Is there anybody out there?

As a young child of twelve, I was always interested in the question “Are we alone?” I even felt proud when a friend asked that question, and I replied “Most people think that we are alone in the Universe, but I do not agree with them. I believe that there is life out there. Maybe there is even life on Mars.”

That youthful conception shattered during the Summer of 1965. Mariner IV, the first United States probe to explore Mars, deliberately flew by the red planet. It crossed a stretch of landscape on which Percival Lowell, who was the famous American astronomer who began the search for “Planet X” (later identified as Pluto), insisted he observed canals. If he were right, then Mars could have a global civilization that built them to protect their precious water supply. However, the spacecraft found only craters. “Mars at Noon,” trumpeted The New York Times that July, “No Canals.”

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Astronomy is a family affair

My grandfather David Levy and I have had many adventures involving the night sky. I remember one night in particular at an astronomy camp in the Adirondack. It was our second night there and I remember looking up at the stars with such wonder. My grandfather walked over to me and said, “Would you like to look through one of my telescopes?” Of course, I said yes and we walked over to his telescope and I looked through it and he said, “That is Saturn.”

After that, he kept pointing me to different stars and planets, and I kept asking more and more questions and he had an answer for every single question. My grandfather is an impressive man to say the least. When it comes to the night sky, he is an expert. I have all the respect and love in the world for him. I hope that in the future he can discover more comets to add to the rest of his impressive achievements.

Sky’s Up digital magazine is made possible through a generous contribution from expertscientists.com.
**Sky**

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**What’s up in the sky**

**April 7 — Jupiter at Opposition**

Early April will be an ideal time to get a good look at our solar system’s most dominating planet. On April 7th, Jupiter will be at opposition, which means it is essentially at a position directly opposite the Sun when viewed from Earth. Near the same time, the gas giant will be at its closest point to the Earth for the year. The combination of these factors puts Jupiter in a prime viewing position from dusk until dawn, peaking at midnight local time.

Because it will be visible for so long, it is possible to see the entirety of the planet in one night because it takes just under 10 hours for Jupiter to complete a full rotation. Ranked as the fourth brightest celestial object, Jupiter can be found in the Virgo Constellation near the bright star Spica. With the naked eye, it will manifest as a stunningly bright point of light, but a modest telescope may reveal the giant planet’s impressive cloud belts, its four greatest Galilean moons.

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**April 22/23 — Lyrids Meteor Shower Peaks**

From mid- to late-April, one of the oldest meteor showers on record will be taking its annual turn in the sky. The Lyrids, which are caused by the Earth’s passage through debris left behind by Comet Thatcher, are set to peak in the predawn hours of April 22nd/23rd. The shower produces an average hourly count of between 10 and 20 meteors during the peak. However, rare outbursts are possible. The Moon will be at a thin waning crescent during the peak so interference will be minimal. Especially favorable for the Northern Hemisphere, the Lyrids appear to radiate from the bright star Spica. With the naked eye, they may manifest as a stunningly bright point of light, but a modest telescope may reveal the giant planet’s impressive cloud belts, its four greatest Galilean moons.

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**May 15 — Saturn at Opposition**

Saturn and its dazzling rings will be in a prime viewing situation as the planet reaches opposition on June 15th. During this event, Saturn will rise as the Sun sets and stay up all night, which provides for ample viewing time. In addition to delving into Saturn’s fascinating ring system, small telescope users might want to look for Titan, the largest of Saturn’s moons, and the dark grove in the rings that is identified as the Cassini Division.

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**May 29 - 6 — Eta Aquarids Meteor Shower Peaks**

The annual Eta Aquarid meteor shower is set to peak in the pre-dawn hours of May 29th/30th. The shower is caused by the Earth’s passage through debris left behind by the famous Halley’s Comet, which is also the source for another meteor shower - the Orionids - every October. Especially amazing for Southern Hemisphere observers, who could be treated to 30 or more meteors per hour, the Eta Aquarids appear to radiate from the Aquarius constellation.

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**June 20 - Asteroid Day**

Far from simple fodder for sci-fi doomsday blockbusters, asteroids present a very real threat to our world. With this in mind, Asteroid Day was launched in 2015 to raise awareness and encourage a drastic acceleration of efforts to detect and track near-Earth asteroids. For more information about Asteroid Day and how you can get involved, click here.

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**Year set to be a busy one for Explore Scientific**

The team at Explore Scientific will be showcasing new products and sharing the skies at star parties and expositions across North America in 2017. Explore Scientific plans to be at:

- Apr 8-9: NEAF (Suffern, N.Y.)
- May 6-7: AstroCats (Milton, Ontario, Canada)
- May 26-28: Explore Scientific Days at Yerkes Observatory (Williams Bay, Wisc.)
- June 21-25: Golden State Star Party (Aden, Calif.)
- July 20-22: StarFest Canada (Ayclay, Ontario, Canada)
- Aug. 16-19: ALCON National Convention (Casper, Wyo.)
- Aug. 27-Sept. 4: Burning Man (Black Rock Desert, Nev.)
- Sept. 16-24: Okie-Tex (Kenton, Okla.)
- Oct. 15-22: Peach State Star Gaze (Sharon, Ga.)

For more information on where Explore Scientific has been and will be, click here.

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**On the road again...**

Stunning views of the Milky Way are the norm at the 2016 Golden State Star Party in Aden, Calif. This year, the annual star party will be held June 21-25.

On the horizon

Awakening others to the marvels of the universe is the most rewarding part of astronomy outreach, and some of the best places to do that are star parties and astronomy expositions. The following is a list of upcoming events that promote amateur astronomy.

**April 8-9 — Northeast Astronomy Forum**

Billed as the world’s largest astronomy and space expo, the Northeast Astronomy Forum (NEAF) will be held April 8-9 at SUNY Rockland Community College in Suffern, N.Y. The event, which is sponsored by the Rockland Astronomy Club, features lectures from world-renowned experts on a range of topics, solar observing, a wide variety of vendors, boys’ activities, raffle prizes and more. NEAF comes on the heels of the Northeast Astro Imaging Festival. This Rockland Astronomy Club event, which will be held April 6-7 at the Crowne Plaza Conference Center in Suffern, focuses on astrophotography. For more information, click here.

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**Star Stare**

Astronomers of all levels can enjoy four nights of observing under extremely dark skies that are ideal for those nights of observing, the event also offers tours of the nearby McDonald Observatory, presentations by astronomers and telescope makers, workshops and more. Attendees can also enjoy attractions like Big Bend National Park, the Marfa Lights. For more information, click here.

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**On the road again...**

The 39th Annual Texas Star Party will kick off on May 21 at the Prude Ranch six miles northwest of Fort Davis, Texas. In addition to offering extremely dark skies that are ideal for seven nights of observing, the event also offers tours of the nearby McDonald Observatory, presentations by astronomers and telescope makers, workshops and more. Attendees can also enjoy attractions like Big Bend National Park and the Marfa Lights. For more information, click here.

