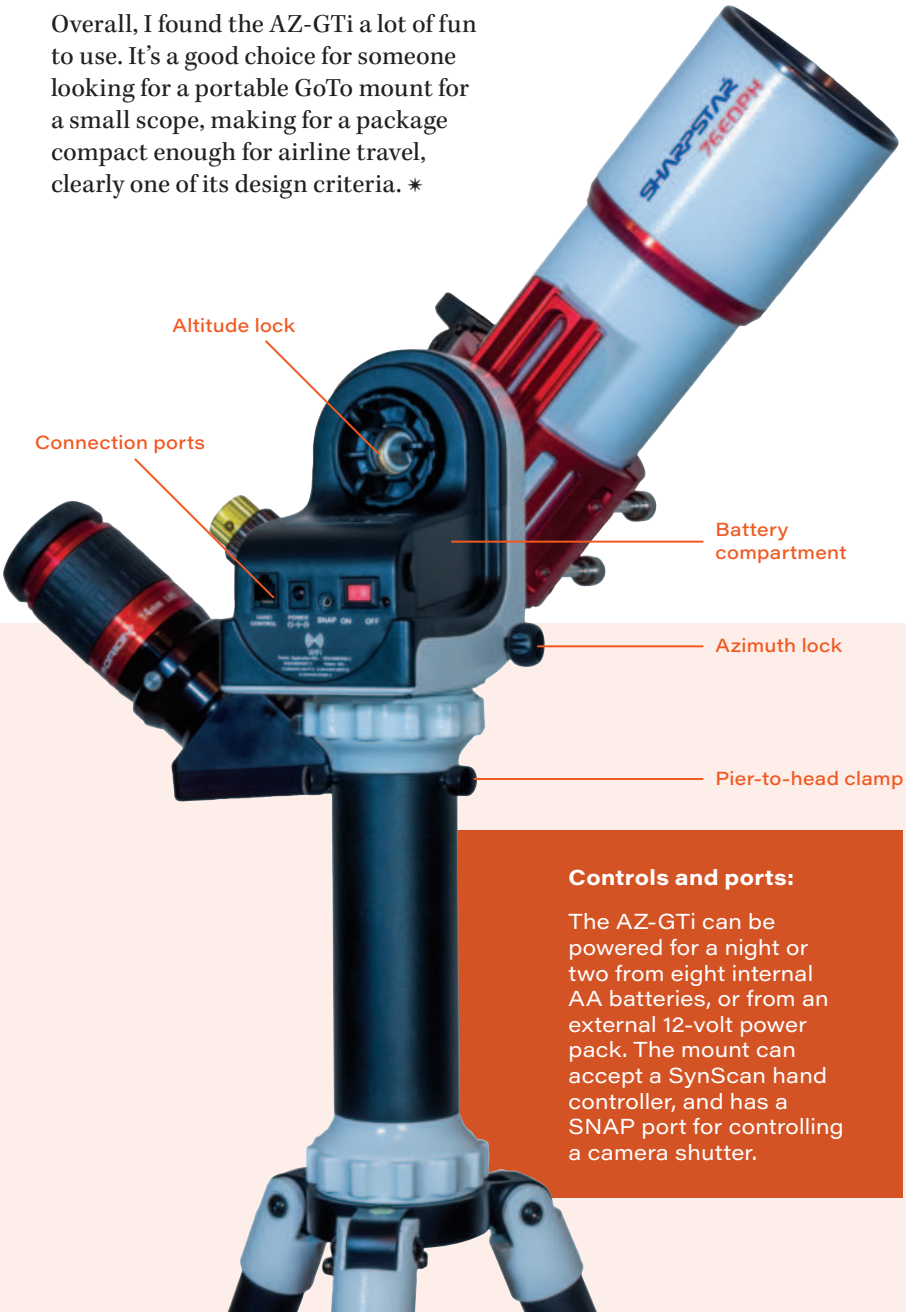
SynScan Pro App:

When aligning using one of several methods, there's no need to enter location, date and time as the app gets those from your device. Once aligned, objects can be called up from lists, to command the mount to "GoTo."



One mechanical downside I encountered, true of the AZ5 as well, is that if you try to turn the head in azimuth by hand with the lock engaged, the bolt that clamps the mount to the tripod's pier is likely to twist loose, so the whole head then spins and wobbles. Fixing this requires removing the head from the pier and re-tightening the bolt, which is an annoyance.

Overall, I found the AZ-GTi a lot of fun to use. It's a good choice for someone looking for a portable GoTo mount for a small scope, making for a package compact enough for airline travel, clearly one of its design criteria. ✶



Controls and ports:

The AZ-GTi can be powered for a night or two from eight internal AA batteries, or from an external 12-volt power pack. The mount can accept a SynScan hand controller, and has a SNAP port for controlling a camera shutter.

Canada's night sky for September/October

CELESTIAL CALENDAR

SEPTEMBER 2 ○ Full Moon, 1:22 a.m. EDT

***SEPTEMBER 5** *Mars 0.03° south of waning crescent Moon (see Page 24)

SEPTEMBER 6 Uranus 3° north of Moon

SEPTEMBER 10 ◑ Last quarter Moon

***SEPTEMBER 11** Neptune at opposition (see Page 25); Moon 0.3° south of M35 (pre-dawn)

SEPTEMBER 12 Jupiter stationary

***SEPTEMBER 14** Venus 4° south of Moon (pre-dawn, see Page 25)

SEPTEMBER 17 ● New Moon, 7:00 a.m. EDT

SEPTEMBER 22 Equinox, 9:31 a.m. EDT

SEPTEMBER 23 ◐ First quarter Moon

***SEPTEMBER 24** Jupiter 4° north of Moon

***SEPTEMBER 25** Saturn 2° north of Moon

***OCTOBER 1** Mercury at greatest elongation east (26°); ○ Full Moon, 5:05 p.m. EDT

* *Impressive or relatively rare astronomical event*

***OCTOBER 2** Venus 0.09° south of Regulus (pre-dawn, see Page 25); Mars 0.7° north of Moon

OCTOBER 4 Uranus 3° north of Moon (pre-dawn)

***OCTOBER 6** Mars at closest approach

OCTOBER 9 ◑ Last quarter Moon; Mercury at greatest heliocentric latitude south

***OCTOBER 13** Mars at opposition (see Page 26)

***OCTOBER 14** Venus 4° south of Moon

OCTOBER 16 ● New Moon 3:31 p.m. EDT

***OCTOBER 21** Orionids meteor shower peak (pre-dawn, see Page 27)

***OCTOBER 22** Jupiter 2° north of Moon; Saturn 3° north of Moon

OCTOBER 23 ◐ First quarter Moon

OCTOBER 29 Mars 3° north of Moon

***OCTOBER 31** Uranus at opposition (see Page 27); ○ Full Moon, 10:49 a.m. EDT (smallest in 2020)

PLANETS AT A GLANCE

	DATE	MAGNITUDE	DIAMETER (")	CONSTELLATION	VISIBILITY
Mercury	Sep. 1 Oct. 1	−0.6 −0.0	5.0 6.7	Leo Virgo	Evening Evening
Venus	Sep. 1 Oct. 1	−4.3 −4.1	19.5 15.5	Gemini Leo	Morning Morning
Mars	Sep. 1 Oct. 1	−1.8 −2.5	18.9 22.4	Pisces Pisces	Evening Evening
Jupiter	Sep. 1 Oct. 1	−2.6 −2.4	44.3 40.5	Sagittarius Sagittarius	Evening Evening
Saturn	Sep. 1 Oct. 1	0.3 0.5	18.0 17.2	Sagittarius Sagittarius	Evening Evening
Uranus	Sep. 1 Oct. 1	5.7 5.7	3.6 3.7	Aries Aries	Evening Evening
Neptune	Sep. 1 Oct. 1	7.8 7.8	2.3 2.3	Aquarius Aquarius	Evening Evening

Our chart shows the major stars, planets, and constellations visible from Canada and the northern United States within one hour of these times:

Early September: 11:30 p.m.
Late September: 10:30 p.m.
Early October: 9:30 p.m.
Late October: 8:30 p.m.

USING THE STAR CHART

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.)

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 cart 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 your night-vision sensitivity.

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 counter-clockwise around it, a motion that becomes evident after about half an hour.

CONSTELLATIONS: The star groups linked by lines are the constellations approved by the International Astronomical Union as a way of mapping the night sky.

