Observations

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CHESTER COUNTY ASTRONOMICAL SOCIETY

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In This Issue

Hubble's Cosmic Reef

These bright ridges of interstellar gas and dust are bathed in energetic starlight. With its sea of young stars, the massive star-forming region NGC 2014 has been dubbed the Cosmic Reef. Drifting just off shore, the smaller NGC 2020, is an expansive blue-hued structure erupting from a single central Wolf-Rayet star, 200,000 times brighter than the Sun. The cosmic frame spans some 600 light-years within the Large Magellanic Cloud 160,000 light-years away, a satellite galaxy of our Milky Way. A magnificent Hubble Space Telescope portrait, the image was released the week of April 20th as part of a celebration to mark Hubble's 30th year exploring the Universe from Earth orbit. Image Credit: NASA, ESA, STScI

Membership Renewals Due

05/2020	Aylam & Martin-Aylam
	Fletcher
	Klapholz
	O'Hara
	Quinn
	Toth
06/2020	Crabb
	Hebding
07/2020	Barasatian
	Bissinger & Family
	Hockenberry & Miller
	Hunsinger
	McGuigan
	Morgan
	Piehl

May 2020 Dates

5th • The Eta Aquariid meteor shower peaks.

7th • Full Moon, the Flower Moon, 6:45 a.m. EDT.

14th • Last Quarter Moon, 10:02 a.m. EDT.

21st • Venus and Mercury are very close as darkness falls.

22nd • New Moon, 1:38 p.m. EDT.

23rd-24th • A very thin crescent Moon joins Venus and Mercury in evening twilight.

30th • The Lunar Straight Wall is visible.

PENNSYLVANIA OUTDOOR LIGHTING COUNCIL

CCAS Upcoming Nights Out

In addition to our monthly observing sessions at the Myrick Conservancy Center, BRC (see pg. 2), CCAS has several special "nights out" scheduled over the next few months. Members are encouraged to help out during these events any way they can. See below for more information.

☼ ***Monthly observing sessions at Myrick Conservancy Center, BVA, and special observing dates have been cancelled until further notice as part of the national effort to limit the spread of the coronavirus. For more information about future observing opportunities, contact our Observing Chair, Don Knabb.***

Spring Society Events

May 2020

4th • Beginner Astronomy Class: Beyond Naked-Eye Observing. 7-8 p.m. EDT. Chester County Night School ONLINE via Zoom.us.

7th • The von Kármán Lecture Series: Becoming a NASA Engineer, Jet Propulsion Laboratory, Pasadena, California. Live stream of free lecture presented by NASA & Caltech.

12th • CCAS Monthly Meeting, ONLINE **via** Zoom.us. Meet & greet online from 7:00 to 7:30 p.m. The meeting starts at 7:30 p.m. Guest Speaker: Scott Engle, PhD, Dept. of Astronomy and Planetary Science, Villanova University, "Revisiting the Drake Equation - New Insights and Revelations. "

20th • Open call for articles and photographs for the June 2020 edition of Observations.

26th • Deadline for newsletter submissions for the June 2020 edition of Observations.

June 2020

9th • CCAS Monthly Meeting, ONLINE via Zoom.us. Meet & Greet online for members from 7:00 to 7:30 p.m. The meeting starts immediately after at 7:30 p.m. CCAS Member Speaker: John Conrad, NASA Solar System Ambassador, "Lunar Science: Historical Overview and Current and Future Missions to the Moon."

18th-19th • The von Kármán Lecture Series: Making a Mars Rover, Jet Propulsion Laboratory, Pasadena, California. Live stream of free lecture presented by NASA & Caltech.

20th • Open call for articles and photographs for the July 2020 edition of Observations.

26th • Deadline for newsletter submissions for the July 2020 edition of Observations.

Minutes from the April 14, 2020, CCAS Monthly Meeting

by Bea Mazziotti, CCAS Secretary

- Dave Hockenberry welcomed 27 members and guests to the April CCAS meeting.
- It was the first CCAS monthly meeting held virtually. Zoom was the platform.
- After some virtual socializing, Don conducted a tour of the April sky using Stellarium. Of interest are the many clusters now visible.
  - He also noted Iota Cancri double star and Markarian's chain, a string of galaxies within the Virgo Cluster.
  - The comet Atlas is also moving through the sky. The best chance to find and view it is in the northern hemisphere.
- Bruce Ruggeri, program chair, introduced the evening's speaker, Dr. Edward Guinan.
  - He is a professor of astronomy and astrophysics at Villanova University. He received his doctoral degree from University of Pennsylvania.
  - Some of his research interests include binary star systems, pulsating stars, black holes, pulsating red stars and exoplanets. Recently he has been involved with a Mars Garden project which studies plant growth in replicated Martian soil.
  - His presentation was titled "Red Thumbs: Mars Gardens in the University - Growing Vegetables in Martian Regolith Simulant." The presentation highlighted how he and his students experimented with a variety of plants, to determine which grow well in replicated Martian soil. Among those that fared best are basil, onions, garlic, the dreaded kale, sweet potatoes and hops.

May 2020 CCAS Meeting Agenda

by Bruce Ruggeri, CCAS Program Chair

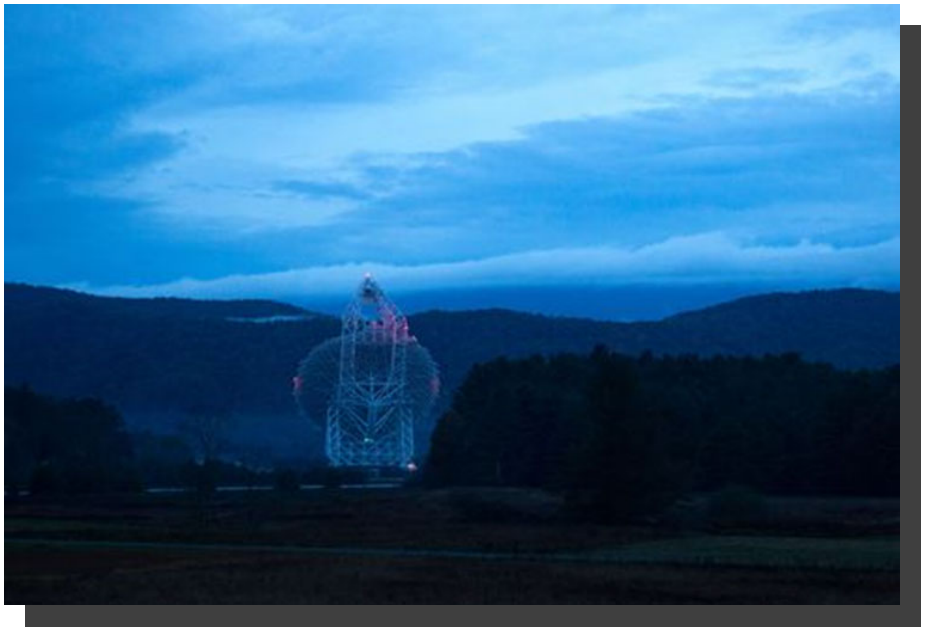
Our next meeting will be held on May 12, 2020, starting at 7:30 p.m. The meeting will be held ONLINE via Zoom.us. Guest Speaker: Scott Engle, PhD, Dept. of Astronomy and Planetary Science, Villanova University, "Revisiting the Drake Equation - New Insights and Revelations. "

Please note that inclement weather or changes in speakers' schedules may affect the program. In the event there is a change, CCAS members will be notified via e-mail with as much advance notice as possible.

