AOH OBSERVER

Winter 2017

The Newsletter of the Astronomers of Humboldt

Most of the Fall was cloudy and rainy. In lieu of our regularly scheduled star parties, we held indoor movie nights. While the movies were entertaining, visiting with each other was even more enjoyable. It was fun to chat about everyone's summer adventures, recent equipment acquisitions, or their travel plans for the August 2017 solar eclipse. On the outreach front, the AOH participated in three well-attended public events: College of the Redwoods Science Night (October 21), Kneeland Fall Festival (November 5), and Eureka Arts Alive (December 3). A report of these outreach events is given on page 8 of the newsletter. Our last big event of the year was the Annual Meeting which was held on Nov. 19th. There were enough attendees to qualify for a quorum, so we held our elections for the AOH Board of Directors and Officers. A summary of the meeting and the election results are on page 2.

For this edition of the Observer, we feature the astrophotography of one of our new members, Bill Hogoboom. Bill wanted me to mention that he is still learning to use his equipment. I find his photos inspiring and I look forward to seeing more of his work in 2017. Bill also shared photos of his trip to Mojave and Yuma in his search of dark skies (page 9). Our resident artist Susie Christian drew her version of what really goes on at the North Pole (and why your telescope might have a dent). The idea for the cartoon came from Herb Larsen, who for many years drew the comic strip for the newsletter of the Sonoma County Astronomical Society. Herb graciously allowed us to borrow this cartoon (and other ones as well).

January 6th marks the 60th anniversary of the founding of the Astronomers of Humboldt. I want to take this opportunity to thank the AOH members for their support of the club. It means a lot that so many of you attend our meetings and public events (even in bad weather), give time, money and materials in support of our AOH projects, and that you are always willing to share your love of astronomy and the night sky with the public. We are small, but we make a difference to our Humboldt community.

Finally, the AOH is having its Annual Potluck Dinner on February 10th at the Humboldt Area Foundation. Professor C.D. Hoyle will be giving a talk on the latest research on gravitational waves. It should be enlightening and a great way to kick off 2017.

Acknowledgements: Many thanks to Ken Yanosko and Donald Wheeler for their help in editing and proofreading the newsletter. Their patience and diligence is deeply appreciated.

Heavenly Bodies
by Susie Christian

Wishing Our AOH Members a Happy 2017!

AOH Annual Meeting and Elections

The AOH Annual meetings (AOH Board of Directors Business Meeting and the General Membership Meeting) were held on November 19th at Babe's Pizza in Cutten. Bob Zigler gave an update on the finances of the club while Grace Wheeler spoke about the various club projects including equipment improvements, grant writing, and outreach. The minutes of the Board and the General Membership meeting are posted under the "Minutes" tab in the "Members Only" section at http://www.astrohum.org

Also on the Meeting agenda was the nomination and election of the AOH Board of Directors for 2017. This was followed by the election of the Officers for 2017 by the Board. The 2017 Board of Directors and Officers are:

Grace Wheeler	President
Mark Mueller	Vice President
Ken Yanosko	Secretary
Bob Zigler	Treasurer
Bernie Christen	Board Member
Greg Deja	Board Member
Dan Eaton	Board Member
Russell Owsley	Board Member
Mark Wilson	Board Member

The nomination and election of the Board and Officers was done in accordance with the AOH By-laws.
The contact information for each Board Member/Officer is on the AOH website http://www.astrohum.org/contact.html. We encourage you to contact us with suggestions, questions, or comments. We are always looking for members to participate in leadership roles, outreach, and help with the maintenance of our equipment.

AOH Calendar of Events: January-March

Changes to the schedule will be posted at http://www.astrohum.org/

Saturday January 7. **Public Observing at Arts Alive.** Meet at the Gazebo on F Street. Telescope set up is at dusk and observing is between 6-9 p.m.

Wednesday January 18**. Solar Eclipse 2017** featuring Dr. Laura Peticolas of the Space Science Laboratory/UC Berkeley. NSN Webinar* More information about this webinar can be found at https://nightsky.jpl.nasa.gov/news-display.cfm?News_ID=707

Saturday January 28. **Regular Monthly Meeting**. We will have an observing session at Kneeland Observatory.

Saturday February 4. **Public Observing at Arts Alive.** Gazebo on F Street. Telescope set up is at dusk and observing is from 6-9 p.m.

Saturday February 11. **Annual AOH Potluck**. Save the date. Speaker will be Professor C.D. Hoyle of HSU Physics & Astronomy Dept.

Wednesday February 15. **The Mercury 13**. featuring space historian and writer Amy Shira Teitel NSN Webinar*

Saturday February 25. **Regular Monthly Meeting**. TBA

Saturday March 4. **Public Observing at Arts Alive**. **.** Gazebo on F Street. Telescope set up is at dusk and observing is from 6-9 p.m.

Friday March 24 or Saturday March 25. **Messier Marathon**. Primary weekend.

Friday March 31 or Saturday April 1. **Messier Marathon**. Secondary weekend.

*Registration link to the NSN webinars: http://www.astrohum.org/members_only/webinars.php

Night Sky Observing Notes (Jan-Mar 2017)

The wintertime constellations include Orion, Taurus, Auriga, Gemini, Canis Major, and Canis Minor. The bright stars of these constellations form an asterism known as the “winter hexagon”.

Auriga (Charioteer). Capella is the brightest star in Auriga. Deep sky objects include open clusters M36, M37, and M38.

Taurus (the Bull). The bright orange star Aldebaran is the fiery eye of the bull. Taurus is known for the two open clusters: the Hyades Cluster (mag. 0.5) which is located in the sky near Aldebaran, and the Pleiades (mag. 1.6). Both clusters are naked eye objects, but enhanced when viewed with binoculars. Other deep sky objects include the supernova remnant M1, the Crab Nebula (mag. 8.4).

Gemini (the Twins). The constellation is known for its two brightest stars Castor and Pollux. Pollux, an orange giant star, is the brighter of the two. The whitish star Castor is actually made up of 3 sets of double stars known as Castor A, Castor B, and Castor C. With a small telescope, it is possible to resolve Castor A and B. Castor C is faint and not easily seen. Gemini also contains the M35 open cluster (mag. 5.3), and a double-shelled planetary nebula known as the Eskimo Nebula (NGC2392; mag. 10.1).