Cartography by Glenn LeDrew

***ndbook*, published by The Royal Astronomical Society of Canada, available at rasc.ca or by calling 1-888-924-7272.**

By Brian Ventrudo

The return of the Red Planet

Three planets reach opposition over the course of two months, with Mars giving us its best opposition this decade

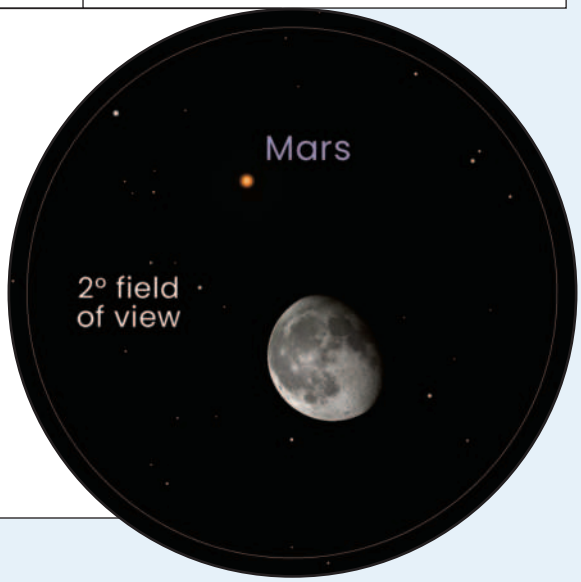
Mars (at right) shone brightly in the head of Scorpius over the badlands of Dinosaur Provincial Park, Alberta on the night of May 16-17, 2016, as the planet neared its May 22, 2016 opposition. Saturn is to the left of Mars, with Antares in Scorpius below the two planets, forming a triangle in the moonlit sky. Shooting from the Trail of the Fossil Hunters, Alan Dyer used a Nikon D750 and Sigma 24mm lens. (Alan Dyer)

Mars is perfectly placed for Canadian observers through September and October, as it arrives at its best opposition of the 2020s. Uranus and Neptune also reach their closest approach of the year. And the Moon stays out of the way for the Orionids, one of the best meteor showers of the year.

DATE:	TYPE:	TIME:	VIEW:
September 5–6, 2020	Conjunction	10 p.m. to dawn	Naked eye, binoculars, telescope

Mars passes the Moon

The brightening planet Mars hangs just off the darkened limb of the waning gibbous Moon on the night of September 5-6. The two rise around 10 p.m. local time and reach appulse — the closest approach of the two celestial objects — at about midnight EDT. For the next several days, Mars lies about five degrees north of the star Alpha Piscium (Alrischa) in Pisces. Already at magnitude -1.9 and far brighter than any star, Mars reaches its stationary point on September 9 and begins retrograde (westward) motion against the background stars on its way to a spectacular opposition next month. The planet is well-positioned just north of the celestial equator for telescopic viewing during September and October.

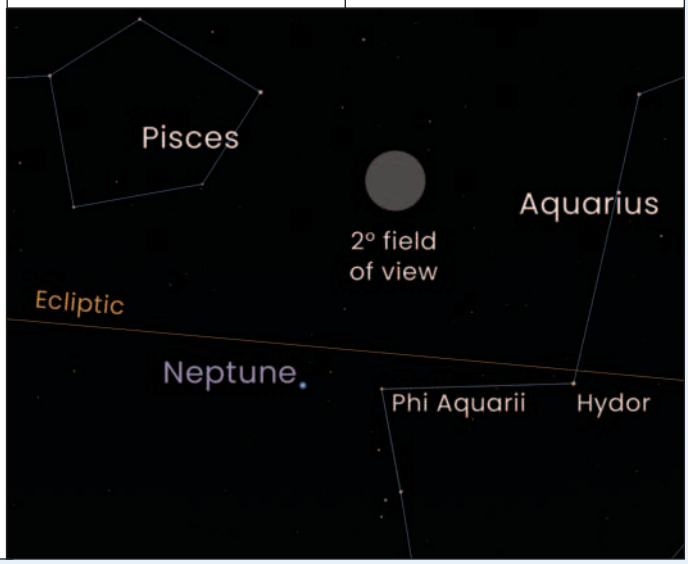


Neptune at opposition

DATE:	TYPE:
September 11, 2020	Opposition
TIME:	**VIEW:**
All night	Telescope

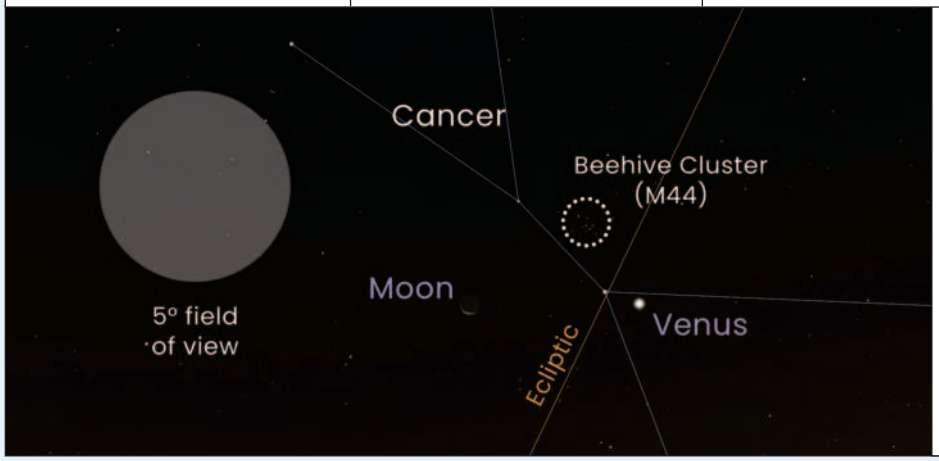
Neptune, the most distant major planet from the Sun, reaches opposition tonight in the constellation Aquarius. At a distance of 28.9 astronomical units (about 4.3 billion kilometres) from Earth, Neptune shines at magnitude +7.8 with a disk just 2.4 arc-seconds across. While Neptune is not a spectacular sight — even in a big telescope — it's worth the effort to glimpse this relatively placid and beautiful ice giant at the edge of the Solar System. At opposition, Neptune lies about two degrees east-northeast of the fourth-magnitude star Phi Aquarii in Aquarius.

While the planet is visible in binoculars, you do need a telescope to perceive Neptune's tiny disk and blue-green colour. Neptune will appear to grow larger as magnification is increased, unlike a star, which offers a good way to ensure you have the planet in your field of view. If you have a 10-inch or larger telescope (or a camera) try to spot Neptune's largest moon Triton, a magnitude 13.4 object that never appears to wander more than 17 arc-seconds from the planet.



CHARTS BY ALLENDRIA BRUNJES

DATE:	TYPE:	TIME:	VIEW:
September 14, 2020	Conjunction	Early morning	Binoculars



Venus and Moon meet the Beehive

Look eastward in the early morning sky to see Venus and a waning crescent Moon. Binoculars reveal a third celestial sight, the Beehive star cluster (Messier 44), joining the show. The three objects form an isosceles triangle about five degrees long.