As for future meetings, we are looking for presenters for our Fall 2020 season. If you are interested in presenting, or know someone who would like to participate, please contact me at programs@ccas.us.

WiFi Is Illegal in This American Town

by Matt Blitz, Popular Mechanics



Rain falls on an October morning at the Robert C. Byrd Green Bank Telescope in Green Bank. Image credit: Julia Rendleman

[Editor's Note: This article was published in Popular Mechanics on October 28, 2019.]

It's the first of October and Route 92 into town is lined with trees dressed with greens, oranges, and yellows. Autumn is refreshingly crisp and colorful here in Green Bank, West Virginia. The road winds and curves past a convenience store, a school, a library, and a post office. There are no shopping plazas, fast food restaurants, office buildings, or apartment complexes here. There's also no cell service.

What *is* here, though, is one of the world's most important facilities for the understanding of our universe.

Right off of the road and nestled in a valley naturally protected by the Allegheny Mountains is the Green Bank Observatory. It opened in 1958 as the United States' first national astronomy observatory and remains today a crucial facility in the field of radio astronomy with a number of active telescopes, including the world's largest steerable radio telescope, the Robert C. Byrd Green Bank Telescope, or GBT.

Over the last six-plus decades, the discoveries made at this observatory have come to define astronomy. Here, telescopes have found black holes, pulsars, radiation belts, and gravitational waves. Just last month, researchers at the GBO uncovered the most massive neutron star ever detected.

Green Bank is also where serious search for extraterrestrial intelligence (SETI) research was born. In 1960, Frank Drake started Project Ozma here, the first U.S. government-funded attempt to listen for extraterrestrial intelligence. It's also where he wrote his famed equation about the possibility of worlds other than ours. And SETI work is still ongoing at Green Bank. Earlier this year, one million gigabytes of SETI data collected over the last three years was released to the public, making it the largest trove ever of its kind.

All of this has been accomplished simply by listening closely and deeply to the sky above this beautiful, rural town. But to do this crucial work, compromises have to be made. "The signals we detect from space are extremely faint," says Harshal Gupta, the National Science Foundation program officer for the Green Bank Observatory. "A source of close-by, man-made radio frequency can completely overwhelm these very faint signals from space." Meaning, any radio frequency interference (RFI) could corrupt that research.

In order to limit RFI, the Federal Communications Commission in 1958 established the National Radio Quiet Zone (NRQZ) covering approximately 13,000 square miles and parts of both Virginia and West Virginia. In the mid-20th century, this meant no radio towers, television antennas, or heavy machinery could be installed unless they met very restrictive guidelines set forth by the FCC (like highly directional antennas and reduced power). It also prohibited private citizens from operating their own radio equipment, like ham radios, within the zone.

An even more strict law was put on the books by the West Virginia Legislature. The state's Radio Astronomy Zoning Act of 1956 says it's "illegal to operate

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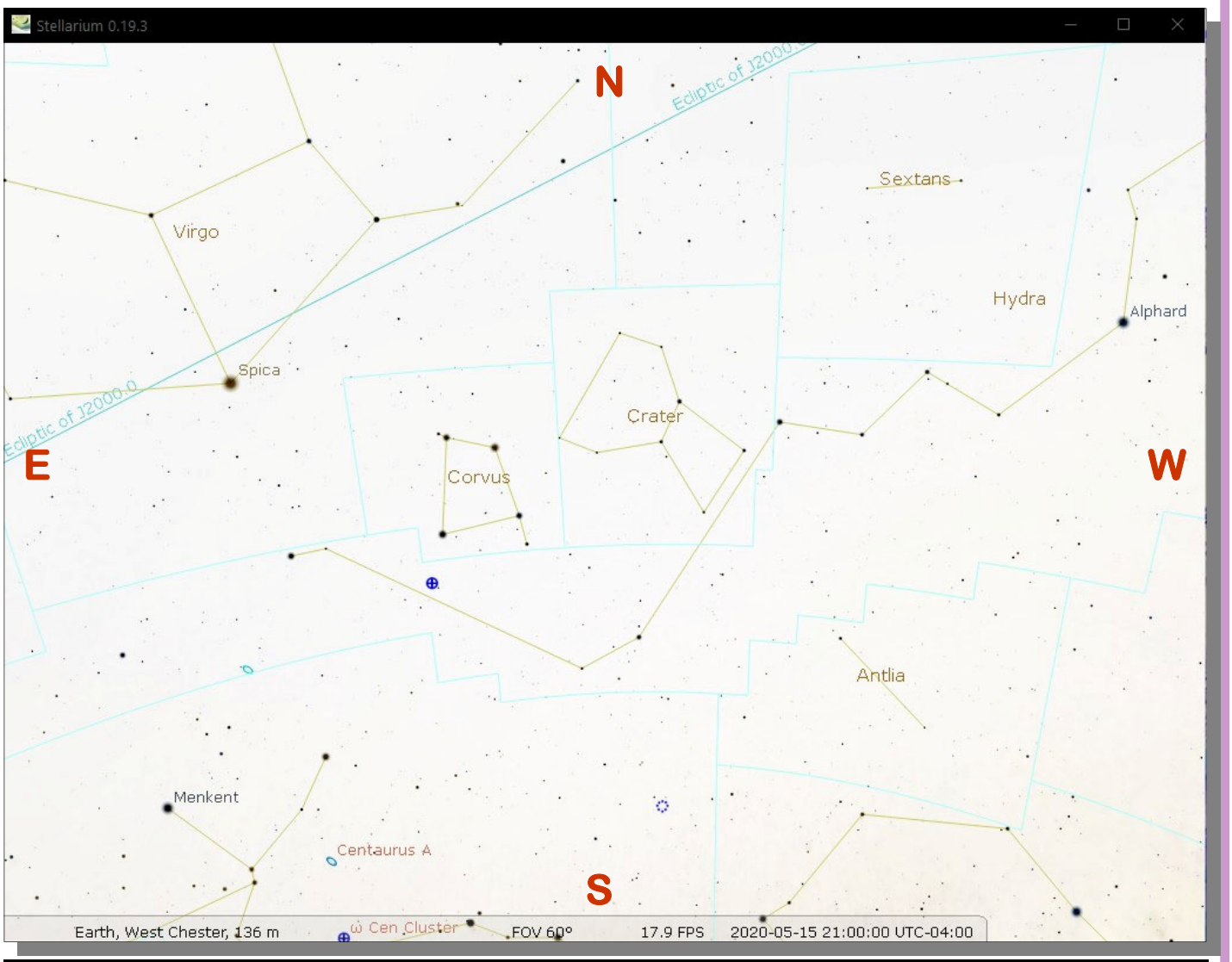
The Sky Over Chester County

May 15, 2020 at 9:00 p.m. ET

Note: This screen capture is taken from Stellarium, the free planetarium software available for download at www.stellarium.org.