Orion (the Hunter). The two brightest stars of Orion are Rigel (blue supergiant) and Betelgeuse (red supergiant). Notable deep sky objects are Orion’s Nebula (M42; Mag. 4.0) and the Trapezium, an open cluster of stars in the heart of the Nebula. The Trapezium is easily recognized by the asterism of four bright stars.

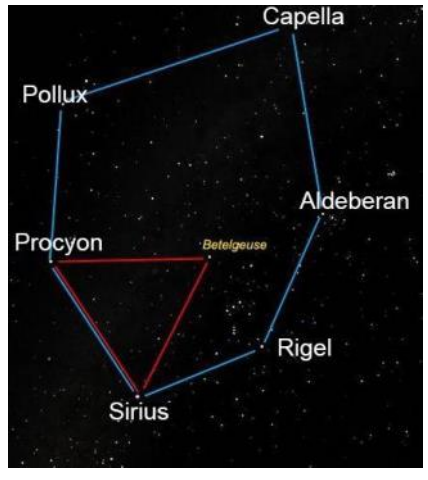
Canis Major (Greater Dog) is a constellation of the southern celestial hemisphere. This constellation contains Sirius, the brightest star in the night sky. Canis Major contains the open cluster M41 (mag. 4.5) which can be seen with binoculars or small telescope.

Canis Minor (Lesser Dog) is a constellation of the northern celestial hemisphere. Procyon. The constellation is recognizable because of its two brightest stars: Procyon (mag. 0.34) and Gomeisa (mag. 2.9).

Venus: The evening apparition of Venus began in late July 2016. Since then Venus has been growing brighter and setting later in the evening. The best time to observe Venus will be in January and February when it will be high in the sky and particularly brilliant. The phases of Venus can be seen with a telescope, but as it approaches crescent phase, binoculars will suffice.

Notable dates:
Maximum Eastern Elongation; Venus at quarter phase on January 12th; Venus sets at 9:08 p.m.
Venus near Crescent Moon (also near Mars): January 31th at 6:30 p.m.
Venus maximum altitude in the sky in early February; Venus sets around 9:20 p.m.
Maximum brilliancy (magnitude -4.8): February 18th.
Venus Crescent/large disk from early- to mid-March. Venus will be low in the sky and setting shortly after sunset.

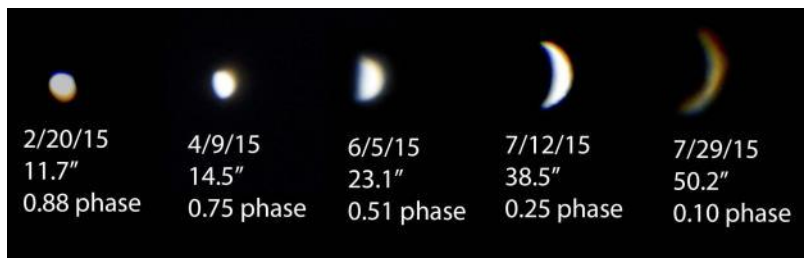
Venus in inferior solar conjunction on March 23.
Dawn apparition of Venus: Venus is visible before sunrise starting in mid-April; the greatest brightness is on 4/29; maximum western elongation on 6/2.



The winter hexagon (image credit: https://commons.wikimedia.org/wiki/File:Wintersky.jpg).

The Eskimo Nebula in the constellation Gemini. (photo credit: GW)

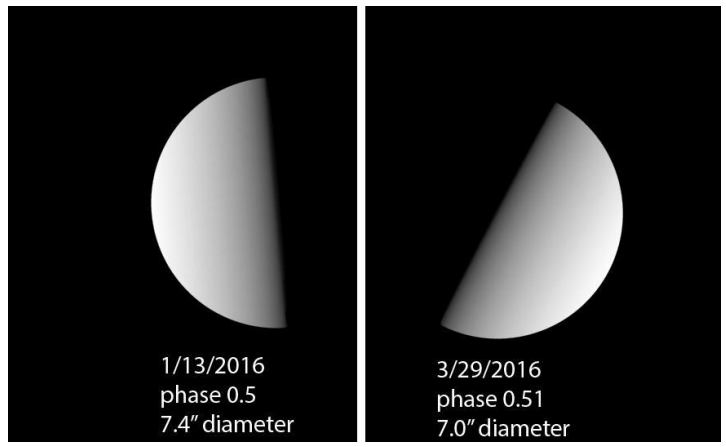
Orion Nebula with Trapezium Cluster. (photo credit: GW)



The 2015 evening apparition of Venus. As Venus moves closer to the Earth, the phase changes from gibbous to quarter to crescent. At the same time, the apparent diameter of Venus increases in size. The 2016 apparition will show the same pattern. Values for the disc size and phase illumination are from http://aa.usno.navy.mil/data/docs/diskmap.php (image credit: GW).

Mercury. For most of January 2017, Mercury can be viewed in the eastern horizon before sunrise. On January 13, Mercury will be at its highest altitude (11 degrees above the horizon) and it will rise 1 hour and 40 minutes before the sun. On that date, Mercury will appear to be in quarter phase. The maximum western elongation for Mercury is on Jan. 19th.

Mercury disappears from the dawn skies in late January, and reappears as an evening planet in mid-March. On March 29, the planet will reach its maximum altitude of 14 degrees above the western horizon; Mercury sets about 90 minutes after sunset. The maximum eastern elongation is on March 31 2017.



January 13th is the date of maximum altitude for the dawn apparition of Mercury. March 29th marks the maximum altitude for the evening apparition of Mercury. Images of Mercury and values for the phase and angular diameter is from http://aa.usno.navy.mil/data/docs/diskmap.php.

Mars was particularly large and bright in 2016 as it approached opposition. May 30th marked the date of Mars' closest approach to Earth. Throughout the summer, Mars continued to shine brightly even though it was farther from the Earth, and surface details on the Martian disk could still be seen through a small telescope. Currently Mars can still be seen as a reddish "star" (Mag. 0.8) in the southwest sky shortly after sunset. Though less bright than before, it can easily be seen with the unaided eye. The gibbous phase of Mars can be seen with a telescope and high magnification (about 100x). Mars will continue to be visible in the winter and spring months. It will disappear from the night sky in late July 2017. Mars will reappear in the morning sky in October 2017.