DATE: October 2–3, 2020

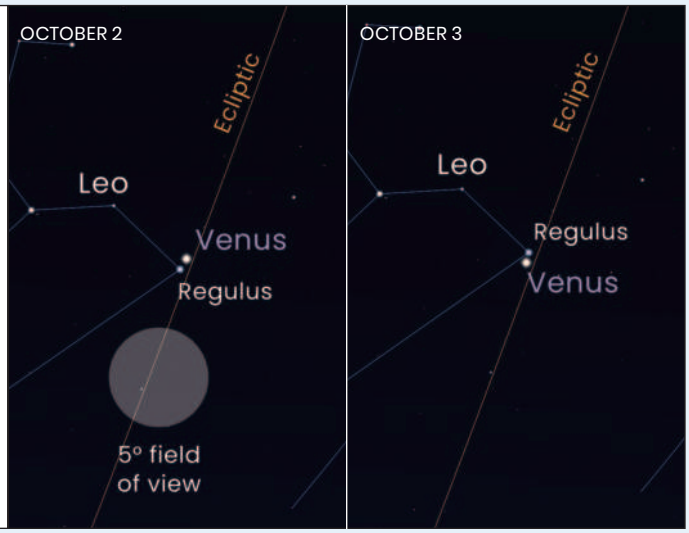
TYPE: Conjunction

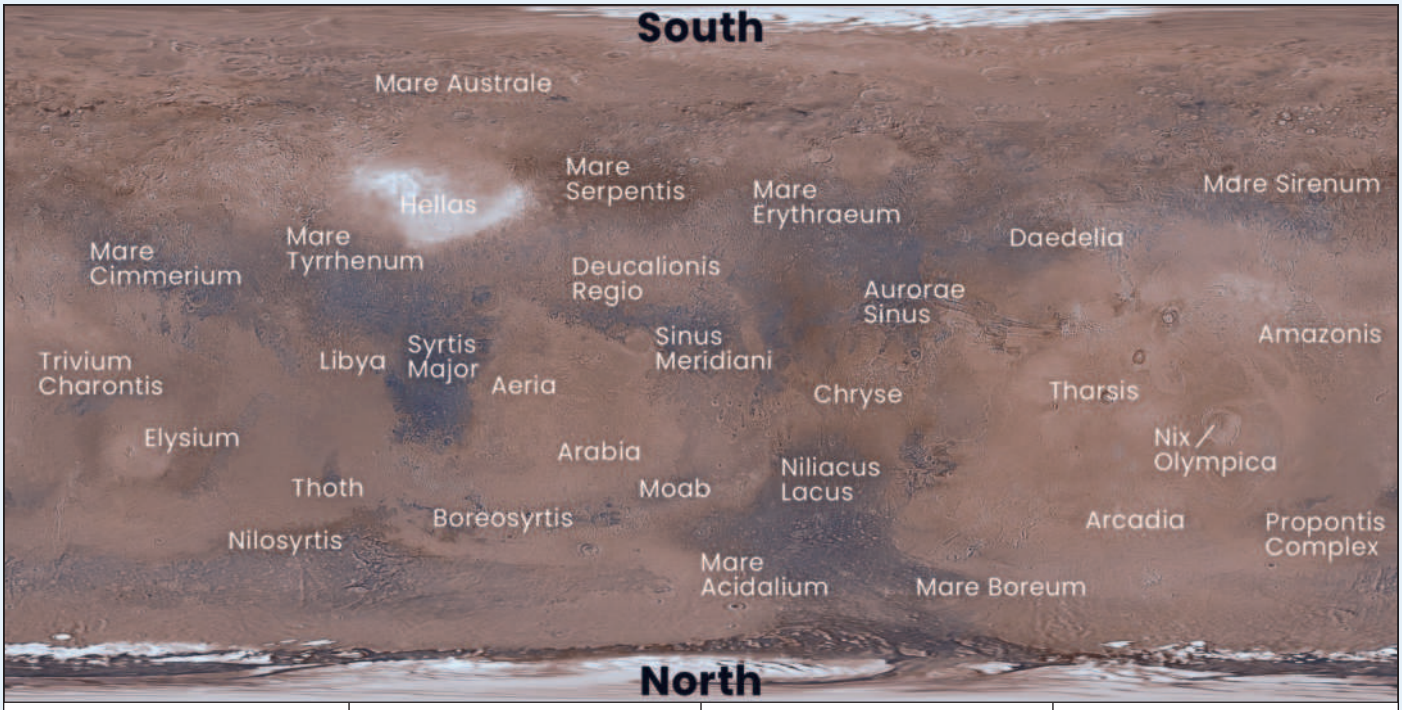
TIME: Early morning

VIEW: Naked eye, binoculars

Venus meets Regulus

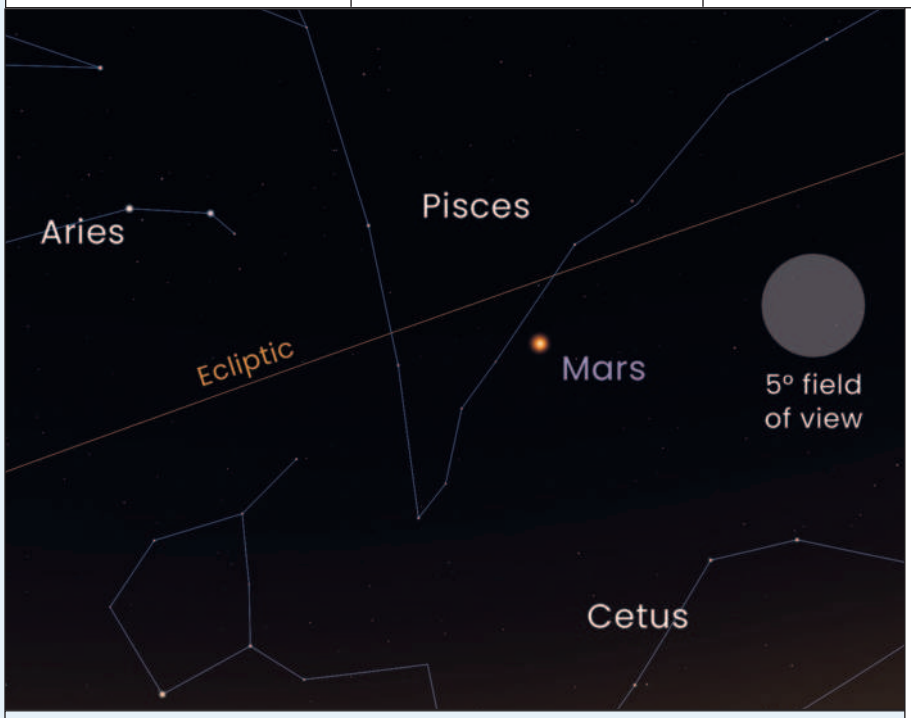
Venus continues to put on a splendid show in the eastern sky before dawn. At 12 a.m. UT (Universal Time), the planet passes just five arc-minutes from the first-magnitude star Regulus. Canadian observers won't see this closest approach, but on the mornings of October 2 and October 3 the planet will be about half a degree away from the star — west of it on October 2, and east on October 3.





(MARS TREK, NASA/JPL-CALTECH)

DATE:	**TYPE:**	**TIME:**	**VIEW:**
October 13, 2020	Opposition	All night	Naked eye, binoculars, telescope



Telescope tip: To observe Mars through a telescope, start at low magnification and work your way up to as much as your optics and local atmospheric conditions allow. Wait for brief moments of steady seeing when fine detail suddenly snaps into view. Try an orange (Wratten No. 21) filter to improve contrast between darker features and the rusty desert regions.

Mars at opposition

Mars reaches opposition tonight some 26 months after the relatively disappointing opposition of 2018. This year, Mars lies about five degrees north of the celestial equator in the constellation Pisces, perfectly placed for Canadian observers. This is the best Martian opposition this decade.

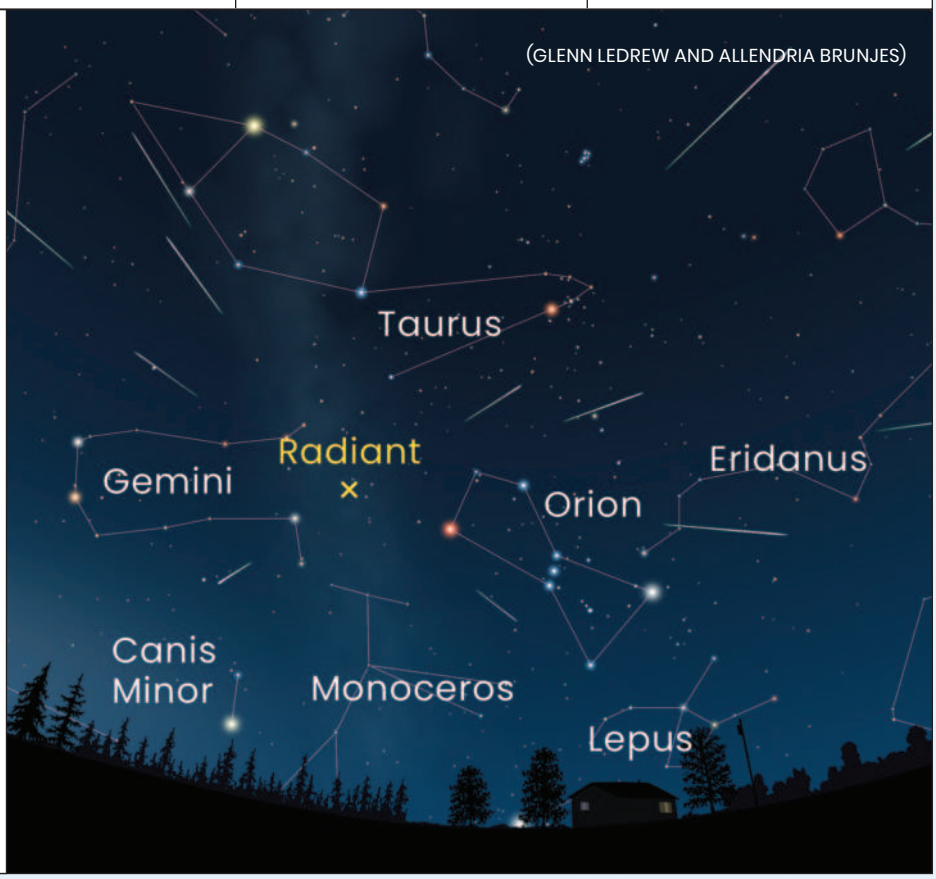
At a distance of 0.41 astronomical units tonight, Mars spans about 22.4 arc-seconds and shines at a brilliant magnitude -2.6, brighter than Jupiter. At midnight (EDT), the unmistakable arrowhead shape of Syrtis Major is prominent near the planet's centre line, and serves to orient you to other surface features (see accompanying illustration). The planet's rotational period of 24 hours and 37 minutes means features on Mars appear to move "backward" from night to night when seen at the same time from Earth.

Mars remains a magnificent sight into November as it moves westward against the stars. By mid-November, Mars resumes prograde (eastward) motion and quickly grows smaller and fainter.