Date	Civil Twilight Begins	Sunrise	Sunset	Civil Twilight Ends	Length of Day
05/01/2020	5:32 a.m. EDT	6:01 a.m. EDT	7:57 p.m. EDT	8:27 p.m. EDT	13h 55m 39s
05/15/2020	5:16 a.m. EDT	5:46 a.m. EDT	8:11 p.m. EDT	8:42 p.m. EDT	14h 24m 26s
05/31/2020	5:03 a.m. EDT	5:36 a.m. EDT	8:24 p.m. EDT	8:56 p.m. EDT	14h 48m 43s

Moon Phases					
			Full Moon	05/07/2020	6:45 a.m. EDT
Last Quarter	05/14/2020	10:02 a.m. EDT	New Moon	05/22/2020	1:38 p.m. EDT
First Quarter	05/29/2020	11:29 p.m. EDT			

May 2020 Observing Highlights

by Don Knabb, CCAS Treasurer & Observing Chair

5	**The Eta Aquariid meteor shower peaks**
7	**Full Moon, the Flower Moon, 6:45 a.m. EDT**
14	**Last Quarter Moon, 10:02 a.m. EDT**
21	**Venus and Mercury are very close as darkness falls**
22	**New Moon, 1:38 p.m. EDT**
23/24	**A very thin crescent Moon joins Venus and Mercury in evening twilight**
29	**First Quarter Moon, 11:29 p.m. EDT**
30	**The Lunar Straight Wall is visible**

The best sights this month: Just as darkness falls on May 21 to 24 we'll see Venus and Mercury in the west, and on the 23rd and 24th they will be joined by a thin crescent Moon. Sounds like a good photo opportunity!

Mercury: Starting on May 11 Mercury appears low in the west and climbs higher each day toward Venus, which is sinking lower. On May 21st they are quite close and a few evenings later they are joined by the crescent Moon. Mercury continues to climb higher through May until it reaches peak height in early June.

Venus: Venus begins May high in the sky but quickly dives toward the sunset through the month as it catches up to us in the race around the Sun. Look for Venus to hang out with its buddy Mercury and the Moon on May 21 to May 24.

Mars: The red planet is rising around 2:30 a.m. during May.

Jupiter: We might be losing the race around the Sun to Venus, but we'll soon pass Jupiter and Saturn. Near mid-month both gas giants will shift to retrograde motion (moving westward relative to the background stars). Jupiter is rising around 1:30 a.m. at the start of May, but around 11:30 p.m. by month's end.

Saturn: Saturn trails Jupiter slightly and at mid-month is slightly less than 5 degrees from the king of the planets.

Uranus and Neptune: Neither distant, cold world are in good viewing position during May.

The Moon: The Moon is full on May 7th. Native Americans called this the Full Flower Moon. In most areas, flowers are abundant everywhere during this time, thus, the name of this Moon. Other names include the Full Corn Planting Moon, or the Milk Moon. Native Canadians called this The Full Frog Croaking Moon.

Constellations: This is a great time of year to look high overhead at the Big Dipper and find the entire constellation Ursa Major, the Big Bear. Leo the Lion is still high in the sky as darkness falls, but he seems to be running away from Hercules as he is rising in the east. And bright Arcturus in Boötes shines like a beacon in the southeast. Boötes and Hercules are well placed for viewing by the time it is completely dark and an hour or two later the summer triangle is rising in the east. And if we have a good dark sky the Milky Way can be seen in Cygnus. Aim your telescope there and gaze into an eyepiece full of stars!

Messier/deep sky: As summer approaches it is once again globular cluster time! M3 is high overhead during May. Look at the glow of 500,000 stars in your eyepiece! And stay up a bit later as M13, the Great Globular Cluster in Hercules rises in the east. M13 contains several hundred thousand stars, perhaps a million!

Comets: Once again we were disappointed by a comet as Comet Atlas broke apart and dimmed considerably. But don't give up on seeing a comet because on the evening of May 22nd Comet Pan-STARRS (C/2017 T2) passes quite close to galaxies M81 and M82. Interestingly, light from the comet reaches us in about 15 minutes, but light from M82, the Cigar Galaxy, takes 12 million years to reach us.

Meteor showers: The Eta Aquariid meteor shower peaks on the night of May 5/6. Unfortunately, this is 2 days before the Full Moon, which will wash the sky with light and overpower faint "shooting stars". This is not expected to be a good show for Northern Hemisphere observers, but unexpected outbursts can happen with any meteor shower, so why not look? These meteors are dust left behind by Halley's Comet!

WiFi Is Illegal (Cont'd)

(Continued from page 3)

or cause to be operated any electrical equipment within a two-mile radius of... any radio astronomy facility." Similar tight restrictions also applied up to 10 miles from the facility.

Sixty-one years later, both the NRQZ and the Radio Astronomy Zoning Act are still in effect. But we no longer live in the 1950s.

2019 is filled with cell phones, Wi-Fi, satellite television, electronic tire pressure systems, cars with hotspots, smart refrigerators, video doorbells, Bluetooth headphones, app-powered Nikes, and toothbrushes that use wireless technology to give you a better smile. Our modern world is nearly always and completely connected by wireless internet, 4G (and, soon, 5G), and Bluetooth capabilities. These days, it's all RFI, all the time.

Yet, in Green Bank, all of this is illegal in the name of science and discovery. But is it even possible to keep technological evolution out of this remote West Virginia town?

"A lot of [consumer] devices you buy now are always transmitting. And it's really tough [to restrict]," says Dr. Karen O'Neil, GBO's Site Director. "It's just so ubiquitous that no one really knows it's there."

In The Beginning...

In May 1933, using an antenna resembling the Wright Flyer, Bell Labs engineer Karl Jansky figured out what was causing the static that was interfering with radio voice transmissions. It was cosmic radio waves coming from the center of the Milky Way galaxy.

Four years later, ham radio operator Grote Reber built a radio telescope in his suburban Chicago backyard. Made of sheet metal, the 30 foot-in-diameter parabolic dish and radio receiver amplified the faint cosmic radio waves by a factor of several million so that they could be recorded and charted. Reber spent his nights listening to the skies because daytime was too noisy due to interference caused by electrically sparking automobile engines passing by.

In 1938, Reber confirmed Jansky's initial discovery using a receiver designed to hear at the longer frequency of 160 MHz (1.9 meters wavelength) and, a few years later, published his findings in an article titled "Cosmic Static." The field of radio astronomy was born.

While advances made in radio and radar technology during World War II sparked growth in the field, by the 1950s, the U.S. was falling behind other countries in building radio telescopes. Then, the "Plan for a Radio Astronomy Observatory" was released by the National Science Foundation in August 1956.

The comprehensive document makes the case that the study of astronomy is essential to the evolution of civilization and America's scientific leadership in the world, and has helped "dispel man's dependence on magic and superstition." Cosmic radio waves bring an "entirely new set of clues to the nature of the surrounding universe. Studying them would be a 'major benefit to mankind.'" It even stokes Cold War fears by noting the Soviet Union's own advancement in the field. The need for more and better facilities in the U.S., so says the plan, is imperative.

It also covers the location requirements for the U.S.'s first national astronomy observatory. It had to be where land was amply available to ensure future expansion. It must be in a rural area free from human-made radio waves. It needed firm soil for stabilizing large radio telescopes and constant weather conditions. Relatively close proximity to Washington D.C. was also desired. A week before Thanksgiving 1956, it was announced that the NRAO was to be built in a remote West Virginia outpost nestled in the Allegheny Mountains, 210 miles from the nation's capital. That town was called Green Bank.

Welcome to Green Bank

Betty Mullenax remembers a time before the observatory. It was all farmland back then, she says while checking out a customer at Trent's General Store. Located less than a mile from the observatory, Trent's is a small shop selling meat and hardware supplies where Betty's worked for as long as she can remember. "It's quiet here and I like it just the way it is," says Mullenax.