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**June 21-25 — Rocky Mountain Star Stare**

Sponsored by the Colorado Springs Astronomical Society, this popular star party takes place on a 35-acre site located two hours southwest of downtown Colorado Springs near Gardner, Colo. The site’s dark skies make it an ideal location for observing. Additional activities include nationally recognized speakers, an ATM walkabout where amateur astronomers show off their telescope-making abilities and ideas, a photo contest, children’s activities and prizes. For more information, click here.

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**Finalize your eclipse plans!!**

Time is running out to finalize your observing plans for the total solar eclipse that will cut a path across the continental United States on Aug. 21. It has been more than 38 years since the United States last experienced a total solar eclipse, so anticipation is at a fever pitch. If you have not already, make plans to get to a point on the path of totality that is depicted on this graphic. The total phase will last less than three minutes at a prime location, but it is worth making the trip to see an epic astronomical event.

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**Promoted and organized by the Astronomical League, Astronomy Day is scheduled for April 29th, and events are being planned around the country to celebrate. Roasting roots that go back to 1973, Astronomy Day has been held in the spring and fall each year since 2007. With a theme of ‘Bringing Astronomy to the People,’ organizers describe the day as a grass roots movement with a mission to expose as many people as possible to the wonders of astronomy. For more information or to view a list of scheduled events, click here or check with your local astronomy club.

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**May 25-29 — RTMC Astronomy Expo**

The much-anticipated Aug. 21 total solar eclipse will take center stage this year’s RTMC Astronomy Expo, which is held annually at Yavapai Camp Oakes near Big Bear City in southern California. In keeping with this year’s “The Day the Sun Disappears” theme, the event will focus heavily on the eclipse event and feature keynote speaker Dr. Fred Espenak, a retired NASA astrophysicist and eclipse expert. The multi-day festivities will also include evening observing, lectures, a swap meet and more. For more information, click here.

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**On the road again...**

For more information on where Explore Scientific has been and will be, click here.
Brittnay Struble and her four sisters grew up in the shadow of the legendary Yerkes Observatory, where their father still serves as building and grounds supervisor.

"I don’t think that there has been one time when this observatory hasn’t been an aspect of my life," Struble recently reflected. “My sisters and I used to run around the outside of the building all the time, or we would come inside the building just for a few minutes to see my dad while he was working. We could actually see the building itself from our kitchen window. That’s how close we were.”

But while the observatory has always been a part of her life, astronomy was not. Instead, it was her younger sister Molleigh who was the family astronomer. From a young age, she was active at the observatory and devoted to sharing the joy of astronomy. At 9-years-old, Molleigh even helped write a grant that started a summer outreach program at Yerkes.

In 2010, Molleigh tragically passed away at just 16 years old, and Struble’s life took an unexpected turn.

“I wanted to keep her memory alive, make sure she wasn’t forgotten and make sure that what she started was able to continue,” Struble said. “I wanted to honor her by helping others learn about astronomy. In the process, I became very passionate about it.”

For the last six years, Struble has worked at Yerkes Observatory. During her tenure, she has witnessed first hand the ways in which astronomy outreach efforts can inspire.

“With the younger students I work with, I will say that once they’ve worked in some of the outreach programs that I do with a few other teachers that helped spark their interest and they want to come back for more,” she said. In this “Rising Star” Q&A feature, Struble discusses her outreach work at Yerkes Observatory.

Outreach educator fuels her passion at Yerkes Observatory

Brittnay Struble stands inside the historic Yerkes Observatory in Williams Bay, Wisc., where she is involved in multiple astronomy outreach efforts.

What kind of astronomy outreach activities are you involved in at Yerkes Observatory?

I work with a robotic observing program called skyNet/skyNet Junior Scholars, which makes it possible for students and educators to have an image of anything in the night sky taken by optical or radio telescopes all over the world.

I also do a summer program called Yerkes Astrophysics Academy for Young Scientist (YAAYS), which my sister helped start back in 2007.

Another program I do is the Family Night Program that started in January of 2011. I started it in memory of my sister. It’s for students and their families to come and learn about science and astronomy here at Yerkes.

They’ll do different activities based on a certain topic. We’ve done comets, asteroids, the solar system in general, black holes, the reasons behind the seasons and then technology aspects. It features talks from astronomers and engineers that work at Yerkes Observatory and some hands on activities to go along with the talks.

I have also worked a few of the star parties we hold here at Yerkes, one of which is a Harry Potter themed one called the “Magic of Astronomy” star party in collaboration with the Wisconsin School for the Blind and Visually Impaired Astronomy Club.

Astronomy advocate: Brittnay Struble fuels her passion at Yerkes Observatory

Built in the closing years of the 19th century, Yerkes Observatory is located on Geneva Lake in Williams Bay, Wisc. The historic facility, which is part of the University of Chicago’s Department of Astronomy and Astrophysics, was founded by George Ellery Hale and named for its financier Charles T. Yerkes.

The first observations at Yerkes were made in 1897 on the facility’s legendary 40-inch refractor, which remains the largest telescope of its kind in the world today.

This impressive telescope was not the only unique aspect incorporated into the observatory’s design. In accordance with Hale’s vision, Yerkes was built to include laboratory space to broaden the capabilities of the facility. The inclusion of space for research in physics and chemistry put Yerkes on the frontier of modern astrophysics.

Today, the observatory continues to operate as an educational and research facility. In addition to the 40-inch refractor, which has been in use for well over a century, the facility offers both a 24-inch and a 40-inch reflector.

For more information on Yerkes Observatory, click here.

Learn more about Yerkes Observatory

COURTESY OF Yerkes Observatory

Brittnay Struble, right, participates in the Harry Potter-themed star party held at Yerkes Observatory in collaboration with the Wisconsin School for the Blind and Visually Impaired Astronomy Club.
What is the most rewarding part of doing astronomy outreach?
The most rewarding part of doing astronomy outreach is seeing the students I work with having fun while learning about the outside world. It’s helping students expand their knowledge from what they learned in school. It’s helping them to learn more than just those basics. Unless you’re in college, the stuff that they learn here, that’s not something they would likely learn in elementary, junior, or senior high.

What activities generate the most excitement during outreach events?
Seeing the great 40-inch refractor and getting to view through it and the other telescopes we have seem to be the most popular activities at outreach events. The opportunity to look through the telescopes here. That’s what really draws them in. They might not be able to just see it from their backyard.

What advice do you have for young people who want to get into the field of astronomy?
Find an observatory that you can visit and work with the astronomers there. If they have an education department then help there to expand whatever knowledge you have.

What will you discover?
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Yuri’s Night celebrates space exploration

When it comes to space exploration, April 12th has long held profound significance. It was on that date in 1961 that cosmonaut Yuri Gagarin became the first human in outer space after he blasted off for a 108-minute flight aboard the Soviet space program’s Vostok 1 spacecraft. Although brief, this journey was a monumental milestone that ignited an international passion for space exploration. To commemorate this historic event and ensure that passion continues to thrive, organizers held the first Yuri’s Night on April 12, 2001, and it has grown every year since.

Dubbed a World Space Party, the event is a “global celebration of humanity’s past, present and future in space.” Although the anniversary of Yuri Gagarin’s flight is the foundation of the celebration, it also coincides with another April 12th milestone - the 1981 inaugural launch of NASA’s Space Shuttle, which was the world’s first reusable spacecraft and a catalyst for international cooperation.