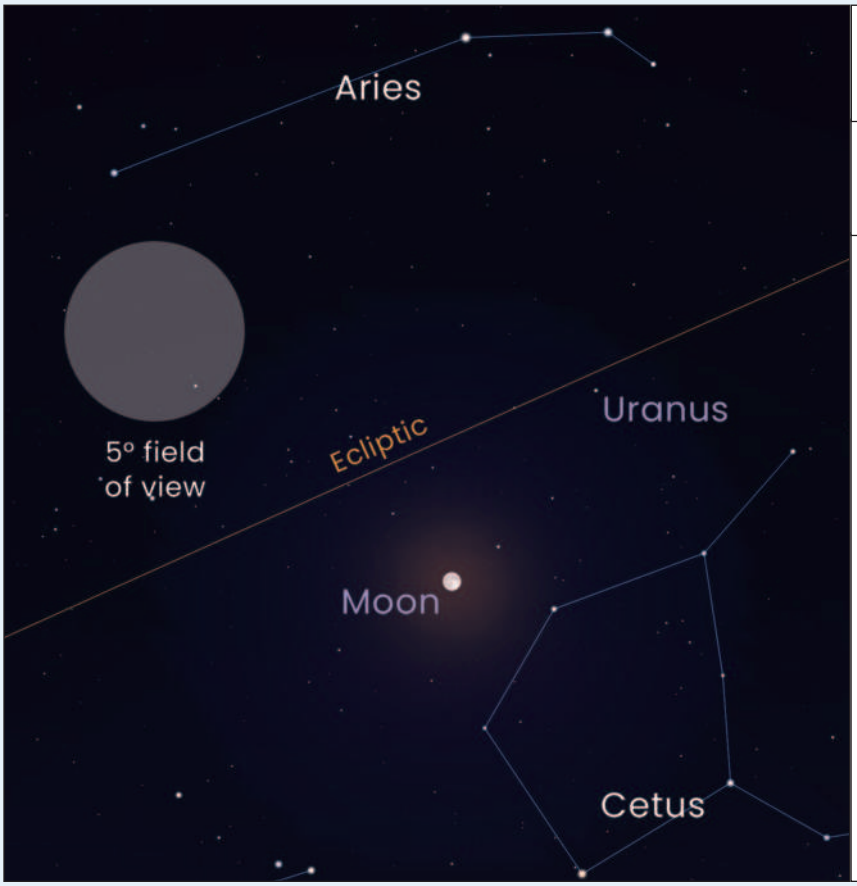
DATE:	TYPE:	TIME:	VIEW:
October 21, 2020	Meteor shower	After midnight	Naked eye

Great year for the Orionids

The Orionid meteor shower peaks in the early morning hours. As one of the finest of all meteor showers, the Orionids show about 20-40 fast-moving meteors per hour in dark sky. The radiant lies near the club of Orion. But you can see the meteors anywhere in the sky, especially from midnight until dawn. The Moon, just five days past new, gets out of the way this year and makes it easier to see the faintest meteors. Like the Eta Aquariid meteor shower in May, the Orionids are bits of Comet Halley that hit the upper atmosphere as the Earth passes through the comet's debris field. It may seem a little too cold to view meteors on a late-October morning. But head out anyway to enjoy the show. It's only going to get colder!



CHARTS BY ALLENDRIA BRUNJES



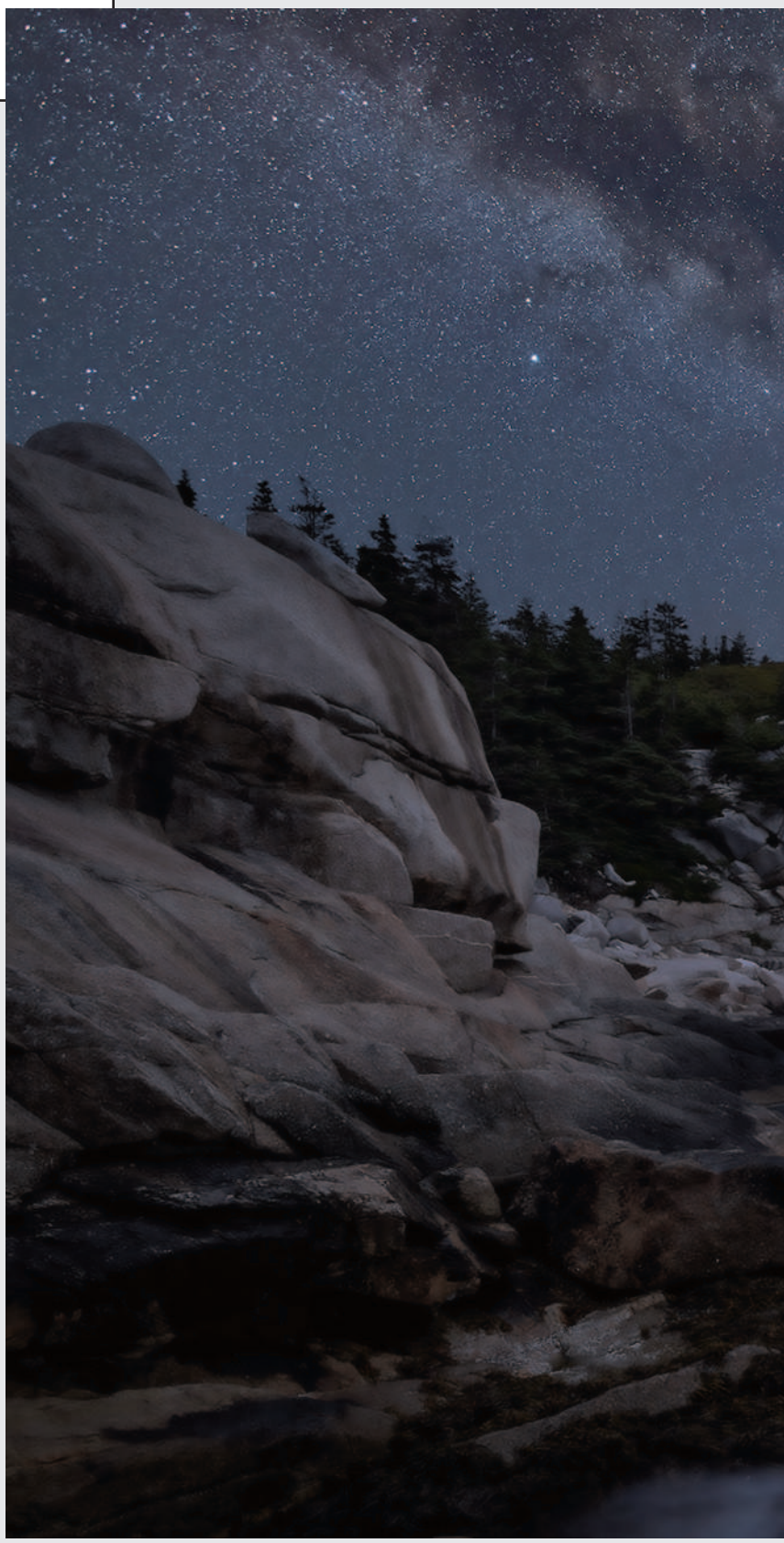
DATE:	TYPE:
October 31, 2020	Opposition
TIME:	**VIEW:**
All night	Telescope

Uranus at opposition

First Neptune, then Mars — and now Uranus reaches opposition as it rises in the east. As a far easier target than Neptune, Uranus shines just at the edge of naked-eye visibility at magnitude +5.7 with a disk that spans about 3.8 arc-seconds. Tonight, the planet lies about 18.8 astronomical units (2.8 billion kilometres) from Earth. Look for this blue-green ice giant just northwest of the head of Cetus, southeast of Aries, and some 5.5 degrees northeast of the fourth-magnitude star Xi Ceti. A full Moon (the smallest full Moon of 2020) makes it a little harder to see the planet, but Uranus remains visible through the rest of the year in this part of the sky. ✶

2020 *SKYNEWS* PHOTO OF THE YEAR CONTEST

Over the course of the past year, you have submitted your exquisite photos of stars, nebulae, planets and other astronomical phenomena to *SkyNews*. Here are the top images in our 18th annual photo contest.



Best of the Best

Winner: Jason Dain

Jason Dain's image of the Milky Way arching over Polly's Cove took knowhow, curiosity and months of patience.

It all paid off, winning him the Grand Prize in the 2020 *SkyNews* Photo of the Year contest.

"Composition-wise, the Milky Way running parallel to the rocky shoreline, with the softening of the water due to the long exposure — everything is just right here," a judge noted.

Dain said he found this location last autumn while pursuing his other hobby, birding. He said he checked the charts and found the Milky Way would be in the perfect position in March and he set a reminder on his phone.