Apparition of Mars in 2016. The gibbous phase of Mars has been apparent since summer. (photo credit: GW).

Currently **Jupiter** rises after midnight and can be seen in the predawn skies. By late February-early March, Jupiter rises in the late evening making it possible to see the planet before midnight. By late March, Jupiter will rise around 8 p.m. so that it is well placed for evening observations. Opposition for Jupiter is on April 7, 2017.

Dates and time for Galilean moon transits, shadow transits, eclipses, and occultation as well as the transit of the Great Red Spot can be found here: http://rfo.org/jackscalendar.html.

Currently Jupiter is high in the southwestern sky at dawn (photo credit: GW).

Useful websites

http://rfo.org/jackscalendar.html (a selection of astronomical events that can be seen in Northern California)
https://www.calsky.com (Comprehensive listing of astronomical events; set location for what can be viewed locally)
https://in-the-sky.org (set location for what can be viewed locally)
http://aa.usno.navy.mil/data/docs/diskmap.php (apparent diameter of the solar system objects)
http://aa.usno.navy.mil/data/docs/mrst.php (rise and set time of solar system objects and bright stars)

AOH Outreach

by G. Wheeler

Science Night at College of the Redwoods

The AOH was invited to participate in Science Night at the College of the Redwoods on October 21, 2016. This was a campus wide event with presenters from different scientific disciplines. Our program was entitled "A View of the Heavens" and we planned to have different telescope designs on display: Newtonian, refractor, and Schmidt-Cassegrain. We also hoped to do some telescope viewing of the night sky.

On the day of the event there was light rain and overcast until the late afternoon. The school gave us the option to set up indoors, but we were optimistic that the evening would be clear (at least that was the forecast). We started out under overcast skies, but at least it was dry. While we waited for the skies to clear, Frank Simpson helped our visitors use a couple of the small telescopes to view distant land objects (trees, streetlights, the mountains).

A small refractor telescope was set up to view an artificial star field (see below) that was set up across the courtyard. The participants were asked to count the number of "stars" before looking through the telescope and then afterwards. This exercise was used to demonstrate how a telescope allows our eyes to see small details in an image. In this case, the viewers were able to resolve two closely placed points of light which to the unaided eye appeared to be a single point of light.

Artificial star field. With the unaided eye, most people saw 8-9 stars. With the telescope, it was possible to see the 12 stars.

Since one of the themes of our program was telescope design, we set up a table of lenses and mirrors to show the configurations of refractor and Newtonian reflector telescopes. A few people commented that they liked the "deconstructed" telescopes because it gave them a better understanding of the inner workings of the two types of telescopes.

Newtonian reflector telescope: configuration of the primary (left) and secondary (middle) mirrors.

Setting up a display of mirrors and lenses to show how reflecting and refracting telescopes work.

Frank Simpson was in charge of the telescope display. An Astroscan telescope (a small Newtonian) was available for visitors to use. Frank's Dobsonian telescope is to the left.

By 8 p.m. the skies cleared to partly cloudy. Frank set up his Dobsonian and I set up my refractor telescope for viewing. We were able to find a few stars and the planet Mars. The humidity was quite high and it was difficult to keep the moisture from condensing onto the lenses and mirrors. By 9 p.m. most of our displays were soaked from the humidity and our telescopes were fogged up. We were ready to call it a night as the crowds thinned out.

Despite the challenges of a cloudy evening and high humidity, the AOH event was well attended. Most of our guests were appreciative of the opportunity to peer through the telescopes, and to find out more about astronomy resources in our town.

Thank you to Johanna Helzer of the College of the Redwoods for coordinating the event, and to Frank Simpson and Don Wheeler for their yeoman's efforts.

Kneeland Fall Festival

The Kneeland Fall Festival was held on November 5 at the Kneeland School. The AOH had planned to do a tour of the Observatory, and a telescopic viewing of the 3 day moon. The volunteers for the Fall Festival were Ken Yanosko, Russ Owsley, and Mark Wilson.

Unfortunately the rain cancelled the Observatory tour and Moon viewing. The AOH instead set up an indoor astronomy presentation in one of the classrooms. Ken Yanosko demonstrated how telescopes are used to see distant objects by setting up his C90 to observe a picture of Saturn across the classroom. As Ken noted in his outreach report, “We aimed a small telescope across the room at a small photo of Saturn; both adults and children reacted with delight at being able to see something through the telescope that they couldn't make out by eye. A few (including adults) even looked at the front of the scope expecting the picture to be there!”

The AOH also set up two tables using items from the Night Sky Network toolkits. One table was a display of the “scale model of the solar system” showing the size of the eight planets relative to a one-meter Sun. The second table had a collection of “meteorites and meteorwrongs”. Visitors were given a lesson on how meteors can be distinguished from ordinary rocks. We hope to increase our collection of rocks/meteorites for future presentations.

Despite the rain, there was a good turnout of about 30 kids and about 20 adults. The program was well received and one of the attendees wrote on our AOH Facebook: “Thanks for the great Meteorite, Meteor Wrong demo at Kneeland school this past weekend! Great interactive fun. Got kids (and adults) thinking...”.

Russ and Mark with the meteorite/meteorwrong display. (Photo Credit: Ken Yanosko)

The scale model of the solar system made quite an impression on this youngster. (Photo credit: K. Yanosko)

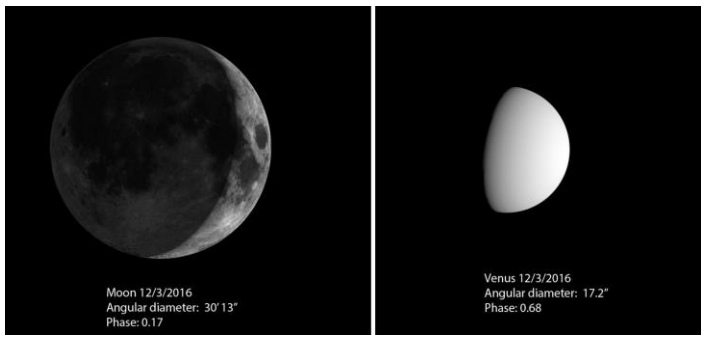
Meteorites or meteorwrongs? (Photo Credit: R. Owsley)

Ken and the planets. The C-90 is in the background. (Photo Credit: R. Owsley)

Arts Alive

Our last public event of 2016 was at Arts Alive in Old Town Eureka on Dec. 3. The sky was clear during the early part of the evening, and from the Gazebo, we had excellent views of the moon and Venus. Ken, Don, and I showed up at about 5 p.m. to set up telescopes. People were curious as to what could be seen in the daylight and were amazed to see Venus in gibbous phase, and surface details of the moon at the lunar terminator. We were joined by Mark Wilson who set up his binoculars, and Mark Mueller who set up his Dob.