For more information or a schedule of the hundreds of related parties across the globe, visit www.yurisnight.net.

The International Space Station makes it easier to spot space station

The International Space Station has been a fixture in the sky since its first component was launched in 1998, and it is a bright sight to behold if you can catch it. Depending on your location, you may be able to witness the ISS blazing a path across the sky several times a week, or it may only appear once or twice a month if that.

To take the guesswork out of your search for the space station, NASA has a handy Spot the Station service available at spotthestation.nasa.gov. Visitors to the site can get a list of upcoming sightings for a location they specify.

Visitors can also sign up to receive email or text alerts that will let them know when an opportunity to view the station is near for their specified location. The alerts will include the time of the sighting, how long the ISS will be visible, the height at which it can be seen, degrees in which it will appear and where it will disappear.

Bright enough to be seen even with city light pollution, the ISS looks like a fast-moving plane or star. The station is the size of a football field and is the largest manmade object in space. It has more livable area than an average six-bedroom house.

On May 29, 2011, a crew member on the Space Shuttle Endeavour captured this photo of the International Space Station following undocking procedures.

International Dark Sky Week begins April 22

Perfectly timed to coincide with Earth Day, the International Dark-Sky Association will kick off its annual campaign to shine a figurative light on the very real problem of light pollution.

 Held each year since 2003, International Dark Sky Week is an awareness event that was the brainchild of Jennifer Barlow, a high school student on a mission to preserve the wonder of the night sky for future generations. The goals for the week are fairly simple: Celebrate the beauty of the stars, raise awareness about the negative effects of light pollution and embolden people to act to reduce the problem.

Organizers encourage individuals around the globe to mark the week in a range of ways such as hosting star parties, sharing their thoughts about the issue on social media, participating in an IDSA activity or simply visiting the website to find out more about the topic and what changes they can make.

For more information, click here.

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For more information, click here.

Constellation corner

Ursa Major is full of deep sky beauties

Like the “Great Bear” it is meant to represent, the Ursa Major Constellation is a domineering force that rises to prominence in the Northern Hemisphere’s skies as winter fades into spring. Encompassing a 1.280 square degree area of celestial real estate, Ursa Major is the third largest constellation and is one of the most recognizable due in large part to the Big Dipper asterism that resides within it. Like Orion’s Belt, this well-known star pattern is a key orientation point for those seeking to navigate the skies.

The Big Dipper is defined by seven stars - Dubhe, Merak, Phecda, Megrez, Alioth, Mizar and Alkaid. Observers can draw an imaginary line from Merak through Dubhe, which make up the outer edge of the Big Dipper’s “bowl” and are often referred to as the Pointers, to locate Polaris — the North Star. They can also follow an imaginary line that extends from the “handle” end of the asterism to find the showy red giant Arcturus. Ursa Major also contains the visual companion stars Mizar and Alcor, which are sometimes called the “Horse and Rider.” These stars, which are actually multiple star systems, show up nicely in binoculars.

When it comes to deep sky offerings, the galaxy-rich Ursa Major Constellation is a popular observing target and has an impressive diameter of around 170,000 light years — making it much larger than our own Milky Way.

NASA makes it easier to spot space station

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Two of the most popular destinations in the galaxy-rich Ursa Major Constellation pop in this image from astrophotographer Chuck Kimball of Ithaca, Ga. On the left is the stunning Messier 81 or Bode’s Galaxy. On the right is the fainter Messier 82 or Cigar Galaxy.

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When it comes to deep sky offerings, this spiral galaxy is a popular observing target and has an impressive diameter of around 170,000 light years — making it much larger than our own Milky Way.
Star search

SETI’s Seth Shostak is on the hunt for alien signals

At the age of 10, a book on the solar system set Seth Shostak on an intriguing career path that would eventually establish him as a bona fide alien hunter.

This simple introduction to our celestial neighborhood led Shostak to earn a doctorate in astrophysics from the California Institute of Technology, where he embraced the field of radio astronomy.

Since 2001, Shostak has served as the senior astronomer at the SETI Institute, a nonprofit organization in Mountain View, Calif., with a mission to “explore, understand and explain the origin, nature and prevalence of life in the universe.”

Prior to joining SETI in the early 1990s, Shostak conducted radio astronomy research on galaxies, including studies using the Westerbork Synthesis Radio Telescope.

Over his career, he has written, edited and contributed to a half dozen books, most recently Confessions of an Alien Hunter: A Scientist’s Search for Extraterrestrial Intelligence, and has published more than 400 articles on astronomy and other topics.

Shostak also hosts the SETI Institute’s weekly science radio show, “Big Picture Science” (http://radio.seti.org/).

In this installment of Sky’s Up’s 10 Questions feature, Shostak shares his thoughts on his work at SETI and the ongoing search for extraterrestrial life.

How did you get your job at SETI?

I studied radio astronomy in graduate school, and was using large antennas to map the radio emission coming from some large, nearby galaxies. But one night, at 3:00 am, while sitting alone at the observatory, I read an article that pointed out that the same antennas I was using could also be used to look for aliens. That was an intriguing idea, and became more than just an idea when I moved to the San Francisco Bay Area many years later. I was here for less than a year before the folks at the SETI Institute called me up and offered a job.

What is your workday like?

I suspect that a lot of folks figure my workdays are glamorous, or perhaps consist of sitting around with headphones, hoping to hear a signal from space. Neither is true. My days are similar to many other people’s I think … dealing with email and phone calls, sitting in lots of meetings, and worrying about finding the money necessary to keep our research going. The “listening” is all computerized and automated, so there’s not much time spent doing that. Rather, my colleagues and I will discuss how we can make the search either faster or somehow more effective.

What do you use to hunt aliens?

The equipment we use is called the Allen Telescope Array. It’s a grouping of 42 small (20 feet in diameter) antennas in California’s Cascade Mountains. We also have very sophisticated electronics and computer software for analyzing any signals picked up by these antennas. So there’s a lot of hi-tech stuff, and our staff is pretty good at designing and building such things.

What would be your next step if you found a definite alien signal?

We would check it out by making simple technical tests to be sure it wasn’t just interference from an orbiting satellite or some other source. Then we would call up someone at another radio telescope, and have them check it out. If it still looked good, we would tell the world.

In their search for extraterrestrial life, SETI astronomers use radio telescopes at the Allen Telescope Array in Hat Creek, Calif.
Do you think aliens could have found signals from us?

It’s certainly possible, at least if they’re close enough. AM radio signals are bent by the Earth’s ionosphere, so they don’t really make it into space. But beginning about the time of the Second World War, we started transmitting FM radio, television and radar. For our own purposes, of course, but these signals have now traveled about 70 light-years into space, and there are roughly 15,000 star systems within that distance. So if they have some big receiving antennas, and are on planets around those systems, they could know that we’re here.

How much of a chance do you think there is that we’ll find a signal in the next 10 years?