He took the image March 28, 2020, using a Nikon D850 and a Nikon 20mm f/1.8 lens and an iOptron SkyGuiderPro tracker. He shot at f/2.8 for eight minutes total. For the sky, he took three two-minute tracked exposures at f/2.8 and ISO 800. Turning off the tracker, he took a single five-minute exposure for the foreground at f/4, ISO 800 to get a bit more depth of field. He stacked the sky images using Sequator and then combined the foreground and background images in Photoshop and did the final edits. →

Best Deep-Sky Object

Winner: Dave Dev

At the heart of the Heart Nebula, shaping it, is an open cluster of stars. Located about 7,500 light years away, NASA says the cluster Melotte 15 contains a few bright stars nearly 50 times the mass of our Sun, many dim stars only a fraction of the mass of our Sun, and an absent microquasar that was expelled millions of years ago.

A clear, crisp image of this cluster, taken by Dave Dev at last year's Starfest, took the top spot Deep-Sky Object category this year, impressing the judges with its depth of capture and perfect processing.

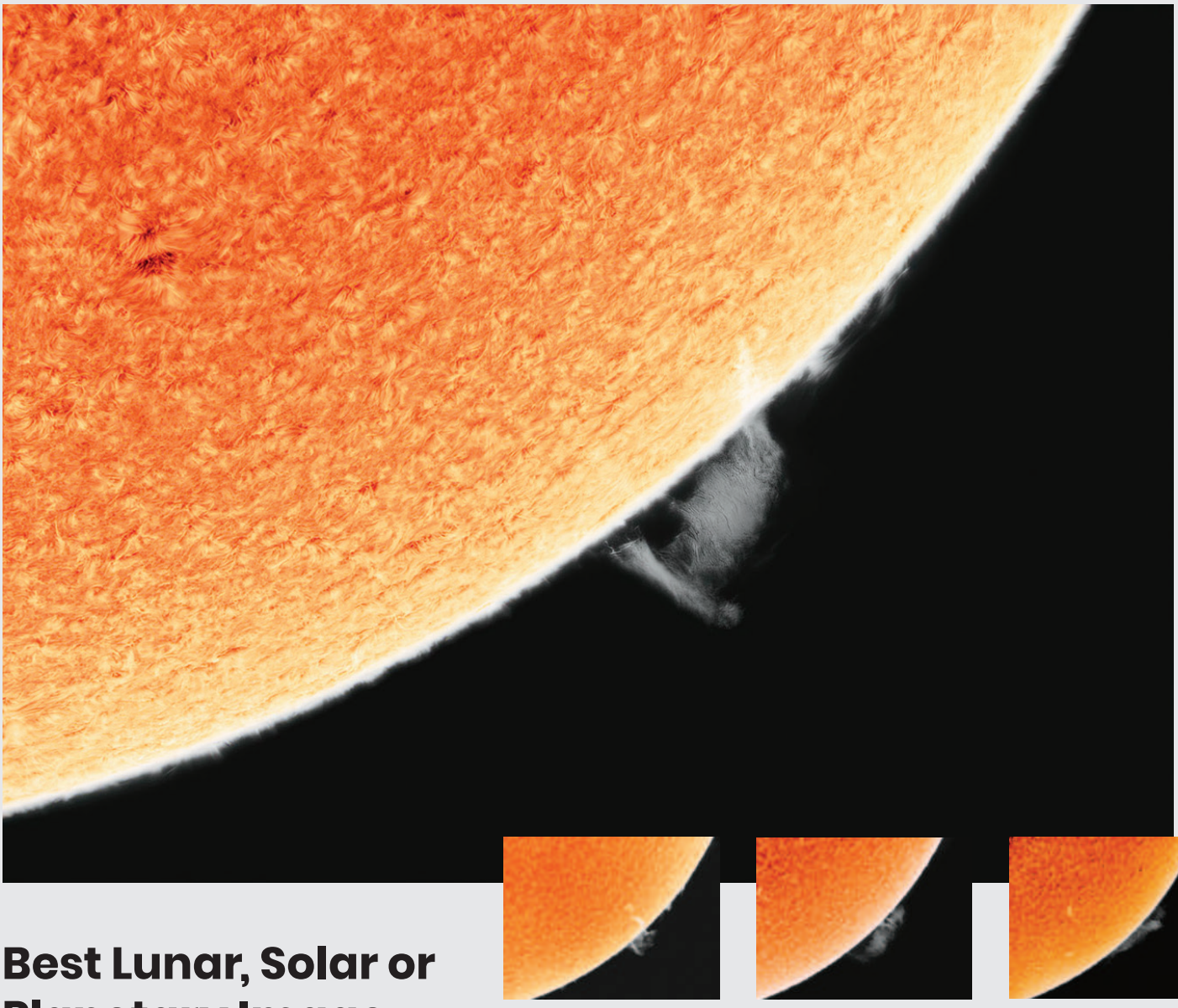
Dev said the image data was taken over two days in August 2019 in Ayton, Ontario. He used an Orion 115 mm refractor at f/7 on a EQ6 mount, with an ASI 1600 mono camera with Baader & AstroDon narrowband filters. He wrote that he imaged: Ha, three-minute subs, for a total of 2.5 hours. O3, 5 min subs, for a total of six hours. S2, three-minute subs, for a total of 3.5 hrs. He processed the image in PixInsight, mapped to SHO (Hubble palette).

Honourable Mention: Yanick Bouchard

Keeping with the love theme, Yanick Bouchard won Honourable Mention with "At the Heart of Cygnus."

His shot encompasses a five-degree wide field near 2.2-magnitude Gamma Cygni, including the Crescent Nebula (NGC6888) in the lower right corner and the open cluster Messier 29 at the bottom of the frame.

From Mirable, Quebec, Bouchard created this nine-tile mosaic using a Celestron EdgeHD 925, 9.25-inch telescope with HyperStar (for a focal ratio of f/2.3) and a ZWO ASI1600MC cooled colour CMOS camera.



Best Lunar, Solar or Planetary Image

Winner: Jean Guimond

Jean Guimond's series of images of a solar prominence were the hottest shots in this category.

He submitted four H-alpha shots of the south-western limb of the Sun, showing the evolution of a solar prominence from June 16 to 19, 2020.

Each image is a stack of the best 100 of 1,000 frames combined with Autostakkert!3 taken with a modified Takahashi TOA-150 for H-Alpha solar imaging equipped with a Baader DERF and a Lunt etalon and blocking filter. He took the images with a PGR (now FLIR) Grasshopper USB3 videocamera with a Televue Powermate 2X (focal length 2200mm, at f/14.6) from his backyard in Quebec City. Image processing was in Photoshop, with the solar surface inverted and colourized, and the prominence in grayscale.

Honourable Mention: Oleg Bouevitch

With its great composition and beautiful processing, Oleg Bouevitch's image of the gibbous Moon was our runner up in the Lunar, Planetary or Solar Image category.

Bouevitch shot for the Moon on November 8, 2019 from Nepean, Ontario. Using a Sony Alpha 7iii full-frame mirrorless camera and an 11-inch Celestron EdgeHD SCT and Losmandy G11 mount, Bouevitch selected and stacked 200 of his best frames out of 400. He stacked the image in AutoStakkert!, and worked on colour saturation, defringing and digimarc in Adobe Photoshop and Lightroom. →

Best Landscape

Winner: Tom Evans

There are a lot of dedicated astrophotographers out there. Even so, Tom Evans went to jaw-dropping lengths — lying on a frozen lake at midnight in 50 km/h winds at -32C — to capture this year's winning Landscape image of Orion over Abraham Lake.

The judges loved this stunning image, noting that the juxtaposition of the eerie ice bubbles, the crack leading in and the constellation is "outstanding."

Evans used an unmodified Canon 6D with a Sigma ART 20mm lens on a fixed tripod. He took seven subframes, selected from 28 exposures at f/1.4, ISO 3200, 18 seconds each.

For the foreground, he used seven focus stacked groups of three exposures each. The seven focal points ranged from 0.3 m to infinity in order to capture the close up ice bubbles yet maintain a clear horizon, and each exposure was 40 seconds at ISO 1600, f/1.4.

He processed the sky using a combination of Pixinsight and Photoshop, and the composite and final adjustments were made in Photoshop.

Honourable Mention: Jeanine Holowatuik

Shot from Greenwater Lake Provincial Park, Saskatchewan, Jeanine Holowatuik's image of noctilucent clouds was a judge favourite.

She took the image June 7, 2020 at 11:15 p.m. She used a one-second shutter, ISO 400, f/3.2 at 50mm. Her camera was a Canon 6D, and the lens was a Canon 50mm f/1.4 lens.

Readers' Choice

Winner: Ian Barredo

Ian Barredo's Pacman Nebula took the biggest bite out of votes in our Readers' Choice contest this year.

The winning image was his second attempt at imaging NGC 281 from his Bortle-8 backyard in Regina, Saskatchewan.