Prior to the observatory, the town and the surrounding areas were already sparsely populated. In the mid-20th century, the logging industry in West Virginia was dying, which created a minor exodus. In 1958, there were no towns with more than 4,000

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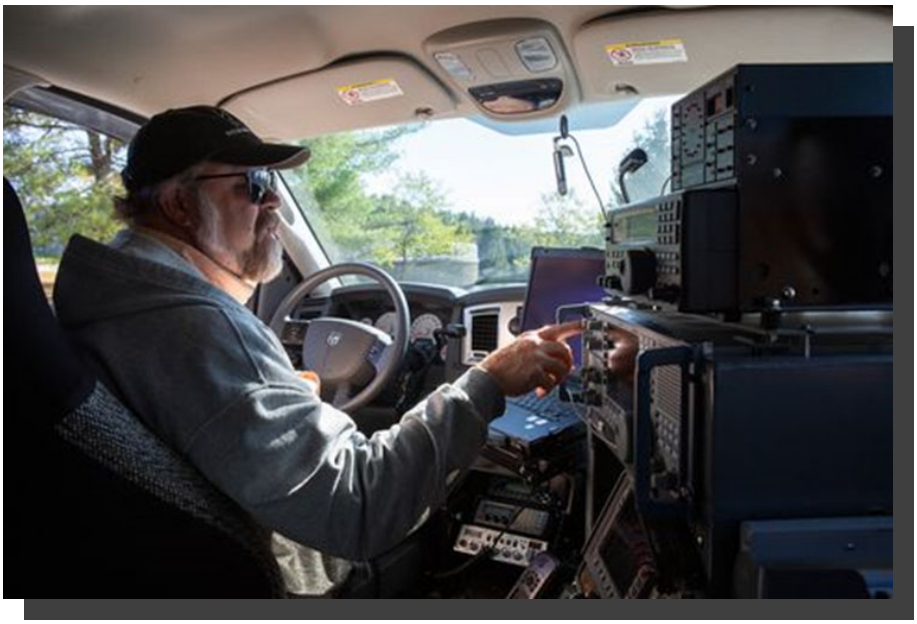
WiFi Is Illegal (Cont'd)



RFI technician Chuck Niday drives his truck through the Green Bank Observatory, where he has been an employee for 22 years, in October. Part of Niday's job is to drive around looking for unauthorized radio waves. "We got tons of WiFi around here. It's kind of don't ask, don't tell," he said. Image credit: Julia Rendleman

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people within 50 miles of Green Bank and only about 125 buildings (like houses, stores, churches) in the surrounding 12 square mile valley. This made it the perfect location for an observatory in need of quiet.

Nearly everyone has a family member or knows someone who has worked at the observatory. The facility is appreciated because it has brought jobs and an economy to Green Bank. And Mullenax hopes it's here forever. "It helps a lot. A lot."

But it also has kept Green Bank in a time capsule. According to the Pew Research Center, 96 percent of American adults own cell phones and 81 percent own smartphones. A 2018 study says that more than three fourths of North American households have WiFi. Green Bank is the extreme outlier and, at times, it can feel like one of those remote far-off galaxies that the GBT is constantly listening for. But that's changing.

Mullenax says she's noticed it's become a little less quiet here. Younger generations now all seemingly have beeping gadgets. Visitors from out of town are upset that their phones won't work. People ask her about WiFi at the store. Trent's does have internet (for ordering and their credit card machines), but it's Ethernet and comes from a cable tethered to the wall.

Green Bank is part of the larger Pocahontas County, which itself has a population of only about 8,500. Jeffrey P. Barlow is the county's sheriff and has been in law enforcement since 1994. He says that policing in Green Bank is a bit more difficult due to lack of communications. There's no cell service, limited radio use, and the online systems for background checks in the patrol cars don't work in Green Bank.

But he, too, has noticed changes and an increase in connectivity in the town recently. "Before we had to knock on someone's door if we wanted to call out," says Barlow, "Now, we can just connect to someone's WiFi [in town]." While he likes the old-fashioned ways, Barlow admits that many things are now reliant on wireless communications.

"Without this tech, it's hard to get anything done. I mean, everything is on the computer these days."

The GBT

The Green Bank Telescope, which was completed in 2000, looks like an extreme erector set with its criss-crossing bars and geometric shapes. It's 485 feet tall, including the receiver, with the parabolic dish large enough to fit two football fields and each dish panel is roughly the size of a full mattress. The GBT is so large, with so many parts, that it takes 10 years of constant work to repaint the whole structure. So, every summer, a different area is focused on and the task completed. Then, after a decade, it's all repeated over again.

The operating range goes from 100 MHz all the way up to 116 GHz. And it moves, capable of observing in the morning Earth's radio leakage radiation as reflected from the moon in one part of the sky and, then, shifting in the afternoon to another part of the sky in an attempt to confirm three previously unknown pulsars. It's also extremely power-

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WiFi Is Illegal (Cont'd)

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ful, so much so that in theory, it can detect a single snowflake hitting the ground.

"The GBT is the most sensitive telescope in the world," says O'Neil, "We use it to answer some of the most fundamental questions, like how stars and planets form and how life actually got created. If we ever lose the GBT, we will lose the ability to dig deep into the universe."

The Ever Ceasing March of Tech Progress

Chuck Niday is an engineer at Green Bank Observatory, but he describes his job slightly differently. "I'm one of two guys who goes out to look for interference," says Niday. This means he hops in his truck (diesel, of course) and rides around town once a week, looking for anything causing RFI, like WiFi or Bluetooth. Using a radio direction finding array and general coverage receiver, he's able to suss out signals anywhere from 100 kHz to 3.3 GHz. For WiFi, he uses a dongle and a spectrum analyzer to crack connections. "It's basically an RFI listening post," says Niday, "And there's plenty out there. Over 100 hotspots."

In order to detect extraterrestrial civilizations, the GBT must be highly, highly sensitive. This also makes it very susceptible to interference. In fact, some astronomical phenomena emit at the same frequency as common RFI. For example, pulsars emit at 2.4 GHz. Go ahead and check your current WiFi connection. It's likely also 2.4 GHz. This overlap can bury astronomical signals and essentially whitewash the research.

"We get interference all the time. You can literally see it in the data that is collected," says Jill Malusky, GBO's public relations specialist. "It does make our work harder." Nonetheless, GBO officials understand it's incredibly hard in this day and age to limit RFI considering how many household items and modern-day amenities emit it. Niday says it was only a few years ago that he could count on his hand the number of hotspots detected on his rounds. "RFI exists in many things we take for granted today," writes Malusky, "Many people have their entire homes set up today with these wireless and Bluetooth technologies. It is part of the world we live in and enjoy."

Niday says some hotspots are unintentional, appliances or gear that have pre-installed functions that the offender simply didn't realize was causing RFI.

"I saw one that had this funny SSID, one that I had never seen before," Niday explains, "So, I looked it up. It was a dehumidifier that you could remotely control with an app on your cell phone." And it doesn't stop there. "Refrigerators, baby monitors, HP printers," Niday rattles off other appliances with pre-installed RFI creators that he's encountered, "God, there's so many HP printers around here."

Some of the hotspots though, says Niday, are purposeful, people ignoring the Radio Astronomy Zoning Act and installing WiFi in their homes. But there isn't much he can do about those. "We just make a note of it and go on," says Niday. "We don't have that type of authority."

He's right. The enforcement of the state law, which was enacted in 1956, actually lies with the county. It states that violators are subjected to a $50 fine, plus an additional $50 fine for each day the interfering electrical equipment is operated after a written notice from county's prosecuting attorney.

Eugene Simmons is Pocahontas County's Prosecuting Attorney and has been working in the office for nearly 20 years. He says that, yes, as written, it is their responsibility to enforce that state law. But no one has ever asked him to send a written notice, nor subject anyone to a fine.