We were a popular attraction and we often had lines of 6 or 7 people waiting for their turn at the telescopes. Many were not aware that Venus had phases like the moon. Over at Ken's telescope, there were a lot of "oohs and aahs" as the visitors saw the craters and mountains of the moon. Mark Wilson had his binoculars trained on the moon while Mark Mueller had Venus, Mars, and the Pleiades in his Dobsonian telescope.



Apparent diameter and phase of the moon and Venus.
http://aa.usno.navy.mil/data/docs/diskmap.php

Unfortunately, between a thickening layer of clouds and the bright lights of Old Town, it was not possible to see other bright night sky objects such as the Perseus double cluster or the Andromeda Galaxy. Mark Mueller was able to find the Pleiades, but only the brightest stars, i.e., the "Seven Sisters", were apparent.

Mark Mueller and his Dobsonian. The telescope was pointed at the Pleiades.
(Photo Credit: D. Wheeler)

We were thankful to have at least the Moon and Venus out for most of the evening. It was an enthusiastic crowd at the Gazebo, and it was certainly a great way to end the year.

A line up at the 8 inch SCT telescopes.
(Photo Credit: D. Wheeler)

Ken Yanosko with his C-8 and Mark Wilson with his binoculars.
(Photo Credit: D. Wheeler)

Deep Sky Astrophotography

Photos by Bill Hogoboom, text by G. Wheeler

I first met Bill Hogoboom back in early September when he attended the last star party of the summer at the Kneeland Airport. Bill mentioned that he was a relatively new amateur astronomer, with an interest in astrophotography. He was also curious about where the locals set up their telescopes for viewing deep sky objects. We told him that the Kneeland Airport was the best place in the area for that purpose. With its mostly 360 views of the horizon and lack of trees and city lights, it is an ideal place for astrophotography. I found out that a few days later, Bill went back to Kneeland Airport on his own. After some prodding, he showed me his photos of the Andromeda Galaxy and the Pinwheel Galaxy. My reaction at the time was "wow!" Bill said then that he was a beginner and just learning to use his equipment—that his telescope and camera were capable of doing much more.

In November, Bill took a trip to Yuma Arizona, and the images featured here are from Bill's astrophotography adventure. For me, it was another wow moment. The last image shown in this article is the "Silver Dollar Galaxy" in the constellation Sculptor. This constellation is best seen in the southern sky, and as Bill noted: "*That one's hard to get from Eureka but in Yuma it was 8 degrees higher in the sky".*

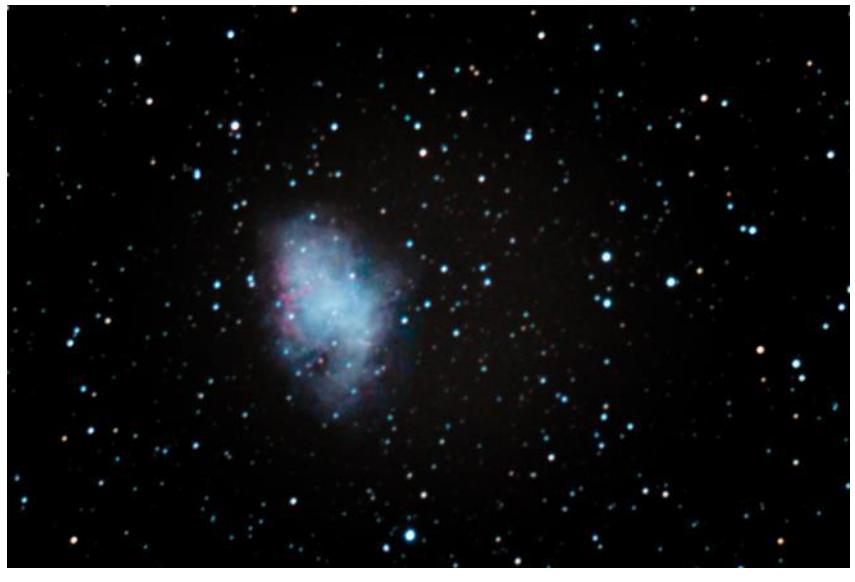
Bill wanted me to mention that these images represent "a beginner's first attempt" and that he is still learning to use his equipment. I hope to see more images from Bill, and look forward to learning from him. Thank you Bill for sharing your work!

Equipment:
Celestron 8" SCT @f6.3
Celestron AVX mount
Orion 60mm guidescope w/Celestron Nexguide autoguider.
Pentax K3II

Processing: Stacked with Deep Sky Stacker, finished with Rawtherapee.

Orion Nebula Single 45 sec exposure.

Dancing Galaxies - M82 and M81
Lights: 48x180s @ 1600asa
Darks: 24
Flats: 32
Bias: 74



M1 - Crab Nebula
Crab1: (For this image the scope was at f10.0)
Lights: 17x180s @ 1600asa
Darks: 5
Flats: 10
Bias: 10

Silver Dollar Galaxy
Lights: 43x150s @1600asa
Darks: 20
Flats: 24
Bias: 60

Deep Sky Astrophotography II—Bill's Excellent Adventure to Mojave and Yuma (Nov. 16, 2016)

Photos and Text by Bill Hogoboom,

First night off highway I stopped at an abandoned railroad site called Archer.
I cruised down the interstates from Humboldt to Amboy, CA, then down old Route 66 to Cadiz. It was a little unnerving to be flying along at 60 in a 5 ton van and see a little sign on a narrow bridge that says "Weight Limit 3 Tons". I was across it before I could touch the brakes.