"I find this nebula beautiful because of its shape and it is Oxygen III structure, which appears bluish-green when processed using the Hubble Palette," he said.

This was his second attempt at imaging this object. The first time, he used an 80mm telescope and 12nm narrowband filters.

"For the second attempt I used a 103mm telescope and camera with smaller sensor than previously, and narrower 7 nm narrowband filters," Barredo pointed out. "That allowed me to have a closer look at the details of the nebula, with finer details."

He used a WilliamOptics 103mm refractor with a ZWO ASI 183 mono and a AZEQ6 mount, shooting 21 hours using narrowband filters. ✶

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A glimpse of telescopic history

By Sahar Fatima

Dorner Telescope Museum tracks Canada's history through the lens, encouraging a tactile learning experience

The Dorner Telescope Museum's contents present what you would expect of its name. Old wood and brass, polished lenses and mirrors, roof and porro prisms.

But amongst the artifacts and historical objects, you might also find yourself, glimpsing through an eyepiece.

At its 2019 general assembly in June, The Royal Astronomical Society of Canada announced the generous gift that launched the institution, a new tool to bring the science and joy of astronomy to Canadians. While the museum still waits on its permanent home due to novel coronavirus quarantine restrictions, it aims to tell the history of telescopes in Canada through the story of their makers, the users and the instruments themselves.

Randall Rosenfeld is RASC's archivist and the museum director. He said the museum already features such instruments as the 1903 telescope that belonged to the family of insulin-discoverer Sir Frederick Banting, a Gregorian reflecting telescope by Francis Watkins from around 1750, and a replica of the astrolabe used by New France colonist Samuel de Champlain from the 1600s.

While other museums around the world do showcase telescopes, this will be the only museum with a primary focus on the history of astronomical instruments in Canada.

Aside from the astronomical science pioneered in Canada through telescopes, the instruments tie into Canada's checkered colonial history, as they were used by land surveyors and explorers, said RASC's executive director Philip Groff. Small telescopes were also used in a co-ordinated effort involving amateurs to keep an eye on Russian satellites during the Soviet era, he noted.

"The goal is really to focus on kind of the story of how those optics play a part in Canadian history … and the role that astronomy played in that for good and ill," Groff said.

"It's a chance to understand how our ancestors appreciated the night sky, and how that relates overall to the story of who we are as a people."

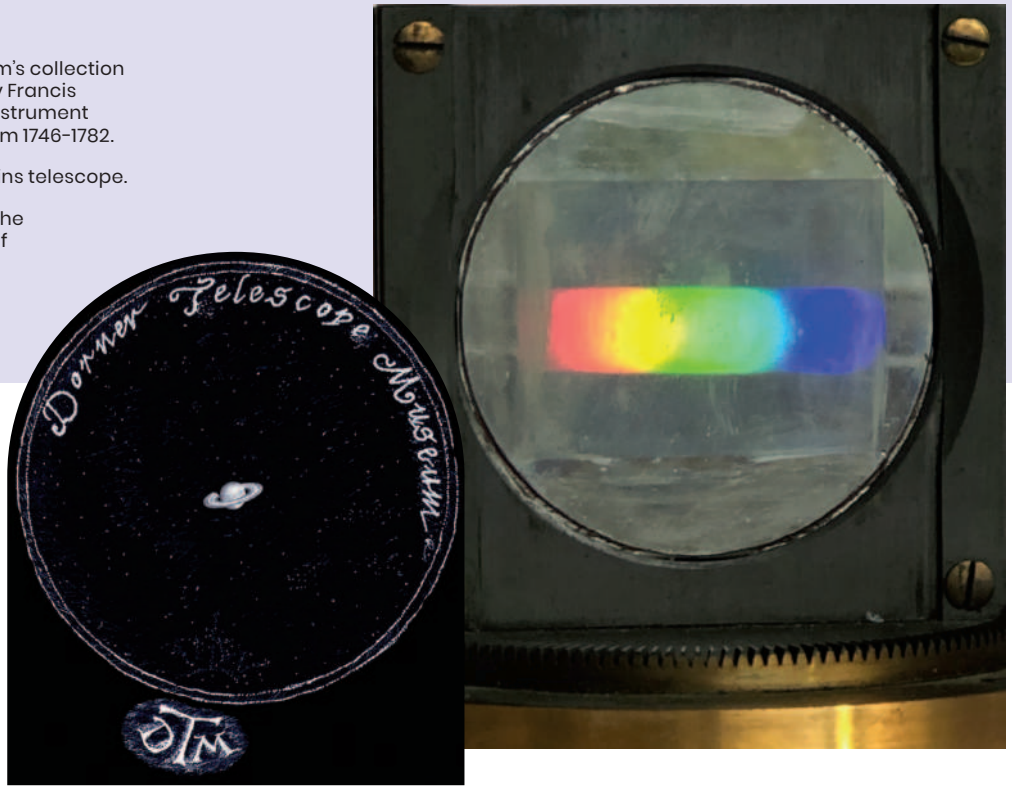
Opposite, left: The Dorner Telescope Museum's collection includes a Gregorian reflecting telescope by Francis Watkins from around 1750. Watkins was an instrument maker in Charing Cross, London, England from 1746-1782.

Opposite, inset: The name plate of the Watkins telescope.

Opposite, right: The museum also features the 1903 telescope that belonged to the family of insulin-discoverer Sir Frederick Banting.

Right, inset: The logo for the Dorner Telescope Museum.

Right: A spectrum revealed by a Rowland-Brashear grating from 1895 is another item in the collection. For more on Dr. John A. Brashear and his gratings for spectroscopy, flip to Page 40.



A hands-on museum

A key goal for the museum is to offer a hands-on learning experience, rather than just keeping pieces behind glass, Rosenfeld said. Visitors will have the chance to touch and actually look through pieces dating back to the 18th century as well as replicas of instruments from the beginning of the astronomical telescope in 17th-century Canada.

"Just the physical appearance of it and certain qualities can evoke a time and place which is not ours," he said. While comparing drawings of the skies from then and now, people can look through older telescopes to personally discover how changes in technology affect what is seen, he noted. "It's almost like a time machine."

"Just the physical appearance of it and certain qualities can evoke a time and place which is not ours ... It's almost like a time machine."

— Randall Rosenfeld, RASC archivist and Dorner Telescope Museum director

Once the museum is up and running — and visitors are allowed in — Groff said there could be programming and workshops, opportunities for students to come in for school trips, as well as a travelling component to take the museum on the road.

"We'd love to give people the opportunity to actually look at celestial objects through historical instruments and historical pieces of equipment so they can start to understand what it was like doing astronomy in those early eras," Groff said.

The museum's potential for igniting astronomical excitement in children and adults intrigues Parshati Patel, an educational outreach and communications specialist at Western University's Institute for Earth and Space Exploration.

"When you talk about it and you show [kids] pictures, it's kind of abstract in many ways. But it's different when they get their hands on it or when they see it operated right in front of their eyes," Patel said. She added that there is also the benefit of museum tour guides being on hand to answer questions right then and there. "Those two things get people more engaged."

Patel said that in her case, it was a visit to a planetarium that sparked her interest in the night sky. As a kid growing up under the smog of Ahmedabad, India, Patel relied on books and photos to satiate her growing appetite for all things space-related.

But a gift from an aunt living in Canada — a telescope, small and basic, but enough for the young teenager to locate and peer at Jupiter from her terrace — opened up a new world of possibilities.

"Actually being able to use my own telescope, set it up myself, try to point it and align it ... That gave me the feeling that, oh, this could be a cool job," Patel, an astrophysicist based in London, Ontario, said. "That got me motivated to do what I've been doing for my life." →

Growing idea

Seeds for the museum were planted last year when amateur astronomer Rudolph Dorner, longtime member of RASC's Kitchener-Waterloo Centre, announced at the society's June 2019 General Assembly that he would be posthumously donating $1.5 million towards the creation of a new telescope museum.

Dorner, who had been diagnosed with life-threatening illness and was told he had a short time to live, wanted to leave behind a legacy project to tell the untold story of the telescope. Fortunately, he survived the prognosis, but his pledge remains. Dorner also committed to supporting the museum with an additional $25,000 per year while he lives.

"You've heard of, 'Build it and they will come.' Well, our mantra is, 'Tell a good story and they will come,'" Dorner told the assembly last year, encouraging other members to support the cause as well. "With your help, this museum can become a source of great pride for RASC. It will be a specialist museum, a focused museum, and perhaps even a world-class museum unlike any other."

A donation this generous gives RASC a solid foundation it can use to build a public face for the society, said RASC president Robyn Foret.

"Having that financial basis that we can build upon, it gives us a physical presence in the Canadian marketplace for the public to see," he said. "It goes beyond the museum and what's in the museum."

But the artifacts, many created or used by RASC members throughout history, also tell the story of the society's evolution and role in Canadian astronomy.