I’ve bet everyone a cup of coffee that we’ll find a signal from E.T. within the next 20 years. The reason I’m optimistic is that the equipment is getting better all the time (mainly due to the increased capability of computers), and that speeds up the search. In the next two decades, we should be able to check out the neighborhoods of about one million star systems in our galaxy. If they have some big receiving antennas, and are on planets around those systems, they could know that we’re here.

How do you think the public would react if you announced a found signal?

I don’t think they would go nuts. Rather, I believe that they would find it very interesting, and immediately would want to know more. For example, how far away are they? Can we see their planet? And eventually, could we figure out any of their signal?

Do you like The X-Files?

I watched some of it, and found it interesting. But I don’t have a lot of time to spend in front of the TV. The idea in the “X Files” was that the aliens might be here, visiting Earth. Despite the fact that one-third of the American public think that’s true, I’m not among them. I don’t believe that some UFOs are really alien spacecraft.

Does your work take you to different locations where similar research is going on? If so, where?

Today, essentially all SETI research is being done by Americans. However, the instruments we turn to the sky are not exclusively in the U.S. One project is using a big, 210-foot diameter antenna in the sheep country of Australia, and I have been there a few times. I’ve also visited radio telescopes in many other parts of the world, and attended conferences on the subject of SETI on just about every continent.

What do you think life that is not carbon based would look like?

Well, even if they’re based on some other element (for example, silicon), they might still be recognizable plants and animals. Not that they’d look exactly like what we have on Earth, of course. But they would presumably have legs, a pair of eyes, and maybe something to cover their bodies (skin, fur, scales …) for protection. But I suspect that the most advanced aliens are no longer biological. Rather, they’re thinking machines. And machines can look like anything you want them to!

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Martian mystery

Scientists disagree on what ALH84001 meteorite reveals about the Red Planet

ALH 84001 — This set of letters and numbers refer to a very-unusual meteorite found in Antarctica.

Meteorites are usually named after the post office that is closest to where they were discovered. For example, the Peekskill meteorite is named after the Peekskill, N.Y., post office, and the Odessa meteorite is named after the Odessa, Texas, post office. Yet since there are not a lot of post offices throughout Antarctica, ALH 84001 is first named for the region it was found in Antarctica: Allan Hills or the ALH letters. The numbers represent the year it was found — 1984 — and then assigned a number for that year’s finds at Allan Hills — 001. ALH 84001 was found December 27, 1984, by a group of U.S. meteorite hunters. The meteorite weighed about 4.3 pounds. It is theorized that the ALH 84001 meteorite was blasted off of Mars about 17 million years ago, and fell on Antarctica some 15,000 years ago, awaiting its 1984 discovery.

It is not the unusual name or even the location that makes this meteorite so rare. First, it was identified as one of the rare class of Shergottite–Nakhliite–Chassignite (SNC) meteorites believed to be from the planet Mars. These Martian SNC meteorites would have arrived on Earth though an impact of their own. A massive meteoroid, comet or asteroid would have struck Mars — sending pieces of the Red Planet into space. Eventually some of these Martian space rocks would hit Earth and be found in a number of places on our planet.

How do we know these meteorites probably originated from Mars in the first place? Like a good detective story, scientists look for clues that show a meteorite’s possible origin. First, all of these Martian SNC meteorites appear to have come from the same parent Solar System body—an asteroid, the Moon, Mars, etc.

Second, Martian SNC meteorites are igneous rock types. Igneous rocks — one of the three major classes of rocks — are formed from the cooling and solidifying of molten material. Martian SNC meteorites and ALH 84001 are of that type of rock, which we would expect to find on Mars.

The major clue comes from examination of rocks and soil on Mars itself. In 1976, the United States landed two probes on Mars. Called the Viking spacecraft, these two unmanned landers conducted a lot of experiments. One of these experiments was to determine specific elements found in the Martian soil. One group of elements, known as the Noble Gases, were found on Mars and closely matched Martian SNC meteorites found here on Earth. This was a major clue: think of fingerprints and how each individual has his or her own set of fingerprints; no two sets are alike. And these fingerprints basically told scientists “we’re from Mars.”

And so based on these clues — same parent body, igneous rocks, and chemical analysis of Mars versus the Martian SNC meteorites — scientists have come to the conclusion that this group of meteorites are indeed from Mars. After ALH 84001 was confirmed as a Martian SNC meteorite, researchers continued to examine the meteorite sample. What they thought they had found next was startling: ALH 84001 appeared to contain microscopic bacteria fossils: proof of life on Mars!

In 1996, President Bill Clinton and officials from NASA presented the fossilized bacteria evidence in the ALH 84001 Martian SNC meteorite to the American public and the world. Scientists had used a special, very powerful type of microscope, called a scanning electron microscope. It revealed chain-like structures in the meteorite, similar to fossilized bacteria found here on Earth. These structures found within the ALH 84001 Martian SNC meteorite are very similar to those found here on Earth, which are known to be bacteria. The pro-fossilized bacteria scientists believe they might have found similar structures in other Martian meteorites.

Not everyone was convinced, however. There was an immediate rejection of the data and theory from other scientists. They claimed the structures found in the ALH 84001 Martian SNC meteorite were geological in nature, not biological. They showed evidence of similar geological structures found in rocks here on Earth. The disagreement as to what these structures are continues today, with both groups presenting data that supports their claims.

So will we ever resolve the mystery of the ALH 84001 Martian SNC meteorite? Probably eventually, especially when we bring rock samples back from Mars to study here on Earth. Even then it might take years — even decades — to determine the truth about the ALH 84001 Martian SNC meteorite structures. Yet that’s part of the adventure of science — working with the unknowns and making discoveries.

In addition to being a longtime STEM advocate, Dr. Mike Reynolds is a dean and professor of astronomy and physics at Florida State College and a recognized expert on meteoritics. He participated in NASA’s Teachers in Space Program and has served as executive director of the Chabot Space & Science Center.
Pedaling Astronomer on epic journey to share the sky

Last May, amateur astronomy enthusiast and Astronomy Technology Today managing editor Gary Parkerson embarked on the ultimate outreach adventure — a solo cycling trip through 48 states plus Washington, D.C. on a bike loaded with astronomy equipment.

His goal for this epic undertaking known as The Pedaling Astronomer Project is to cultivate enthusiasm for both astronomy and cycling by traveling thousands of miles across the continental United States to engage people one on one with the wonders of the sky.

In addition, Parkerson is using this unique opportunity to build anticipation for this year’s momentous total solar eclipse that will captivate observers across America on Aug. 21.

Here, Parkerson reflects on his amazing journey.

What inspired you to create the Pedaling Astronomer Project?

I was driving home from Astronomy Outreach network’s 2014 Big Bear Starlight Festival, still stoked from participating in the sharing of solar and night-sky telescope views with so many thousands of delighted guests, when I noticed a fellow struggling up a steep grade pushing a bicycle along the shoulder of I-40 just west of Flagstaff, Ariz. And by struggling, I mean, it looked like it was all he could do to move his overloaded bike up the very long, very steep incline. It’s the first time I can recall seeing a cyclist on an interstate highway, much less seeing one pushing his bike.