"It's never come up to my knowledge," says Simmons, "No one has ever raised that to me." He chuckles at the thought. "I can just imagine going to an old lady's house who's making biscuits in the morning and say, 'Sorry, we have to turn off your electricity.'"

The GBO confirms this, saying that they'd much rather not go to Simmons. "If it's nearby, in our small community, we just have a conversation with the person," says Malusky. "Our priority is to work together and find a solution."

The Workarounds

Since progress cannot be stopped, the observatory is exploring innovative workarounds. While they're doing their best to educate the public, they're also proceeding on technical solu-

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WiFi Is Illegal (Cont'd)

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tions. The observatory is developing what they call "RFI excision techniques," which would remove the interference in real time before the data is even recorded. They're also in the process of creating and improving a software system that separates human-made signals from cosmic data after collection. The observatory is also looking into getting in on the ground floor of the reinvention of WiFi.

Carla Beaudet is the observatory's radio frequency test and measurement engineer. Her main job is to figure out what equipment can be used at the observatory and find work arounds for RFI-emitting equipment that must be used. This often means constructing Faraday cages, which are enclosures that restrict RFI emissions.

She's currently experimenting with LiFi, a wireless communication technology that uses infrared and visible light. "It's in the terahertz range," says Beaudet. "It's electromagnetic radiation, but at a much higher frequency and much easier to contain."

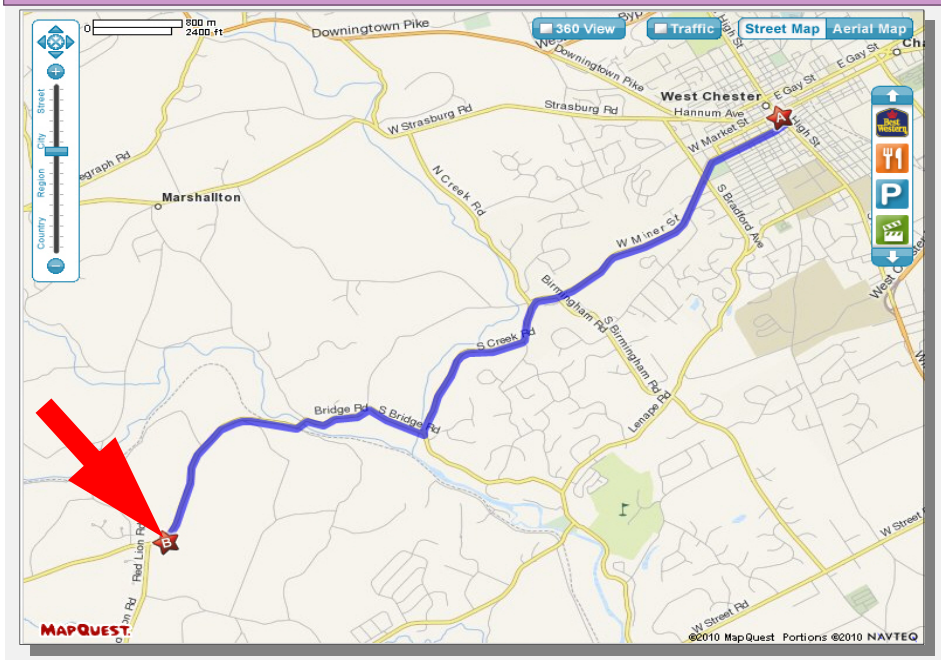
Around the apparatus is her self-made Faraday cage, constructed from sheet metal, glass, and fine mesh. She says that bandwidth-wise it works just as well WiFi, but reach is where it falls short. They're currently experimenting with this new tech in conference rooms, but six are needed to give every seat access. This makes LiFi fairly expensive. Beaded says the nearby school also has expressed interest in this new tech. "They want a grant for it … but they would need a lot of them."

While workarounds for this unique challenge are continuing to be figured out, the good news is Green Bank is still far more quiet than many, many areas. Both O'Neill and Niday say that visiting astronomers love doing their work here because interference is still greatly limited, especially compared to other places. The bad news is it may not stay that way for much longer.

"It's just everything now," says Niday, "And it's not going to get any better."

Read the complete article online at https://www.popularmechanics.com/space/telescopes/a29589714/town-wifi-illegal/

CCAS Directions



Brandywine Red Clay Alliance

Brandywine Red Clay Alliance
1760 Unionville Wawaset Rd
West Chester, PA 19382
(610) 793-1090
http://brandywinewatershed.org/

BRC was founded in 1945 and is committed to promoting and protecting the natural resources of the Brandywine Valley through educational programs and demonstrations for all ages.

The monthly observing sessions (held February through November) are held at the Myrick Conservation Center of the Brandywine Red Clay Alliance.

To get to the Myrick Conservation Center from West Chester, go south on High Street in West Chester past the Courthouse. At the next traffic light, turn right on Miner Street, which is also PA Rt. 842. Follow Rt. 842 for about 6 miles. To get to the observing site at the BRC property, turn left off Route 842 into the parking lot by the office: look for the signs to the office along Route 842. From that parking lot, go left through the gate and drive up the farm

Looking Up: Mizar and Alcor, the Famous Double Star in The Big Dipper

by Don Knabb, CCAS Treasurer & Observing Chair

Here is a screen shot from the free planetarium software Stellarium.

At any star party there are a few classic objects to see in the sky. One of those objects is the double star Mizar and Alcor in the Big Dipper. It seems that The Big Dipper, that most famous of all asterisms in Ursa Major, is almost always in the sky for our star parties. With a low horizon one can always see Ursa Major in the sky. It is a circumpolar constellation. That is, from our latitude, Ursa Major never sets. Yes, it is low in the sky during the winter months, but star parties are few during those cold months.

At a star party it is always fun to point to the Big Dipper and tell people there is a double star right in front of them that they might not know about. Anyone with reasonable eyesight, if they look closely, will then see that the 2nd star from the end of the

(Continued on page 11)

Looking Up (Cont'd)

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Big Dipper's handle is indeed a double star. Those stars are Mizar and Alcor.

There is quite a collection of mythology concerning Mizar and Alcor. Mizar and Alcor together are sometimes called the "Horse and Rider." Native Americans named these stars the Squaw and the Papoose. In Japanese mythology, Alcor is known as the lifespan star or "jumyouboshi" as it was believed that one who could not see this star would pass away by year's end.

There are two stories that link Alcor to The Pleiades in Taurus. The Pleiades are often called the Seven Sisters. But it is quite difficult to see more than six stars in this beautiful cluster with the naked eyes. What became of the Lost Pleiad? One story is that the seventh sister was taken away by Mizar, one of the seven brothers of the Big Dipper, and there she remains, little Alcor, at his side. Another story that is Greek in origin also suggests Alcor was once part of the Pleiades and that Alcor was the Lost Pleiad Electra, which had wandered here from her companions and became Alopex, the Fox.

The ability to resolve the two stars with the naked eye is often quoted as a test of eyesight. Mizar shines at magnitude 2.2 while Alcor is quite a bit dimmer at magnitude 4.0. That puts it at the limit in light-polluted skies, so if you can't see Alcor don't assume your eyes are failing!

Mizar and Alcor lie three light-years apart, and though their proper motions show they move together (they are both members of the Ursa Major Moving Group), it was believed long ago that they did not form a true binary star system, but were simply a double star resulting from a chance alignment of the two stars. The pair of Mizar and Alcor are actually much more than a simple double star. It is actually a collection of 6 stars, although not all of these are within the reach of amateur level telescopes.