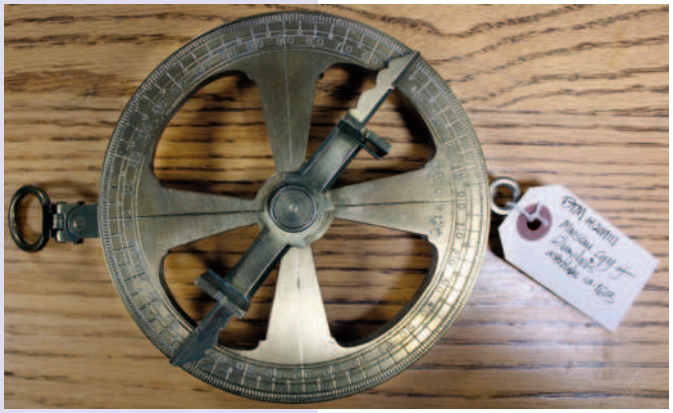
"It's important to understand the history of things, so that you can appreciate where you are and where we need to get to," Foret said.

The existing collection is currently displayed around the boardroom of RASC's Toronto headquarters. The society is looking to move to a new location early next year — ideally still within the Greater Toronto Area — that can accommodate an approximately 1,000-square-foot space, Groff said.

In the meantime, much of the collection is available to browse in an online catalogue. This works out well during a pandemic, and it is also great for people in other parts of Canada who cannot make the trek to Toronto.

"When you talk about it and you show [kids] pictures, it's kind of abstract in many ways. But it's different when they get their hands on it or when they see it operated right in front of their eyes."

— Parshati Patel, an educational outreach and communications specialist at Western University's Institute for Earth and Space Exploration.



Rosenfeld, who has been volunteering his time to run the museum, said he is starting out with a "shopping list" of telescopes and related equipment used throughout Canadian history, and searching for them with the hope that they survived.

"We've been pretty lucky so far that some things that I was sure would not survive actually did survive, and some people gave them to us," Rosenfeld said, noting an example would be a 1929 three-metre long amateur telescope with a 30-centimetre mirror, featured in *Scientific American*.

He is now appealing to astronomy enthusiasts to share their own stories and knowledge about local telescope makers. He hopes that the museum will be trusted to aid First Nations, Métis and Inuit peoples in the ongoing story of how telescopes were and are used.

"The story the museum presents now is a very 'white guy' story," Rosenfeld said. "But of course, that's not the whole story because there are a lot of other people here." ✶

Opposite, top: RASC executive director Philip Groff (left) shakes the hand of telescope maker Normand Fullum as he presents the Fullum 10-inch Dobsonian telescope to the Dorner Telescope Museum.

Opposite, bottom: Longtime RASC member Rudolph Dorner announced at the society's June 2019 General Assembly that he would be posthumously donating $1.5 million towards the creation of a new telescope museum.

Top left: Purchased from Réal Manseau, this museum piece is a reproduction of Samuel de Champlain's astrolabe which was made circa 1603 in France.

Bottom left: Produced in the 1970s in Canada, ELCAN (Ernst Leitz Canada) made these 7x50 roof-prism binoculars. This particular artifact includes the original Canadian Armed Forces' issued green cloth case, and filters in the CAF-issued green leather case.

Right: The Dorner Telescope Museum has its own mascot, too.

Dear *SkyNews* Readers

From the desk of Robyn Foret, president of The Royal Astronomical Society of Canada

As I step into my new role as president, the world is in turmoil, angry with itself for turning a blind eye to atrocity.

We look across our borders and see the great United States of America, perhaps the greatest glass house in all the world. Glass houses reveal the beauty of the home as well as any ugliness within. In the United States, we see a desire to promote independence, democracy, equality — one country built from many. We also see racism and violence against Black people, ethnic and religious profiling, bigotry based on sexual orientation and exploitation of women.

But glass houses aren't just transparent. They are also mirrors. Look closely into that maelstrom, and you will realize the unimaginable: that's me in there. Those are my neighbours. There are our Chinese friends in Vancouver. Those are my Sikh and Muslim co-workers' families. There's the Stampede Princess from the Siksika Nation; I cooked pancakes with her last year.

It's not just the overt racism or misogyny or homophobia. It's the systemic and pervasive culture that allows these things to thrive. The underlying problem isn't just that police used violence against George Floyd; the problem is the culture that allows and entitles police to use deadly force against Black people, Indigenous peoples and people of colour.

And when we look within our own Canadian society, we see the same problems.

The roots are deep, as deep as RASC. At any of our club meetings, if a woman is afraid of sharing her opinion because of dogpiling fears, if a new citizen doesn't speak up because English is their second language, if any person faces discrimination based on sexuality, if someone doesn't attend because of the worries associated with religious symbols they wear — simply if someone is afraid to attend and share their thoughts because they don't look or speak like most others in the room — then we have failed.

The truth is, we are all different, and it is our differences that make each of us unique and special. That is the beauty of humanity. It is time to stop dividing ourselves based on these differences. Instead, it is time to celebrate them.

MORGAN FORET

Astromart

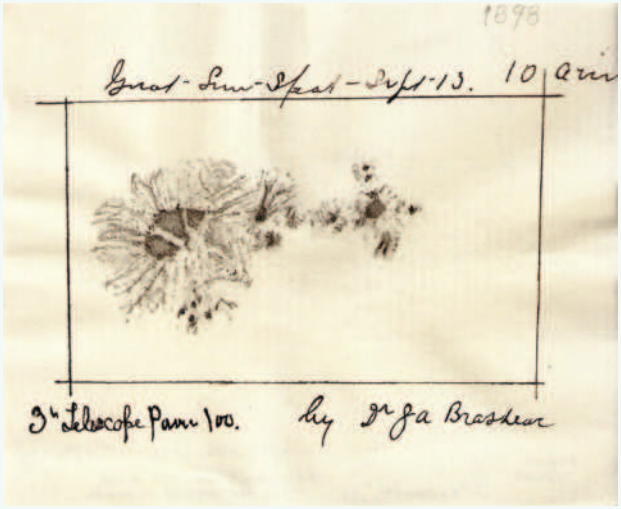
19th Annual **SkyNews**

PHOTO of the WEEK CONTEST

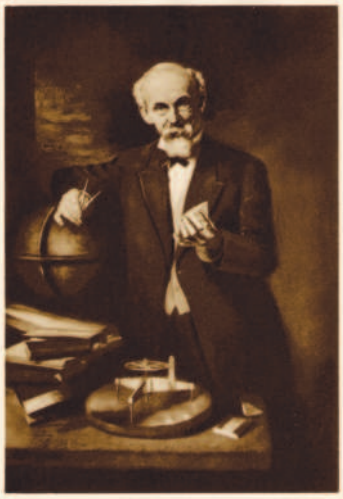
Submit your best nightscapes, lunar / planetary / solar images and deep-sky object pictures to enter in the 2020-21 Photo of the Week contest! All images will be submitted into our Photo of the Year contest. New this year, the Contest will also include a category for "Best Youth Image" to highlight the work of people up to 25 years old.

Want to put your image editing skills to the test? Each month, the RASC Robotic Telescope team will release the data for an image for the public to edit, and judges will pick a winner out of those submitted.

See contest details at skynews.ca



Above:
A modern reconstruction of Dr. John A. Brashear's Great Sunspot of 1898 drawing. It was created using materials similar to those available in the 1890s.



Right:
In 1896, Dr. John A. Brashear became a member of the Astronomical & Physical Society of Toronto, the pre-cursor to The Royal Astronomical Society of Canada.

THROUGH TIME'S LENS

Dr. Brashear's tremendous top-notch telescopes

In 1896, Dr. John A. Brashear did the Astronomical & Physical Society of Toronto the honour of becoming a "corresponding" member.

"Uncle John" was one of the outstanding professional opticians of his generation. John A. Brashear Co. Ltd. — of Allegheny, Pennsylvania — provided the lenses, mirrors, prisms and gratings that enabled Canada's professional astronomers to become our first astrophysicists. Their work included the 15-inch Great Refractor, the principal instrument at the Dominion Observatory in Ottawa, and the 72-inch reflector telescope that was the principal instrument at the Dominion Astrophysical Observatory in Saanich, British Columbia.

Brashear took his honorary membership seriously. In 1899, he gave a well-attended public lecture for the Society in Toronto, and gifted us with one of his coveted and expensive gratings for spectroscopy. The previous year, he had sent us his drawing of the Great Sunspot of 1898, observed with the small refractor he kept on Urania Island in Lake Muskoka, Ontario, an instrument he also enjoyed sharing with the public. Sadly, we no longer possess either mark of his respect.