Only water for many miles. Edge of the Old Woman Mountain Wilderness.

I was happy to find out that the van handles sand pretty well with the tires aired down.
I didn't see another vehicle in 2 days. It was good to find out that with good water conservation the van can go 3 weeks with one person in it without any sort for resupply except for diesel every 500 mi.

http://www.hillmap.com/m/ag1zfmhpbGxtYXAtaGRychULEghTYXZlZE1hcBiAgIDIgLitCgw

After 100 miles of dirt, sand, and rock in the Mojave, I crossed over into Arizona and down into the Kofa Wildlife Refuge.

Nice flat wide open spot for stargazing

My telescope at dawn after a night of taking star pictures.
In 2 nights I was able to get these 4 images. (see previous page)

DINO-KILLING ASTEROID MADE ROCKS BEHAVE LIKE LIQUID AND COULD HAVE PROVIDED HABITAT FOR NEW LIFE

Posted on November 17, 2016

Republished with permission from the University of Texas, Austin News
http://www.jsg.utexas.edu/news/2016/11/dino-killing-asteroid-made-rocks-behave-like-liquid-and-could-have-provided-habitat-for-new-life

Sean Gulick (right) of UT Austin and Joanna Morgan of Imperial College London examine a core sample from the Chicxulub crater. UT Jackson School of Geosciences

A study of the massive crater that formed when an asteroid crashed into Earth 66 million years ago, wiping out all non avian dinosaurs and most life on the planet, is giving insights into how impacts can help shape planets and possibly even provide habitat for the origins of life.

The study published in the journal *Science* on Nov. 17, http://science.sciencemag.org/content/354/6314/878 represents the first findings from the expedition that drilled into the peak ring of the Chicxulub crater in the Gulf of Mexico in April and May. The international team was led by researchers from The University of Texas at Austin and Imperial College London.

The findings validate the theory that violent asteroid impacts cause a planet's surface to behave like a fluid, said study author Sean Gulick, a research professor at the University of Texas Institute for Geophysics, a unit of the Jackson School of Geosciences. The research puts a definitive end to an alternative explanation that suggested that such impacts, which are common on other planets and moons, deform the surface by melting most of the rock around the impact.

The findings are important for our understanding of this and other planets, Gulick said, because researchers found that the peak ring – the mountain or hills around the impact – consists of rock that comes from deep in the crust.

A map showing the location of the Chicxulub crater. Google Maps/UT Jackson School of Geosciences

"It is the same exact kind of feature that we see on all large impacts on rocky planets, whether it be on Venus, on Mercury or on the moon," said Gulick, who was the expedition's co-principal investigator. "They're a ubiquitous feature. Yet, prior to this drilling, we did not know how they were formed or what they were made of. What you're actually seeing is a window into the crust kilometers down".

The team took core samples of the peak ring, which is now covered by water and the limestone of the modern gulf floor. They found that the asteroid, which hit with the force of 100 million atomic bombs, quickly opened a massive hole nearly 19 miles deep and 120 miles wide.

The cores were collected by a drill rig aboard the Liftboat Myrtle. UT Jackson School of Geosciences

Gulick said he knew they had solved the mystery of how large impacts affect the surface when the cores revealed an unmistakable pink granite, which is found deeper in the Earth, as opposed to the limestone that was present at the time of the impact.

“It was obvious and exhilarating,” he said. “That was the big find because it says the peak ring didn’t come from something shallow. It came from something deep because it is made up of these buried crustal rocks that are now near the surface.”

Researchers found that the roughly 10-mile-wide Chicxulub asteroid, which hit in the Gulf of Mexico near the Yucatán Peninsula, pushed rock up from 6 miles below the surface to form the peak ring.

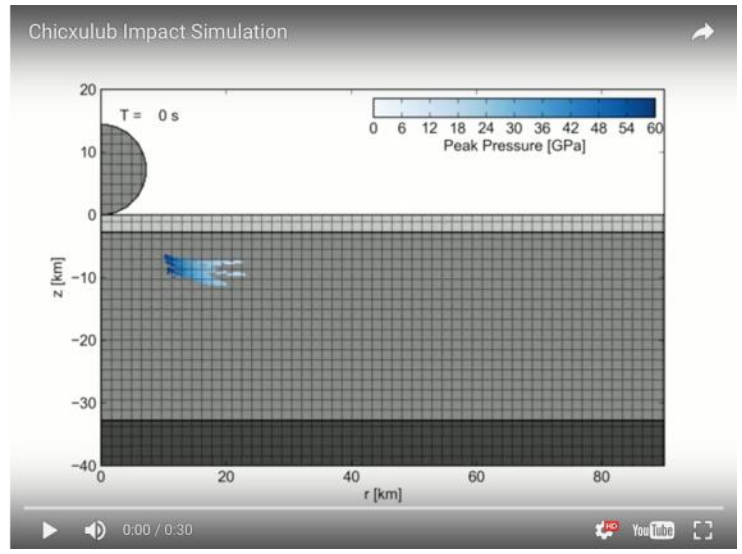
Those rocks travelled approximately 20 miles in a few minutes, first being pushed outward from the impact, then rebounding upward above the Earth’s surface and finally collapsing outward to form a ring of peaks around the center of the impact.

The team also found that impacts appear to fundamentally lower the density and increase the porosity of rock. The granites found in the Chicxulub peak ring contained about 10 percent pore space, much greater than the 1 or 2 percent that scientists would expect, Gulick said. This finding could help explain why NASA’s recent GRAIL mission showed the moon’s crust — which has been impacted multiple times — has an unusually high porosity.

These highly porous rocks may also provide a habitat for chemosynthetic life in the wake of impacts, researchers said, by providing places where simple organisms can take hold. There could also be nutrients available within the

Three core samples taken from different parts of the Chicxulub crater. UT Jackson School of Geosciences

pores from circulating water that would have been heated by the impact event. Early Earth was constantly bombarded by asteroids, and the team has inferred that this bombardment must have created rocks with similar physical properties, which may partly explain how life took hold on Earth. Future studies will examine this theory.