Anyway, the scene was so improbable, I pulled off at the next exit and waited for him. When he finally caught up, I asked if he needed help. He laughed and explained that, no, he was traveling coast-to-coast by bike and pushing it up steep hills was just part of his daily routine. When I asked why he wanted to travel so far by bike, his main explanation — that you see things from the seat of a bike that you miss at highway speeds in an automobile — resonated so, that I resolved then and there to make a bicycle journey of my own. I’d driven through all 48-states in my old van, and that’s the problem: I’d been through the 48 states, but had stopped to enjoy only a few of them.

My initial plan was to bike the East Coast Greenway from Key West to Calais, starting in early February of 2015 and stopping at the Winter Star Party and NEAF along the way. That plan was interrupted by a minor stroke in January of 2015, which also gave me more than enough down time for the scheme to evolve into a 48-state ride.

As lagniappe, I discovered while preparing for the project that cycling and amateur astronomy push many of the same positive emotional buttons. Both are engaging outdoor activities, both speak to our senses of adventure, both represent investments in ourselves, and both return enormous rewards for minimal investments. So, combining the two made even more sense the more I explored the possibilities.
How has cycling contributed to your astronomy outreach?

I ride a cargo bike produced by Surly Bikes. Surly calls the design the Big Dummy, but the Dummy moniker upset my local bike-shop owner’s young son, so he scratched off the Dummy portion of its decals. I’ve since come to know it simply as the Surly Big or the Big. The Surly Big is much longer than standard bikes and when in full astro-lab mode, people are compelled to stop and ask about it. Bottom line: It makes for a great introduction into conversations about astronomy.

I camp out most nights, so I usually stop where people are already gathered outdoors. Bike tourists are fairly rare at most campgrounds I visit, and bikes like the Big are even rarer, so it doesn’t take long to get folks’ attention. Once I set a solar scope up on the bicycle, gathering interested guests pretty much takes care of itself. When I can, I also travel established bike-touring routes, such as the Natchez Trace from Natchez, Miss., to Nashville, Tenn., the Missouri Katy Trail and the East Coast Greenway. This ensures that I meet a lot of cyclists, none of whom have seen a telescope mounted on a too-long bicycle because, well, as far as I can tell, it had not been done before, at least not in such a public way. As I mentioned earlier, the project is about conversations about astronomy.

What equipment do you carry with you?

I carry solar glasses produced by the DayStar Filters Company, which I hand to guests while setting up a solar telescope on the Big. Most folks have used center-focus binoculars, so handling and focusing the DayStar glasses is comfortably familiar. First magnified views of the Sun through the DayStar glasses reliably yield “OMG!” reactions. Following up with hydrogen-alpha telescope views seals the deal. I’ve been carrying a DayStar Filters Quark Chromosphere, because it’s no larger or heavier than high-end, wide-field eyepieces, yet converts a standard 80mm or smaller refractor into a full-bore Ha solar scope, freeing me to use the same refractor for sharing views of night-sky objects, as well. We’ve had an abundance of planets during the trip so far, and views of the Moon through a quality refractor always thrill. As for which refractor I carry, I’ve actually tested several in the early months of the project, but recently received one of Explore Scientific’s ultra-lightweight 80-mm carbon-fiber apo refractors, which serves the project’s peculiar application perfectly. I also carry a variety of Explore Scientific’s wide-field eyepieces, although only in the 1.25-inch format accepted by the DayStar Quark. The fact the ES eyepieces are nitrogen-purged really helps, given that I’m out in the elements 24/7 and have no way to protect the equipment I carry from humidity, much less the occasional downpour. I’m carrying a couple of Explore Scientific’s even wider 2-inch eyepieces, but the bike is already loaded beyond my ability to comfortably pedal it up even slight inclines. I mount the refractor on one of Sky-Watcher USA’s Sky Adventurer micro mounts. It’s among the smallest German equatorial mounts available, plus it’s lightweight, easy to set up and tracks with remarkable accuracy.

The Star Adventurer mount attaches to the bike frame via a one-off custom bracket designed and crafted by Telescope Support Systems. The guys at TSS saw my crude setup at NEAF 2016 and offered to supply something better. Something better, indeed! What’s most amazing to me is that they had just minutes to take measurements of the Big at NEAF, yet produced a system that fits perfectly. Before the TSS bracket, I had to remove the Big’s seat and replace it with a hardwood block attached to a wood dowel. After the TSS bracket, the seat stays in place, as does the bracket. The Star Adventurer mount now attaches with a quick-release dovetail, making it so much easier to convert the Big from travel to astro-lab mode.

In addition to the astro gear, I carry some ultralight camping gear by Kelty, three changes of clothes, food and water, plus tools, spare tire tubes, spare spokes, etc. When loaded with everything, the Surly Big weighs as much as I do.

How do you find your audiences?

Mostly, what I do is closer to sidewalk astronomy. I’ve shared views of the Sun in front of grocery stores after shopping in them, and I’ve shared views in front of bike shops, in the backyards of B&Bs and in motel parking lots. I set up most often though at the established campgrounds where I typically spend the night. When possible, I’ll share telescope views of the Sun at cycling events and expos that coincide with my travels. It’s not often that I’m able to coordinate the ride schedule with existing star parties, but we’re working on some along upcoming routes.

How have people responded to this unique outreach project?

You know what, something else that cyclist on I-40 said has proved true: People are nicer to folks on bicycles. Add that I’m an old man on a peculiar bike carrying telescopes, and I’m both humbled and honored by people’s reactions. I don’t presume that I’ll convert significant percentages of those I encounter to the ranks of hardcore amateur astronomy enthusiasts, but I am converting some, if only slightly.
because I do this every day. Better yet, I’ll deliver first telescope views to thousands during the very long ride project, and everyone I encounter seems genuinely thankful for the opportunity to view the Sun, Moon, planets and other celestial wonders through quality telescopes.

What has been the most challenging aspect of your journey to this point?

Doing the work of editor of *Astronomy Technology Today* while traveling by bike and camping most nights has been a challenge, as is consuming the 4000+ calories it takes to fuel rides averaging 50 miles per pedaling day. Mostly though, it’s the simple physical challenge of pedaling a bike that weighs as much as I during the heat of summer that is most daunting. I’m hardly an athlete. I love traveling by bike, but there’s no sugar coating the rigors of pedaling a bike as loaded down as the Big.

What has been the most rewarding aspect of your journey to this point?

I’m getting to see the U.S. in a way most never will, and I understand fully now the privilege that represents. It’s a privilege, because I could not do this without the support of family, friends and sponsors — even strangers. But no one I encounter during the project remains a stranger for long. The most rewarding aspect of the journey? A renewed sense of connection to, well, everyone.

What role has the upcoming total solar eclipse played in this trip?

The 2017 solar eclipse will be the first total eclipse of the Sun to cross as much heavily populated landmass since the 1999 solar eclipse across Europe and Asia. It also will be the first such eclipse to have the potential of being witnessed by so many people since the advent of social media. Put simplest, it is shaping up to be the greatest astronomical event of our lifetimes, and I wanted to do something to help our industry leverage that opportunity into maximum awareness of the life-enhancing benefits of amateur astronomy. I can’t do much, but I can pedal a bike. Many others have accomplished and will accomplish far more, but this is what I can do.