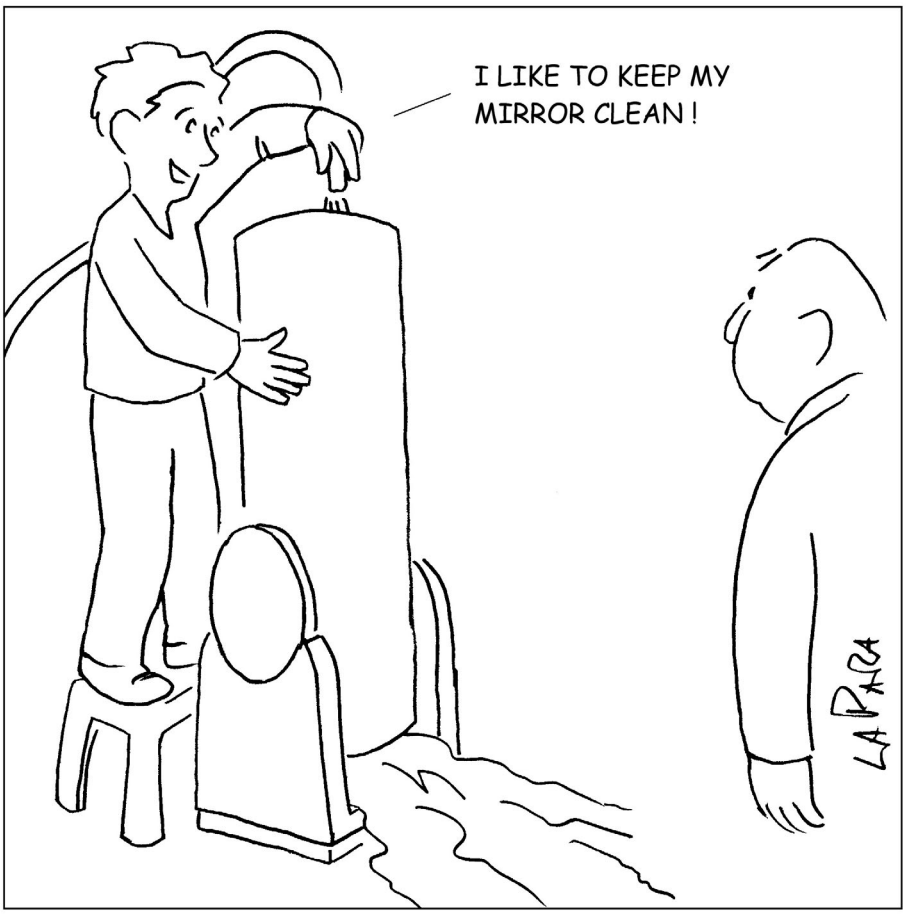
Mizar is a prime target for someone with a new telescope, as the components are an easy 14 seconds of arc apart, the two taking at least 5000 years to make their orbit about each other. More remarkably, each of these two components is AGAIN double. The brighter of the two (magnitude 2.27) contains a very close pair a mere 7 or 8 thousandths of a second of arc apart (an angle made by a penny at a distance of 300 miles) that has an orbital period of 20.5 days. The fainter of them (magnitude 3.95) contains a pair with a period of about half a year. Mizar is thus actually a quartet of stars, a double-double.

In 2009, it was reported by astronomer Eric Mamajek and collaborators that Alcor actually

(Continued on page 13)

Classic La Para

by Nicholas La Para



[Editor's Note: As we start month three of self-isolation, I'm running out of things to clean. However, I won't go to this extreme. I think. Ask me next month. JCH]

NASA Night Sky Notes: Become a Citizen Scientist with NASA!

by David Prosper

This article is distributed by the NASA Night Sky Network, a coalition of hundreds of astronomy clubs across the US dedicated to astronomy outreach.

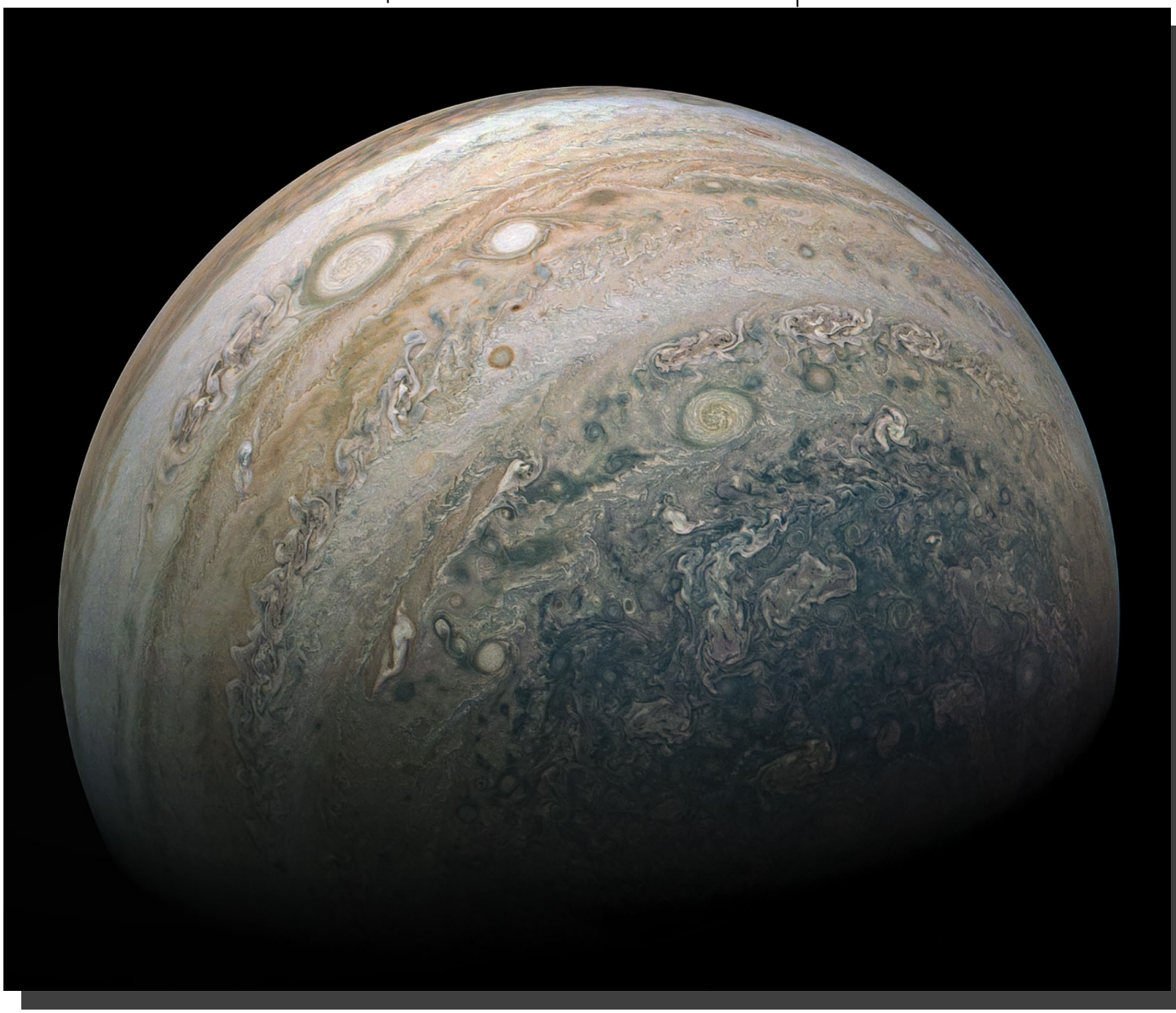
Visit nightsky.jpl.nasa.gov to find local clubs, events, stargazing info and more.