Chicxulub Impact Simulation
http://www.jsg.utexas.edu/news/2016/11/dino-killing-asteroid-made-rocks-behave-like-liquid-and-could-have-provided-habitat-for-new-life

The expedition was conducted by the European Consortium for Ocean Research Drilling (ECORD) as part of the International Ocean Discovery Program (IODP) and was supported by the International Continental Scientific Drilling Program (ICDP). The Yucatán Government, Mexican federal government agencies and scientists from the National Autonomous University of Mexico (UNAM) and the Yucatan Center for Scientific Research (CICY) also supported the expedition.

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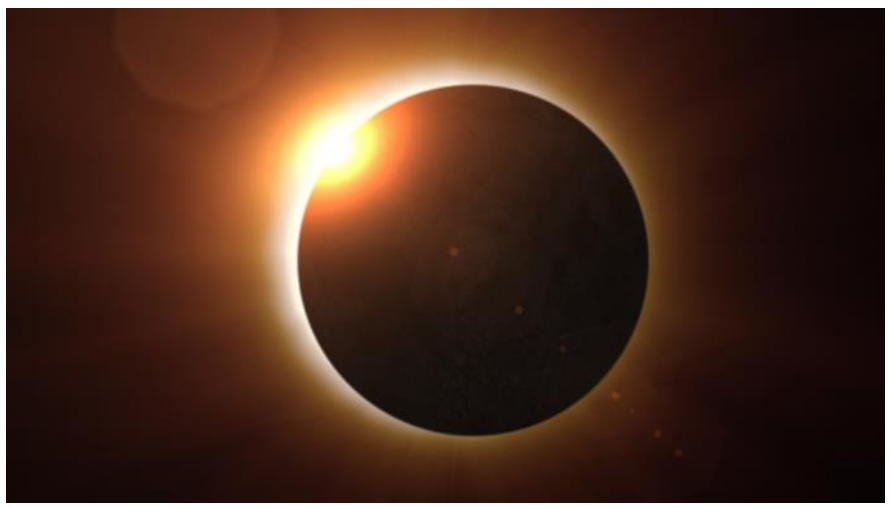
Astronomers prepare for 2017 solar eclipse spectacle

By Christopher Crockett

https://www.sciencenews.org/article/astronomers-prepare-2017-solar-eclipse-spectacle



Cover image courtesy of NASA/GSFC/CI Lab
https://nasaviz.gsfc.nasa.gov/12170

On August 21, 2017, moon's shadow will race across U.S. from Oregon to South Carolina

Eeriness creeps in. Colors change and shadows sharpen. The last minutes before a total solar eclipse trigger a primal reaction in the human psyche, says astronomer Jay Pasachoff.

"You don't know what's going on," says Pasachoff, of Williams College in Williamstown, Mass. "But you know something is wrong."

Millions of people will know something is wrong on August 21, 2017, when a total eclipse of the sun sweeps across the country, the first to grace the continental United States since 1979 (and the first to go coast-to-coast since 1918). The roughly 120-kilometer-wide-path of totality https://eclipse.gsfc.nasa.gov/SEgoogle/SEgoogle2001/SE2017Aug21Tgoogle.html created the moon's shadow will travel through 12 states, from Oregon to South Carolina. And although it's still a year away, researchers and non-researchers alike are gearing up to make the most of this rare spectacle — they won't get another chance in the United States until 2024.

Eclipse enthusiasts will travel from all over the world to experience up to nearly three minutes of midday twilight and glimpse the seldom-seen solar corona, a halo of light from plasma that will frame the blacked-out sun. "People cheer and people cry," says Pasachoff, who has seen 33 total solar eclipses and 30 partial ones.

Though some of the corona is visible all the time to a few telescopes in space, the region where the corona meets the surface is masked by the sun's intensity. "Only on days of eclipses can we put together a complete view of the sun," Pasachoff says. For researchers, the 2017 eclipse is another chance to connect what they see on the surface of the sun to what's happening in the outer reaches of the corona.

One enduring mystery is why the corona is millions of degrees hotter than the surface of the sun, which is a relatively balmy 5,500° Celsius. "The consensus is that the sun's magnetic field is responsible," says Paul Bryans, a solar physicist at the National Center for Atmospheric Research in Boulder, Colo. "But it's not clear how."

The magnetic field in the corona is too tenuous to study directly. Instead, researchers want to look at the effect of magnetism on certain wavelengths of infrared light emitted by the corona. Bryans is leading a team that will point a spectrometer at the sun during the eclipse to detect that light. "The plan is to put us in the back of a trailer, drive north to Wyoming and just sit and stare at the sun," says Bryans, for whom the 2017 eclipse will be his first. "People keep telling me it's a terrible thing to do because I'll be stuck in the back of the trailer."

This experiment will test whether the corona emits light at the predicted wavelengths and, if so, how brightly. (Scientists will have to wait for improved instruments and another eclipse to see how these wavelengths are distorted by the magnetic field.) One of the advantages of a mobile observatory, Bryans says, is that the team can look at weather forecasts the day before and drive to clear skies.

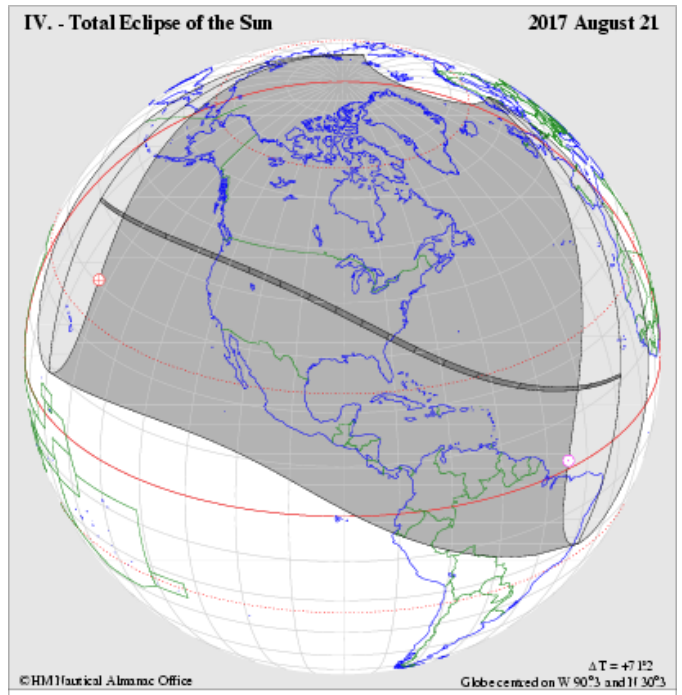
Another option is to point an infrared spectrometer out the window of a Gulfstream V Jet https://www.eol.ucar.edu/observing_facilities/hiaper-gulfstream-gv and cruise at an altitude of about 15 kilometers along the path of the eclipse. That is what Jenna Samra, a Harvard University applied physics graduate student, will be doing. Aside from getting away from weather intrusions, the flying telescope will soar above much of Earth's water vapor, which absorbs a lot of infrared light.