For more information on The Pedaling Astronomer Project, visit pedalingastronomer.com or follow The Pedaling Astronomer Project on Facebook.
Late March is the perfect time for a Messier Marathon

Catch 'em all

For amateur astronomers, late March presents the perfect opportunity to embark on one of the greatest observational challenges in the Northern Hemisphere — the Messier Marathon. Although it is billed as an observing challenge, a Messier Marathon is actually more than that. It is an epic quest in which participants attempt to see in one night all of the 110 objects in the Messier Catalog.

“The successful Messier Marathon is when you find and identify the most Messier objects that you can. For some astronomers that can be 110 objects, for others it might be 30 or 50 or 100. Everyone tries for their personal best,” said Don Machholz, one of a handful of amateur astronomers who created the daunting challenge in the late 1970s. Since 1979, Machholz has undertaken 53 marathons. During 34 of those, he has found between 100 and 109 objects. Six times he has seen all 110 objects in one night. In April 2003, he tackled an enhanced version of the marathon and became the first to find 108 Messier objects in one night using no star charts or other aids and navigating entirely by his memory.

It is not only these achievements that have made Machholz a legend in the decades-long history of this challenge. He also wrote the observing order that is considered to be the gold standard when it comes to the Messier Marathon.

The key to a successful Messier Marathon is having the ideal observing order. The following order, which was written by expert Don Machholz, is widely regarded as the gold standard. It is important to hunt for M77 and M74 as soon as the Sun sets because they will dip below the horizon fast. The ideal latitude to observe from is 25° North.

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>CONSTELLATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>M77</td>
<td>Cetus</td>
</tr>
<tr>
<td>M74</td>
<td>Pisces</td>
</tr>
<tr>
<td>M33</td>
<td>Triangulum</td>
</tr>
<tr>
<td>M31</td>
<td>Andromeda</td>
</tr>
<tr>
<td>M32</td>
<td>Andromeda</td>
</tr>
<tr>
<td>M110</td>
<td>Cassiopeia</td>
</tr>
<tr>
<td>M52</td>
<td>Cassiopeia</td>
</tr>
<tr>
<td>M76</td>
<td>Perseus</td>
</tr>
<tr>
<td>M34</td>
<td>Perseus</td>
</tr>
<tr>
<td>M45</td>
<td>Taurus</td>
</tr>
<tr>
<td>M79</td>
<td>Orion</td>
</tr>
<tr>
<td>M42</td>
<td>Lepus</td>
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<tr>
<td>M43</td>
<td>Orion</td>
</tr>
<tr>
<td>M78</td>
<td>Orion</td>
</tr>
<tr>
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<td>Taurus</td>
</tr>
<tr>
<td>M35</td>
<td>Gemini</td>
</tr>
<tr>
<td>M37</td>
<td>Auriga</td>
</tr>
<tr>
<td>M36</td>
<td>Auriga</td>
</tr>
<tr>
<td>M38</td>
<td>Auriga</td>
</tr>
<tr>
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<td>Canis Major</td>
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<td>Ursa Major</td>
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<tr>
<td>M97</td>
<td>Ursa Major</td>
</tr>
<tr>
<td>M108</td>
<td>Ursa Major</td>
</tr>
</tbody>
</table>

**Observing Order**

--- Courtesy of Don Machholz

--- Courtesy of Babak Tafreshi, The World at Night (twanight.org)

With the Milky Way as a backdrop, this group of about 150 astronomy enthusiasts undertakes the Messier Marathon challenge in April 2011 from the desert area of Seh Qaleh in eastern Iran.
Marathon Tips

• Know your equipment, study the observing order and get familiar with using star charts.
• Pick an observing location that has an open horizon to the west and southeast.
• Practice locating harder objects like M77 and M74 in advance because you will not have a lot of time to catch them.
• Prepare for a long night by having layers to put on as the night gets cooler and packing snacks and warm beverages.
• If you plan on napping during the break, make sure you set an alarm so that you don’t miss a chance at a pre-dawn object.
• Bring binoculars, red light viewfinders or other aids that might help in tracking down objects.
• Keep a record of your observations.
• Always pay close attention to your observing checklist to stay on track.

For more tips, click here.

There are a lot of factors that determine the success of a marathon. Key among these are the observer’s location, weather conditions, knowing your equipment and adhering closely to the recommended observing order.

“The most critical times are getting the first few objects in the evening, before they set, and the last few objects in the morning, just after they rise,” Machholz said. “The night can be long, and many Messier Marathoners take a break for a nap in the middle of the night.”

If you are up to it, this break is a good time to search for other objects that cannot be found in the Messier catalog.

The greatest reward is at the end of the night — that is at morning twilight — being able to remember seeing each and every Messier object you have observed that night,” Machholz said.

No matter how many objects you find, the Messier Marathon is a quest that is worth attempting.

Other/Unknown

B

F

G

K

M

Open Cluster

Globular Cluster

Double star

The observatory changed the face of astronomy from being a mere housing of telescopes and astronomers to being an integration of optics with a laboratory for chemistry and physics. Those who worked at Yerkes Observatory represented a who’s who of astronomers, scientists, and physics icons including Hale, Barnard, Hubble, Einstein, and Sagan. Now you can experience for yourself the amazing views through the world’s largest refractor, the 40-inch, at Yerkes Observatory, using Explore Scientific Waterproof Eyepieces.

Every month during the year, on select weekday and weekend evenings, Yerkes Observatory offers observing sessions with the “Great Refractor”, the 40-inch Refractor Telescope, the largest refracting telescope in the world, weather permitting, for participants who are age 10 and older.

The World’s Largest Refractor

One Person Pass to Yerkes Observatory, founded in 1897 by George Ellery Hale and financed by businessman Charles T. Yerkes, is the birthplace of modern astrophysics.

The observatory changed the face of astronomy from being a mere housing of telescopes and astronomers to being an integration of optics with a laboratory for chemistry and physics. Those who worked at Yerkes Observatory represented a who’s who of astronomers, scientists, and physics icons including Hale, Barnard, Hubble, Einstein, and Sagan. Now you can experience for yourself the amazing views through the world’s largest refractor, the 40-inch, at Yerkes Observatory, using Explore Scientific Waterproof Eyepieces.

Explore Scientific eyepieces are used for Yerkes Observatory outreach programs.
Measuring the Moon's motion

Everyone knows that the Moon revolves in orbit around the Earth — or so we’ve been told in school. But how do we really know this? Can we see the Moon move? Can we measure it? You may have also been told that the Moon’s motion has something to do with the lunar phases, but how can we understand that if we don’t really even know how the Moon moves through space?

It turns out that the Moon does indeed circle the Earth once every 28 days or so just as you’ve been told in science class, but you don’t have to take your teacher or textbooks word for this. You can see and measure it yourself!