Ever want to mix in some science with your stargazing, but not sure where to start? NASA hosts a galaxy of citizen science programs that you can join! You'll find programs perfect for dedicated astronomers and novices alike, from reporting aurora, creating amazing images from

real NASA data, searching for asteroids, and scouring data from NASA missions from the comfort of your home. If you can't get to your favorite stargazing spot, then NASA's suite of citizen science programs may be just the thing for you.

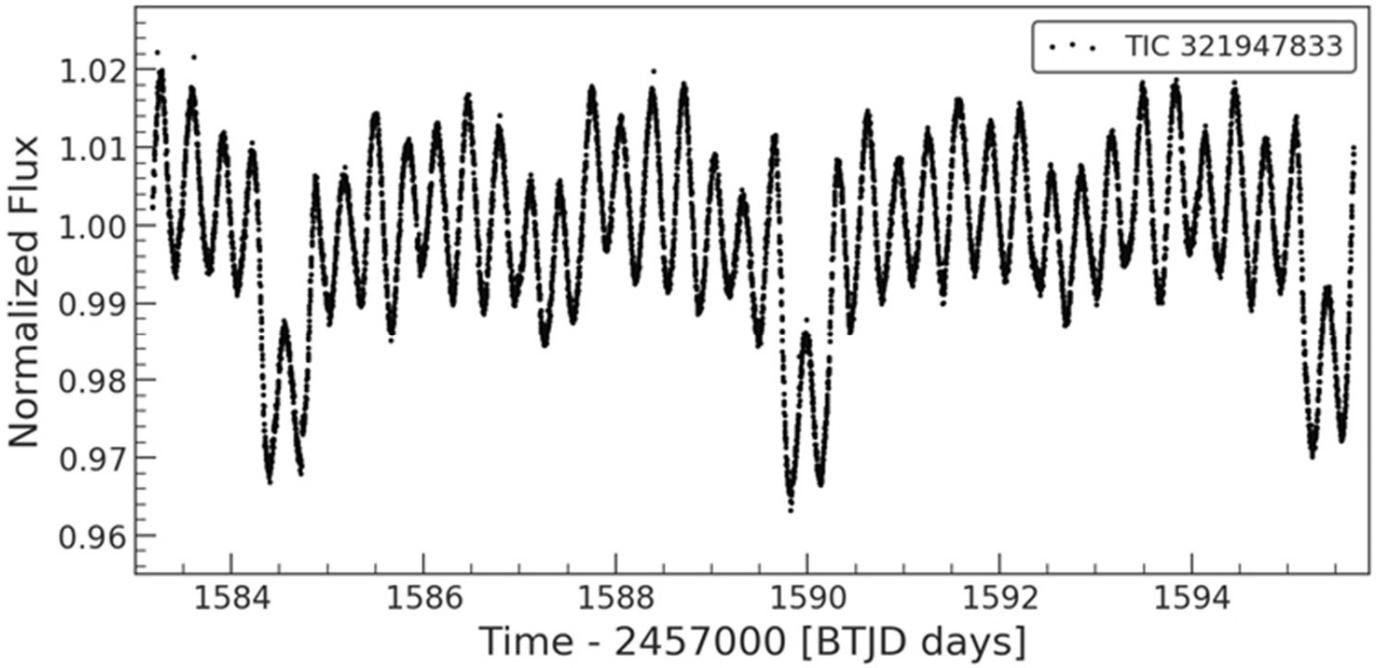
Jupiter shines brightly in the morning sky this spring. If you'd rather catch up on sleep, or if your local weather isn't cooperating, all you need is a space tel-

(Continued on page 13)



GREAT SOUTHERN JUPITER: Incredible image of Jupiter, submitted to the JunoCam site by Kevin M. Gill. Full Credits : NASA/JPL-Caltech/SwRI/MSSS/ Kevin M. Gill

Night Sky Notes (Cont'd)



Light curve of a binary star system containing a pulsating (variable) star, as spotted on Planet Hunters TESS by user mhuten and featured by project scientist Nora Eisner as a "Light Curve of the Week." Credit: Planet Hunters TESS/NASA/mhuten/Nora Eisner

(Continued from page 12)

escope - preferably one in orbit around Jupiter! Download raw images straight from the Juno mission, and even process and submit your favorites, on the **JunoCam** website! You may have seen some incredible images from Juno in the news, but did you know that these images were created by enthusiasts like yourself? Go to their website and download some sample images to start your image processing journey. Who knows where it will take you? Get started at bit.ly/nasajunocam

Interested in hunting for asteroids? Want to collaborate with a team to find them?? The **International Astronomical Search Collaboration** program matches potential asteroid hunters together into teams throughout the year to help each other dig into astronomical data in order to spot dim objects moving in between photos. If your team discovers a potential asteroid that is later confirmed, you may even get a chance to name it! Join or build a team and search for asteroids at iasc.cosmosearch.org

Want to help discover planets around other star systems? NASA's TESS mission is orbiting the Earth right now and scanning the sky for planets around other stars. It's accumulating a giant horde of data, and NASA scientists need your help to sift through it all to find other worlds! You can join **Planet Hunters TESS** at: planethunters.org

Intrigued by these opportunities? These are just a few of the many ways to participate in NASA citizen science, including observing your local environment with the GLOBE program, reporting aurora with Aurorasaurus, measuring snowpack levels, training software for Mars missions – even counting penguins! Discover more opportunities at science.nasa.gov/citizenscience and join the NASA citizen science Facebook group at facebook.com/groups/Sciencing/

And of course, visit nasa.gov to find the latest discoveries from all the research teams at NASA!

Looking Up (Cont'd)

(Continued from page 11)

is itself a binary, consisting of Alcor A and Alcor B, and that this binary system is most likely gravitationally bound to Mizar, bringing the full count of stars in this complex system to six.

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CCAS Directions

West Chester University Campus

The monthly meetings (September through May) are held in Room 112 in Merion Science Center (formerly the Boucher Building), attached to the Schmucker Science Center. The Schmucker Science Center is located at the corner of S. Church St & W. Rosedale Ave. Parking is generally available across Rosedale in the Sykes Student Union parking lot (Lot K).

Looking Up (Cont'd)

(Continued from page 13)

So at our next star party, or anytime you gaze upward at the Big Dipper, tell someone the story of these stars that at first glance look like one star, but with closer inspection are actually two that can be seen with the naked eye by most people on a reasonably clear night. And with really close inspection by high powered telescopes it is revealed that there are really six stars in the group.

Information credits:

Raymo, Chet. 1982. 365 Starry Nights. New York, NY. Simon & Schuster
http://en.wikipedia.org/wiki/Mizar_(star)
http://stars.astro.illinois.edu/sow/mizar.html
http://stars.astro.illinois.edu/sow/alcor.html

CCAS Membership Information and Society Financials

Treasurer's Report

by Don Knabb

April 2020 Financial Summary

Beginning Balance	$1016
Deposits	$75
Disbursements	-$133
Ending Balance	$958

New Member Welcome!

Welcome new CCAS members Dexter Chisholm and Joan Odell from Unionville, PA. We're glad you decided to join us under the stars! Clear skies to you!

Membership Renewals

You can renew your CCAS membership by writing a check payable to "Chester County Astronomical Society" and sending it to our Treasurer:

Don Knabb
988 Meadowview Lane
West Chester PA 19382

The current dues amounts are listed in the *CCAS Information Directory*. Consult the table of contents for the directory's page number in this month's edition of the newsletter.

CCAS Information Directory

Join the Fight for Dark Skies!