The moon's shadow, racing across the country at about 2,700 kilometers per hour, will catch up with the jet in southwest Kentucky. "We won't be able to keep up with it," Samra says. "But we will be able to stay in for about four minutes." That's more than a minute longer than for anyone stuck on the ground.

For earthbound observers, the eclipse first touches U.S. soil at 10:16 a.m. Pacific time near Oregon's Depoe Bay. The shadow moves through five state capitals — Salem, Ore.; Lincoln, Neb.; Jefferson City, Mo.; Nashville; and Columbia, S.C. — and even a few national parks: Grand Teton, Great Smoky Mountains and Congaree. A spot in the Shawnee National Forest (just southeast of Carbondale, Ill.) has the honor of longest time in darkness: about 2 minutes, 42 seconds. Cape Island, S.C., is the shadow's final stop, before leaving the continent around 2:49 p.m. Eastern time, just about an hour and a half after entering Oregon.

Based on typical weather patterns in late August http://eclipsophile.com/overview/ the weather has a better chance of cooperating in the western half of the eclipse path, from Oregon to western Nebraska. That's why Pasachoff will be setting up in Salem. He won't be looking for elusive infrared photons, but instead will be taking rapid-fire images of plasma loops — coils of ionized gas trapped in billowing magnetic fields — arcing off the sun and peeking out from behind the moon. One idea for why the corona is so hot is that these loops subtly jiggle, which stirs up the surrounding plasma and heats the corona. By looking for subsecond oscillations along the loops, Pasachoff's team will see if this hypothesis holds up.

The sun won't be the only thing scrutinized during the eclipse. Some researchers will be keeping an eye on Earth's atmosphere to see how it responds to a sudden loss of sunlight. The National Eclipse Ballooning Project http://eclipse.montana.edu led by Angela Des Jardins, a solar physicist at Montana State University in Bozeman, will launch over 100 weather balloons at various times along the path of totality and measure changes in such parameters as temperature and wind speed.



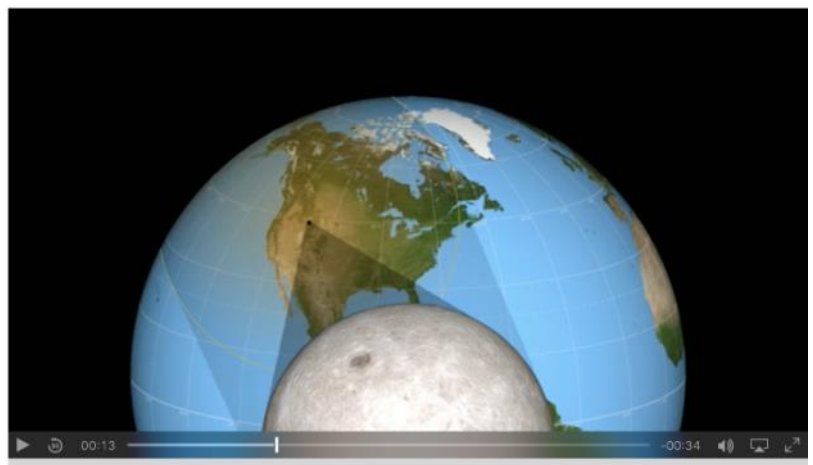
Circumstances	Time (UT) h m	Longitude ° ′	Latitude ° ′
Eclipse begins; first contact with Earth	15 46.8	W153 04.5	N30 32.5
Beginning of southern limit of penumbra	16 32.9	W159 18.4	N 8 38.7
Beginning of southern limit of umbra	16 48.8	W171 24.4	N39 27.7
Beginning of centre line; central eclipse begins	16 49.0	W171 34.3	N39 43.9
Beginning of northern limit of umbra	16 49.3	W171 44.3	N40 00.2
Beginning of northern limit of penumbra	18 06.2	E 71 40.1	N77 34.4
Central eclipse at local apparent noon	18 13.2	W 92 32.5	N38 55.3
End of northern limit of penumbra	18 45.1	E 12 38.4	N61 55.3
End of northern limit of umbra	20 01.8	W 27 18.7	N11 16.1
End of centre line; central eclipse ends	20 02.1	W 27 25.7	N11 00.9
End of southern limit of umbra	20 02.3	W 27 32.7	N10 45.8
End of southern limit of penumbra	20 18.0	W 38 11.4	S20 17.2
Eclipse ends; last contact with Earth	21 04.3	W 44 59.0	N 1 42.2

View global map and circumstances (USNO Eclipse Portal)
http://aa.usno.navy.mil/data/docs/Eclipse2017.php

Interactive Google Map showing the solar eclipse path. Eclipse Predictions by Fred Espenak, NASA's GSFC
https://eclipse.gsfc.nasa.gov/SEgoogle/SEgoogle2001/SE2017Aug21Tgoogle.html

For those who can't make it to the eclipse path, or who get stuck under cloudy skies, the ballooning project will serve up live feeds from a vantage point unlike any other: roughly 30 kilometers above the ground. More than 50 teams of high school and college students will launch cameras on additional balloons from 30 sites along the eclipse path. Video and images will be transmitted in real time and be accessible via a website.