Images reproduced courtesy of the Specula Astronomica Minima

Measuring stellar spectra using RSpec software

Read the full article at SkyNews.ca

For our astronomy class's final project at John Abbott College in Montreal, we wanted to analyze starlight to find out the star temperature and place on a Hertzsprung-Russell diagram. The task would have been a difficult one, if not for an amazing spectroscopy software called RSpec.

The software boasts a number of useful features; importing photos and live video is easy and the spectrum is processed quickly. Your spectrum is read in terms of pixel brightness and can be calibrated into wavelength through the software.

At The Royal Astronomical Society of Canada's Montreal Centre, we were interested in implementing spectroscopy and RSpec into our astronomy outreach events, which generally include inviting the public to look through our telescopes at planets, stars, nebulae and Messier objects.

Spectroscopy is, much like astronomy more broadly, an entirely visual endeavour, which is why people get excited in the first place. If you're interested in involving a dimension of science to the way you approach and do astronomy, then RSpec is the software you're looking for. It works wonders with high-quality photos to produce brilliant, detailed graphs with visually clear details.

This tool makes learning about stellar and atmospheric composition engaging. Grounded in visualizations as opposed to hard mathematics, it greatly benefits new astronomers. If you're interested in astronomy outreach (and indeed, science outreach) like we are, we believe that spectroscopy is one of the best ways to do it.

— *Julien da Silva, Danielle Richard, Virginia Rufina Marquez-Pacheco, Abubakar Ali Hawas (Professor Karim Jaffer)*

A view of Venus occultation — and reappearance

Nova Scotians were uniquely positioned to observe Venus' occultation June 19, 2020, and blessed with clear skies.

I rose at 4 a.m. to grab my gear and drive to a nearby ridge with a great eastern horizon, in an industrial park overlooking the highway to Truro and a lake.

Dawn was already breaking when I arrived, about an hour before sunrise. I could only see the bright planets and stars. I picked out Capella in the direction of the expected sunrise. The Moon had already risen, but was obscured by haze. I eventually managed one photo while it was near the horizon. I used my TeleVue 70mm f/6.8 Ranger (focal length 480mm) on a sturdy mount with no tracking, coupled to my Canon SL1 camera. This gives a three-degree diagonal field of view.

I got decent before-and-after still photos, and also a video, although I was a few seconds late starting. Drat!

What I was not expecting was the manner of the reappearance of Venus. At first, I saw a growing bright blob of light to the upper right. It grew, but then I blinked, and I saw another, smaller blob of light a little below and to the right of the first. What the …

The two blobs grew, then merged, and finally the full crescent of Venus was on view.

What I observed was the northern and southern cusps of the crescent of Venus reappear from occultation before the illuminated equatorial region. It all makes sense, but I did not see it coming.

Afterward, I just watched the two in the twilit sky with my unaided eyes. It was a beautiful sight, hard to capture on camera — plus the birds, the 18-wheelers, the mosquitos.

I watched for about 15 minutes, and then I lost them both.

All in all, a great morning!

RASC Fellow Dave Chapman is a member of the Halifax Centre. He lives in Dartmouth, Nova Scotia.

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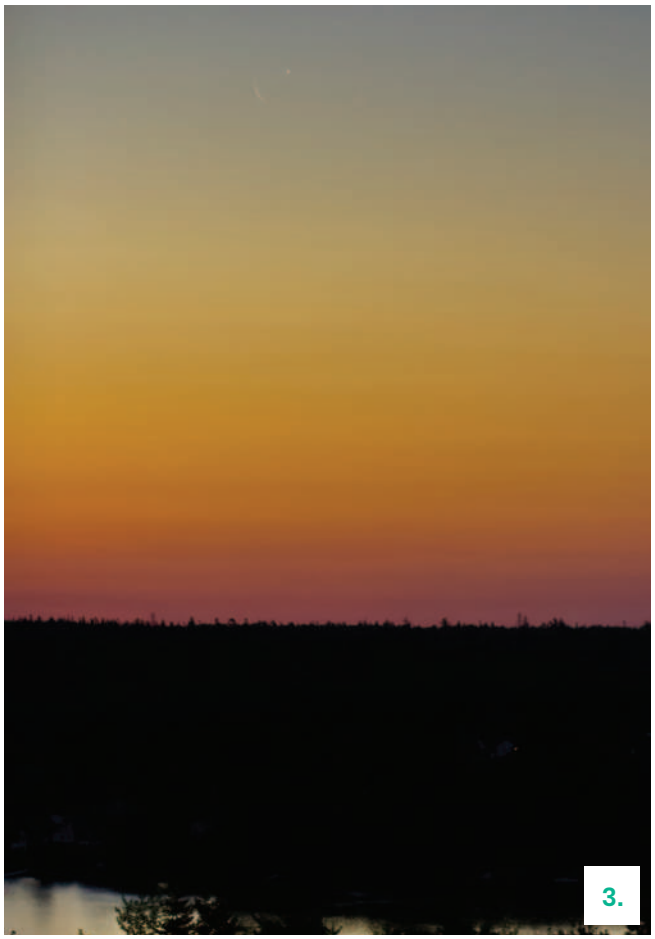

3.

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1. This photo was taken at about 5:07 a.m. ADT, with a TeleVue 70mm f/6.8 Ranger (focal length 480mm) on a sturdy mount with no tracking, coupled to a Canon SL1 camera.

2. This photo was taken at about 5:09 a.m., about a minute after Venus reappeared.

3. This photo was taken at 5:13 a.m. with a Canon SL1, paired with a Canon 85mm lens.

4. Chapman took this "selfie" with his iPhone 11 Pro at 5:02 a.m. while waiting for Venus to reappear.

Photos by Nathan Hellner-Mestelman

A 'career' in iPhone astrophotography

Hello Canada! My name is Nathan, and I am a 13-year-old amateur iPhone astrophotographer.

This is my first time writing in *SkyNews*. Like, seriously! *SkyNews* magazine!

I have had an eight-inch Dobsonian telescope for about two-and-a-half years, and the day I got it, I looked at the Moon. I was very impressed, and I started seeing stars. I loved the view, but I wanted to try to capture it on camera. You know — it's "all about the photo." At the time, being a complete newbie, I simply held my parents' iPhone 5s up to the eyepiece and got a then-impressive picture.

iPhone astrophotography has been serving me well. I've captured the whole Solar System and have been obsessed with planetary observations. iPhones are definitely at the bottom of the ranks for astrophotography, but I'm very happy with one.

You might wonder how I process my images. Mine is seriously a newbie technique — I use Microsoft Word. I've mastered how to insert, move, edit, sharpen, enhance, crop, reformat and overlay images in Word. I used it to submit the images you see here, though they have now been touched up by the *SkyNews* team.

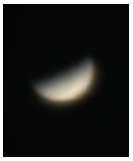
2020 has been a great year to observe Venus. In 2012, I seriously messed up by not seeing the Venus transit, something which I had no idea about at the time, but now I'm going to regret it for eternity (unless I survive to 110 and see the next). 2020 was still slated to give me the best view of Venus in the sky since 2012, sadly without a transit at the end.

I've gotten great views of Venus and I observed it as often as possible, taking images with my — well, my mother's — trusty iPhone. Here, you can see my completed sequence. I got the images from December 23, 2019, to June 1, 2020.

Let me point out some of my favourites from the series.

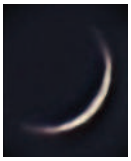
December 23, 2019. This was the first picture in my series.

March 11, 2020. I began to use my "colossal eyepiece combination" which features a five-millimeter eyepiece with a 2.5x Barlow lens. This is beyond what most people recommend for an eight-inch telescope, but clearly not beyond what I recommend.

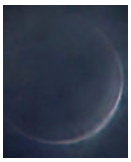


April 2, 2020. It was so high in the sky, it was very easy to observe, and with little atmospheric turbulence. This was also around the time I tried to see Venus shadows. I was not successful in seeing them, but my father and I captured them on his camera.

April 23, 2020. This was one of my clearest pictures. The seeing conditions were excellent.



May 13, 2020. This was when I started to care a lot about my eyesight. I had observed Venus the night before, but realized it was so low in the sky that it was a blur. Realizing Venus was becoming too low to observe in the evening, I observed it in the daytime and realized how risky it was to see it with the Sun nearby. Here, Venus was still over 20 degrees from the Sun.



June 1, 2020. This was the last picture of my series. Venus was by this point 2.8 degrees away from the Sun, and only 0.1 per cent illuminated. I observed it mid-day at the very edge of the shadow of a long building. I was very careful getting this image, because I like having my vision and I would only be able to enjoy the image afterwards if I could see it.

To find Venus in the sky, I did not use the finderscope, but rather I used an augmented reality app on the phone, Star Walk 2. Because Venus was 2.8 degrees from the Sun, it was beginning to show cusp extensions — the crescent appears to extend as a circle because sunlight is streaming through backlit Venus's upper atmosphere.

This is my favourite image of the whole series. It is possibly the coolest thing I've captured with my telescope. ✷

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