The best times to measure the Moon’s orbital motion is in the first week or so after the new moon phase. Measuring the Moon’s motion through the sky is easier than you think. All you need is for about a 10-foot circle in your backyard, something you can use as markers to stick in the grass and a 5-ft length of string. You can use almost anything for markers, such as sticks or small stones. Popsicle sticks with ribbons or strips of construction paper glued on also work well. I like to use irrigation flags, and you can get a package of 10 for about $2 at any home improvement store. Four of the flags should be marked north, south, east and west, one should be left blank, and the rest numbered 1, 2, 3, etc.

Place the blank marker at the center of your circle and tie one end of the string to it (the exact length isn’t important, but larger is better here!) We are going to make a compass rose in your yard by marking off points of the compass (north, south, east and west). Most smart phones have a compass application, if not, there are many free applications available to you — any app that gives your direction in degrees will be fine. Use your compass app to find the directions for each of the markers that you placed and write them down next to the times in your notebook.

What do you notice? Does the Moon move at a steady pace? How can you measure this with the data you have? This measurement made in a single day is really measuring the motion of the Earth as it spins on its axis! Think about it — if the Moon takes 28 days to circle the Earth just once, it wouldn’t move very much at all in just a few hours. The Earth spins much faster than the Moon orbits. Earth takes just 24 hours to spin once, rotating 15 degrees per hour. Check your measurements from the last night — was the Moon moving about 15 degrees across your compass rose each hour?

Measuring the Moon’s orbital motion takes more than just a few hours; instead we measure the Moon at about the same time of night for several nights running. This works best in the week or so after new moon. Pick a time when you can observe every day — just after sunset works best. Each night, measure and place a marker to indicate the position of the Moon on your compass rose. Four or five nights running will make an excellent observation set. Remember to record the time and azimuth direction for each observation. These daily changes are the result of the Moon’s motion in orbit around the Earth. By observing at the same time each day, we cleverly eliminate the Earth’s spin from our observations, all we see now is the motion of the Moon in orbit!

Once you have a complete data set, what do you notice? What direction is the Moon moving as it orbits the Earth? Did you notice anything about the phase of the Moon as the days went by? Like the Sun and the stars, the Moon rises in the east and sets in the west each day. This daily or diurnal motion of the Moon is caused by the Earth’s rotation in space. It is the same spin that gives us day and night. The direction of each of the markers that you placed and write them down next to the times in your notebook.

Dr. Daniel Barth left a career as a research scientist to teach; he has spent more than 30 years teaching astronomy, physics and chemistry at the high school and college level. A successful science fiction writer, Barth is the author of Maurice on the Moon, Doomed Colony of Mars and other works. He is currently assistant professor of STEM Education at the University of Arkansas in Fayetteville, and author of the Astronomy for Educators program.

Top left, use a 5-foot length of string to create a compass rose that is 10 feet across. Top right, use the string to align the markers for the cardinal directions. Above, set up your compass rose in an area where it can remain undisturbed for several nights.

15 degree per hour rate of motion is the same whether you measure the daily motion of the Sun, Moon or the stars – all are simply apparent motion caused by Earth’s daily rotation. The Moon’s motion in orbit is different. The Moon moves from west to east as it orbits — the opposite direction from the Moon’s nightly path across the sky! The Moon also moves much more slowly in orbit than the Earth spins. Moving just 13 degrees per day, it takes the Moon an entire month to orbit the Earth just once, and you were able to observe and measure it for yourself!

Next time, we will take what we’ve learned about the Moon in motion around the Earth and build a working model of the Earth-Moon system that shows how lunar phases really work – and then we will use that model of the Earth-Moon system to make a short film or gif of the lunar phases!
on the road with David Levy

The thrill of visual comet hunting

By DAVID H. LEVY
Sky’s Up Editor in Chief

Decades ago when I was finding comets, I had a dream. It was during the summer of 1990. I was on the Moon, walking about and exploring a crater when I encountered an alien. She was shaped like a shopping bag. She had four feet beneath the bag, four hands at the top of the bag, and a head protruding from the top where the handles would be. “Who are you?” I inquired.

“My name is “Tanya,” she replied. “I’ve been assigned to you. I help you find comets.” As we talked, Tanya admitted that she could not force the comets to come my way, but that she could influence their orbits in a small way. If I kept watching the sky, then some of the comets might find their way into the field of my telescope. I still search for comets, but my extraterrestrial friend no longer accompanies my nights.

The date of her last visit was the morning of October 2, 2006. On that clear, mild morning, a comet, located just half a degree from Saturn as they rose in the predawn hours, cautiously entered the field of view of my telescope. It was so close to Saturn that I thought it must be a reflection. It was easy to check. It was so close to Saturn that I thought it to be a few more stragglers from time to time. Most likely, the comet brightened in the hours preceding my discovery. Or maybe it was Tanya.

Tanya is gone now, probably lurking on the Moon or helping some professional astronomers find faint comets, and so are the other ETs watching over visual comet hunters. My 2006 comet is one of the last visual finds ever made. Oh yes; there may be a few more stragglers from time to time, but essentially the era of my visual comet search is over. And with that, so goes my extraterrestrial friend.

Are there really ETs out there helping us? I seriously doubt it. But I will always remember that wonderful reverie from all those years ago, when somebody from a distant world came by and helped me make my dream come true.
“The Moon is a wonderful friend and companion to the Earth and its residents. Hardly a day goes by that someone does not hear me say, ‘Oh! Look at the Moon.’ It is like Earth’s little brother, and a rocky soul mate to all who dwell here.”

— Howard Eskildsen
The broad arc of the Apennine Mountains angles from the lower left to the right upper margins of the image, arising abruptly on the side facing the great Imbrium impact that created them. Rough tailings that taper away towards the lower right portion of the image represent material ejected from that great impact. The Archimedes Mountains on the upper left represent a portion of an inner ring of the Imbrium basin. Some of the lower region between the two ranges has been filled with mare basalt while other parts consist of unnamed hills and ridges here and there. One of the flat, lava-filled areas has been named as Palus Putredinis, the “putrid marsh,” for obscure reasons.

Crevices known as rilles appear in the lower region as well, the most notable being Hadley Rille which was visited by Apollo 15. On July 30, 1971, James Irwin and David Scott landed within the narrow confines between Mount Hadley and Hadley Delta near the verge of the Hadley Rille. It was the first of the “J” missions that carried the Lunar Rover Vehicle (LRV) which made it possible for them to travel farther and conduct experiments not possible on earlier missions. One of their notable discoveries was the “genesis stone.” It was composed of a light-colored mineral known as anorthosite and is believed to represent the original surface material of the moon. Anorthosite is much brighter than the mare basalts as can be seen during full moon. The bright lunar regions are anorthosite and the contrasting dark areas are basalt.

Notice how Hadley Rille winds around like a river over its course; it is a typical “sinuous rille.” At one time some believed that water had flowed through it, the Apollo mission, however, proved that it was a river of lava, not water that created the channel. Conon Rille on this image is a similar type of rille. In contrast, Bradley Rille is distinctly different and likely traces faults associated with the Apennine formation rather than the flow of lava.