You can help fight light pollution, conserve energy, and save the night sky for everyone to use and enjoy. Join the nonprofit International Dark-Sky Association (IDA) today. Individual memberships start at $30.00 for one year. Send to:

International Dark-Sky Association
3225 North First Avenue
Tucson, AZ 85719

Phone: **520-293-3198**
Fax: **520-293-3192**
E-mail: **ida@darksky.org**

For more information, including links to helpful information sheets, visit the IDA web site at:

http://www.darksky.org

Dark-Sky Website for PA

PENNSYLVANIA OUTDOOR LIGHTING COUNCIL

The Pennsylvania Outdoor Lighting Council has lots of good information on safe, efficient outdoor security lights at their web site:

http://www.POLCouncil.org

Find out about Lyme Disease!

Anyone who spends much time outdoors, whether you're stargazing, or gardening, or whatever, needs to know about Lyme Disease and how to prevent it. You can learn about it at:

http://www.LymePA.org

Take the time to learn about this health threat and how to protect yourself and your family. It is truly "time well spent"!

Good Outdoor Lighting Websites

One of the biggest problems we face in trying to reduce light pollution from poorly designed light fixtures is easy access to good ones. When you convince someone, a neighbor or even yourself, to replace bad fixtures, where do you go for good lighting fixtures? Check out these sites and pass this information on to others. Help reclaim the stars! And save energy at the same time!

Starry Night Lights

Light pollution from poor quality outdoor lighting wastes billions of dollars and vast quantities of valuable natural resources annually. It also robs us of our heritage of star-filled skies. Starry Night Lights is committed to fighting light pollution. The company offers the widest selection of ordinance compliant, night sky friendly and neighbor friendly outdoor lighting for your home or business. Starry Night Lights is located in Park City, Utah.

Phone: **877-604-7377**
Fax: **877-313-2889**

http://www.starrynightlights.com

★ ★ ★ ★ ★

LIGHTHOUSE OUTDOOR LIGHTING

Lighthouse Outdoor Lighting is a dedicated lifetime corporate member of the International Dark-Sky Association. Lighthouse's products are designed to reduce or eliminate the negative effects outdoor lighting can have while still providing the light you need at night.

Phone: **484-291-1084**

https://www.lighthouse-lights.com/landscape-lighting-design/pa-west-chester/

Local Astronomy-Related Stores

Listing retail sites in this newsletter does not imply endorsement of any kind by our organization. This information is provided only as a service to our members and the general public.

Skies UNLIMITED

Skies Unlimited is a retailer of telescopes, binoculars, eyepieces and telescope accessories from Meade, Celestron, Televue, Orion, Stellarvue, Takahashi, Vixen, Losmandy and more.

Skies Unlimited
Suburbia Shopping Center
52 Glocker Way
Pottstown, PA 19465

Phone: **610-327-3500** or **888-947-2673**
Fax: **610-327-3553**

http://www.skiesunlimited.net

★ ★ ★ ★ ★

Spectrum Scientifics
Quality Science Products for All Ages

Located in Manayunk, Spectrum Scientifics educates and entertains customers with an array of telescopes, microscopes, binoculars, science toys, magnets, labware, scales, science instruments, chemistry sets, and much more.

4403 Main Street
Philadelphia, PA 19127

Phone: **215-667-8309**
Fax: **215-965-1524**

Hours:
Tuesday thru Saturday: 10AM to 6PM
Sunday and Monday: 11AM to 5PM

http://www.spectrum-scientifics.com

CCAS Information Directory

CCAS Lending Telescopes

Contact Don Knabb to make arrangements to borrow one of the Society's lending telescopes. CCAS members can borrow a lending telescope for a month at a time; longer if no one else wants to borrow it after you. Don's phone number is 610-436-5702.

CCAS Lending Library

Contact our Librarian, Barb Knabb, to make arrangements to borrow one of the books in the CCAS lending library. Copies of the catalog are available at CCAS meetings, and on the CCAS website. Barb's phone number is 610-436-5702.

Contributing to *Observations*

Contributions of articles relating to astronomy and space exploration are always welcome. If you have a computer, and an Internet connection, you can attach the file to an e-mail message and send it to: **newsletter@ccas.us**

Or mail the contribution, typed or handwritten, to:

Dr. John C. Hepler
21103 Striper Run
Rock Hall, MD 21661

CCAS Newsletters via E-mail

You can receive the monthly newsletter (in full color!) via e-mail. All you need is a PC or Mac with an Internet e-mail connection. To get more information about how this works, send an e-mail request to Dr. John Hepler, the newsletter editor, at: **newsletter@ccas.us**.

CCAS Website

Dr. John Hepler is the Society's Webmaster. You can check out our Website at:

http://www.ccas.us

Dr. Hepler welcomes any additions to the site by Society members. The contributions can be of any astronomy subject or object, or can be related to space exploration. The only requirement is that it is your own work—no copyrighted material! Give your contributions to Dr. Hepler at (410) 639-4329 or e-mail to webmaster@ccas.us

CCAS Purpose

The Chester County Astronomical Society was formed in September 1993, with the cooperation of West Chester University, as a non-profit organization dedicated to the education and enjoyment of astronomy for the general public. The Society holds meetings (with speakers) and observing sessions once a month. Anyone who is interested in astronomy or would like to learn about astronomy is welcome to attend meetings and become a member of the Society. The Society also provides telescopes and expertise for "nights out" for school, scout, and other civic groups.

CCAS Executive Committee

For further information on membership or society activities you may call:

President:	Dave Hockenberry 610-558-4248
Vice President:	Pete Kellerman 610-873-0162
ALCor, Observing, & Treasurer:	Don Knabb 610-436-5702
Secretary:	Beatrice Mazziotta 610-933-2128
Librarian:	Barb Knabb 610-436-5702
Program:	Bruce Ruggeri 484-883-5092
Education:	Don Knabb 610-436-5702 Dennis O'Leary 610-701-8042
Webmaster & Newsletter:	John Hepler 410-639-4329
Public Relations:	Ann Miller 610-558-4248

CCAS Membership Information

The present membership rates are as follows:

REGULAR MEMBER……$25/year
SENIOR MEMBER…….$10/year
STUDENT MEMBER……..$ 5/year
JUNIOR MEMBER……..$ 5/year
FAMILY MEMBER…….$35/year

Membership Renewals

Check the Membership Renewals on the front of each issue of *Observations* to see if it is time to renew. If you need to renew, you can mail your check, made out to "Chester County Astronomical Society," to:

Don Knabb
988 Meadowview Lane
West Chester PA 19382-2178

Phone: **610-436-5702**
e-mail: **treasurer@ccas.us**

*Sky & Tele*scope Magazine Group Rates

Subscriptions to this excellent periodical are available through the CCAS at a reduced price of **$32.95,** much less than the newsstand price of $66.00, and also cheaper than individual subscriptions ($42.95)! Buying a subscription this way also gets you a 10% discount on other Sky Publishing merchandise.

To **start** a **new** subscription, make **sure** you make out the check to the **Chester County Astronomical Society**, note that it's for *Sky & Telescope*, and mail it to Don Knabb.

To **renew** your "club subscription" contact Sky Publishing directly. Their phone number and address are in the magazine and on their renewal reminders. If you have **any** questions call Don first at 610-436-5702.

Astronomy Magazine Group Rates

Subscriptions to this excellent periodical are available through the CCAS at a reduced price of **$34.00** which is much less than the individual subscription price of $42.95 (or $60.00 for two years). If you want to participate in this special Society discount offer, **contact our Treasurer Don Knabb.**