From an altitude of 30 kilometers, "you can really see the curvature of Earth and the blackness of space," says Des Jardins. "Seeing the shadow of the moon come across the Earth gives you an amazing perspective of what's going on."



https://svs.gsfc.nasa.gov/4321

A solar eclipse occurs when the Moon's shadow falls on the Earth. The shadow comprises two concentric cones called the umbra and the penumbra. Within the smaller, central umbra, the Sun is completely blocked by the Moon, and anyone inside the umbra sees a total eclipse. Within the larger penumbra, the Sun is only partially blocked. (Visualization by Ernie Wright/NASA)

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Dimming stars, erupting plasma, and beautiful nebulae

By Marcus Woo

Boasting intricate patterns and translucent colors, planetary nebulae are among the most beautiful sights in the universe. How they got their shapes is complicated, but astronomers think they've solved part of the mystery—with giant blobs of plasma shooting through space at half a million miles per hour.

Planetary nebulae are shells of gas and dust blown off from a dying, giant star. Most nebulae aren't spherical, but can have multiple lobes extending from opposite sides—possibly generated by powerful jets erupting from the star.

Using the Hubble Space Telescope, astronomers discovered blobs of plasma that could form some of these lobes. "We're quite excited about this," says Raghvendra Sahai, an astronomer at NASA's Jet Propulsion Laboratory. "Nobody has really been able to come up with a good argument for why we have multipolar nebulae."

Sahai and his team discovered blobs launching from a red giant star 1,200 light years away, called V Hydrae. The plasma is 17,000 degrees Fahrenheit and spans 40 astronomical units—roughly the distance between the sun and Pluto. The blobs don't erupt continuously, but once every 8.5 years.

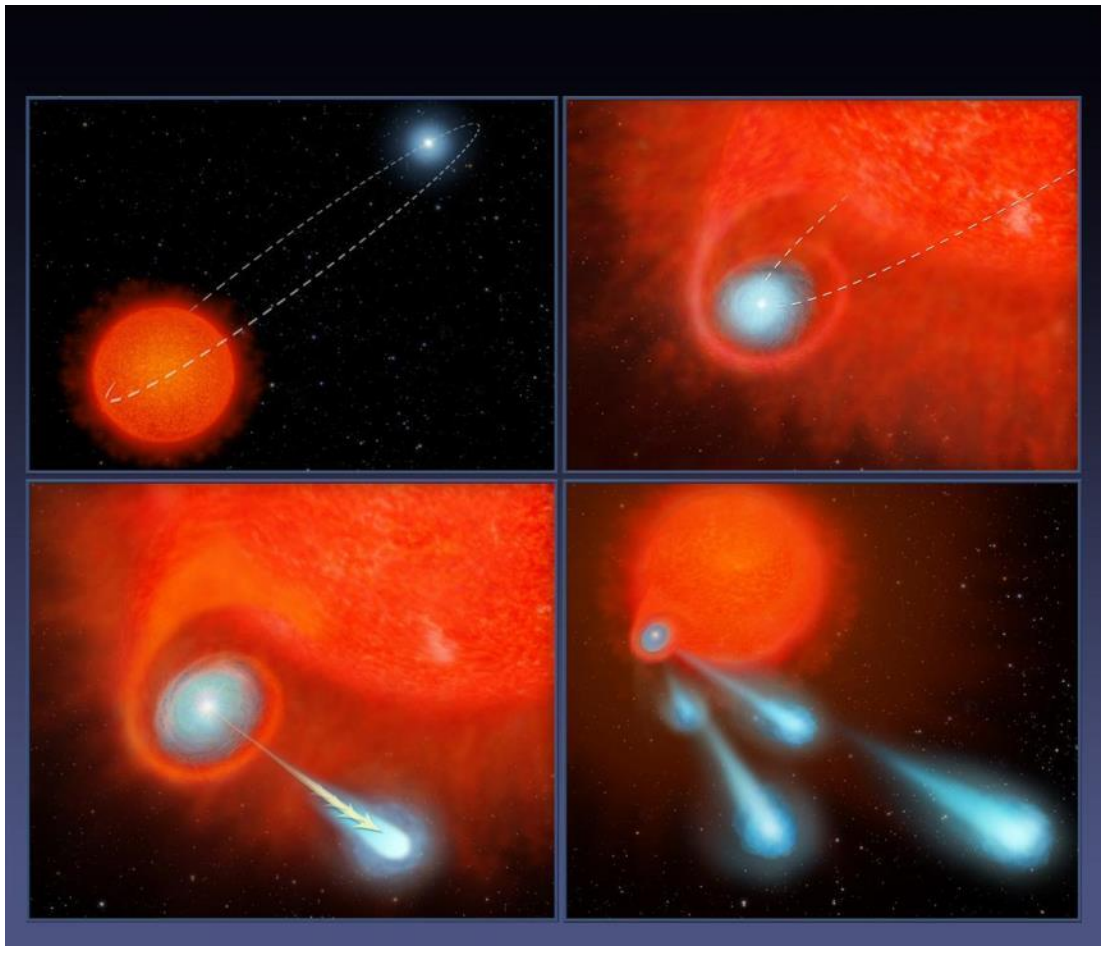
The launching pad of these blobs, the researchers propose, is a smaller, unseen star orbiting V Hydrae. The highly elliptical orbit brings the companion star through the outer layers of the red giant at closest approach. The companion's gravity pulls plasma from the red giant. The material settles into a disk as it spirals into the companion star, whose magnetic field channels the plasma out from its poles, hurling it into space. This happens once per orbit—every 8.5 years—at closest approach.

When the red giant exhausts its fuel, it will shrink and get very hot, producing ultraviolet radiation that will excite the shell of gas blown off from it in the past. This shell, with cavities carved in it by the cannon-balls that continue to be launched every 8.5 years, will thus become visible as a beautiful bipolar or multipolar planetary nebula.

The astronomers also discovered that the companion's disk appears to wobble, flinging the cannonballs in one direction during one orbit, and a slightly different one in the next. As a result, every other orbit, the flying blobs block starlight from the red giant, which explains why V Hydrae dims every 17 years. For decades, amateur astronomers have been monitoring this variability, making V Hydrae one of the most well-studied stars.

Because the star fires plasma in the same few directions repeatedly, the blobs would create multiple lobes in the nebula—and a pretty sight for future astronomers.

If you'd like to teach kids about how our sun compares to other stars, please visit the NASA Space Place: http://spaceplace.nasa.gov/sun-compare/en/



This four-panel graphic illustrates how the binary-star system V Hydrae is launching balls of plasma into space. Image credit: NASA/ESA/STScI