Coarse rubble slopes downward from the Apennine front towards the lower right of the image. The lower regions have been flooded by lava to form the shores of various lacus (lake) and sinus (bay or gulf) features before finally totally disappearing beneath basalt. Perhaps the depressions of Mare Vaporum and Mare Aestuum are the filled remnants of large, ancient craters that lowered the terrain over which the rubble was spread in a matter of minutes by the formation of the Imbrium basin. Note the ridges of rubble that rest between Aestuum and Vaporum and also to the lower right of Vaporum. The terrain between Conon and Lacus Felicitatis also consists of ejected rubble, but at the right margin by Lacus Odeii and Lacus Doloris, lower sun-angle images show a change in landforms that will be discussed in Quadrant 31.

Finally, an unusually dark lava flow appears on a region southeast of the ruined crater Marco Polo on the western flow of Mare Vaporum. Careful examination of Vaporum reveals other areas of darker and lighter flows and confirms that the flat maria were filled with multiple flows of varying composition.

The mountainous rubble of the Apennine Mountains was formed in a geologic instant nearly 3.85 billion years ago and over eons altered by multiple lava flows and subsequent crater-forming impacts. Now it preserves the moon’s early history of cosmic collisions and volcanic eruptions that happened eons ago. As for recent times there has been little notable change except for the footprints left behind by intrepid Earthling explorers decades ago.
The Hadley Rille area has much more to offer than can be given in a regional discussion of the quadrant. It arises at the margin of the Apennine front and meanders 82 km along the front and into Palus Putredinis where it tapers out. Rising magma opened fissures seen as Jomo, Bela, Taizo and Carlos, and finally erupted from Jomo. The flow bypassed Taizo, crossed through Bela, then angled away from the uplift, leaving Carlos as a bypassed appendix-like feature.

Over the course of the rille there appear to be breaches in its continuity. Perhaps part or all of it was once a lava tube that since has collapsed save for a few remnants. The small crater near the midpoint of the rille, known as Hadley C, obviously filled in part of the rille with its ejected rubble long after the flows had ceased. Whether lava passed through Hadley Rille in a lava tube or as surface flow or both, it was one of the major sources of the basalt that now fills the region. Apollo 15 astronauts drove their LRV to the edge of the rille and discovered multiple layers of basalt in the valley walls. The astronauts also were able to sample rocks that had tumbled down from Hadley delta, some of which were of much different composition than the dark mare basalt. The celebrated genesis stone completed their quest to find a sample of the bright highland mineral anorthosite. This light colored mineral is believed to be remnants of the original crust of the moon and hence the oldest mineral from the moon. Anorthosite has been theorized to have crystallized in an early moon that was molten to a depth of at least 700 km, perhaps more, and floated to the surface to create the original crust. Later impacts and basaltic flows have altered the original crust, but samples of it remain.

The Imbrium impact fractured that crust, raising the Apennine Mountains and also creating deep swarms of cracks that provided passage for the dark basalt flows from Hadley Rille as well as many, many other lava flows that have since hidden so much of the original crust from view. The study of the rille and the discovery of the genesis stone were two of the major accomplishments of the Apollo 15 mission.
NGC 6357

Also known as the Lobster Nebula, this diffuse nebula can be found in the Scorpius Constellation. O’Neill captured this image with an Explore Scientific ED127-FCD100 Air-Spaced Triplet and an SBIG ST-10 XME camera through narrow band filters of Hα, OIII and SII. Exposure times were three 800 second subs through each filter. The telescope was equipped with a Feather Touch focuser with Astro Physics 27TVPH .75X reducer, and the mount was a Takahashi EM-200 2M.

NGC 6590

NGC 6590 is a reflection nebula in the Sagittarius Constellation. This image was taken with an Explore Scientific ED127-FCD100 Air-Spaced Triplet and an SBIG ST-10 XME camera through narrow band filters of Hα, OIII and SII. Exposure times were three 800 second subs through each filter. He used a Feather Touch focuser with Astro Physics 27TVPH .75X reducer, and a Takahashi EM-200 2M mount.

The Omega Nebula (M17) is an emission nebula 15 light years in diameter that is lit by an open cluster of about 35 young stars. This image was taken with the ED127-FCD100 and an SBIG ST-10 XME camera through narrow band filters of Hα, OIII and SII. Exposure times were three 800 second subs through each filter.

The Pelican Nebula is an emission nebula in the Cygnus Constellation. This image was taken with an Explore Scientific ED127-FCD100 and an SBIG ST-10 XME camera through narrow band filters of Hα, OIII and SII. Exposure times were three 800 second subs through each filter. The telescope was equipped with a Feather Touch focuser with Astro Physics 27TVPH .75X reducer, and the mount was a Takahashi EM-200 2M.

The Pelican Nebula

The Pelican Nebula is an emission nebula in the Cygnus Constellation. This image was taken with an Explore Scientific ED127-FCD100 and an SBIG ST-10 XME camera through narrow band filters of Hα, OIII and SII. Exposure times were three 800 second subs through each filter.
Also known as the Flaming Star Nebula, IC 405 is an emission/reflection nebula in the Auriga Constellation. It is about five lightyears across and surrounds AE Aurigae - a brilliant blue star characterized as a “runaway star” due to the fact that it is moving at a higher velocity than its neighboring stars. This image was captured with an Explore Scientific 102mm ED Air-Spaced Triplet and a Canon T3i.

**Astrophotographer:** Mark Sibole

The Rosette Nebula is a star-forming region located in the Monoceros Constellation. The enormous emission nebula has a radius of about 65 light years and is about 5,200 light years away. It is home to the open cluster NGC 2244, which has several hot blue stars that belong to a rare class. To get this image, Sibole used an Explore Scientific 80mm refractor and a Starlight Xpress SXVF-H9 camera.

**North America Nebula**

The North America Nebula, which is also known as NGC 7000, can be found just 3° from Deneb, the brightest star in the Cygnus Constellation. Deneb is one of five standout stars that form the constellation’s popular Northern Cross asterism and it anchors one corner of the famed Summer Triangle. The North America Nebula, which is approximately 1,600 light years away, is the larger of two worthy emission nebulas that form a cozy pair in Cygnus. It is separated from its partner — the Pelican Nebula — by a dark lane of dust. Sidentop captured this image using an Explore Scientific 127mm Air-Spaced Triplet ED Apochromatic Refractor.
With a universe of options to explore, it can be difficult to track what awe-inspiring treasures are visible in your sky each month. To help guide your explorations throughout the year, Sky's Up is providing the following collection of seasonal star maps created by noted celestial cartographer Wil Tirion. Based in The Netherlands, Tirion has been crafting stars maps since the 1970s and became a professional uranographer shortly after the publication of his highly regarded Sky Atlas 2000.0 in 1981. To learn more about Tirion and his work, click here.
the key to your sky

SPRING SKY
For observers at 10° to 30° northern latitudes

SPRING SKY
For observers at 40° to 60° northern latitudes
SUMMER SKY
For observers at 10° to 30° northern latitudes

SUMMER SKY
For observers at 40° to 60° northern latitudes

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For observers at 10° to 30° northern latitudes

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AUTUMN SKY
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in memory of

This issue is dedicated to Joe Napolitano —
A devoted advocate of astronomy outreach and
a friend to astronomers everywhere