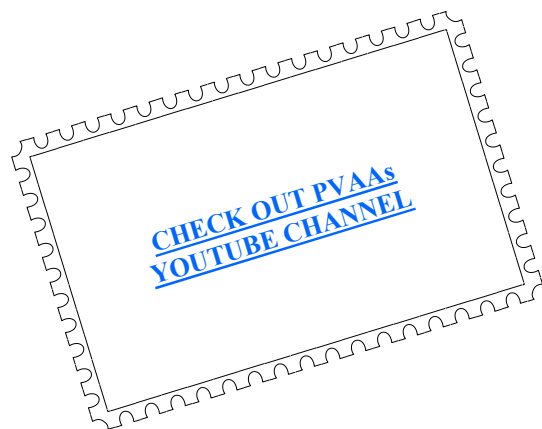




Newsletter of the Pomona Valley Amateur Astronomers

The only true wisdom
is knowing you know nothing.

Socrates



Volume 42 Number 11

nightwatch

November 2022

**Our speaker for November is Alex McConahay.
His presentation is about the American astronomer Halton Arp.**

Club Events Calendar

- Nov 4** **General Meeting Presentation: See Above
7:30 PM**
- Nov 19** **Star Party – Joshua Tree**
- Nov 26** **Star Party in the Park – Cahuilla Park**
- Nov 30** **Board Meeting 6:15 PM**
- Dec 10** **Christmas Party – Casa Jimenez,
Claremont 6PM**

PVAA Officers and Board

Officers

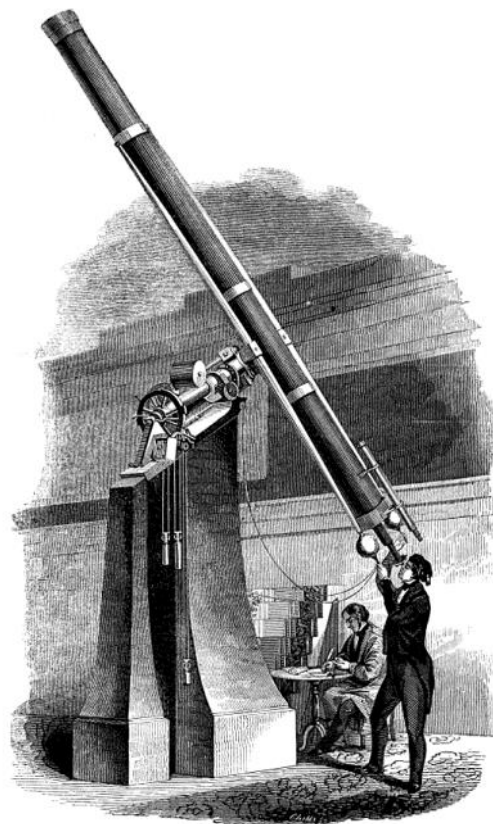
President	Mathew Wedel	909-767-9851
Vice President ..	Joe Hillberg	909-949-3650
Secretary	position is currently open	
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Jim Bridgewater (2024).....	909-599-7123
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Outreach	Jeff Schroeder	909-758-1840
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Wanted – Telescope Builders and Mentors

Mt. SAC is launching a new Adopt-A-Telescope program this semester. We've had several telescopes generously donated to Mt. SAC for this program, but these telescopes are in need of some repair. Mt. SAC students who participate in giving these telescopes some much needed TLC will be eligible to adopt these scopes at the end of the semester to take home and keep. However, these students are not experienced astronomers! They don't know everything you know! They need your guidance to learn how to fix and use these scopes. Please help us mentor the next generation of astronomers by meeting with us once a month for a Telescope Repair Party. Meet with the students, enjoy some pizza and help mentor a future astronomer in repairing and using their telescopes.

Tools will be available to use. There may be some restrictions on some tool use. You will need to sign up as a Mountie MakerSpace member (registration is free) and have a safety tour before repairing telescopes. Closed-toe shoes are required at all times. Eye protection will be required for some activities.

Skills especially needed this semester are:

- Collimating
- Aligning finder scopes
- Cleaning mirrors/lenses
- Motor repair of a "The Optical Craftsman" 1968 telescope
- Replacing a homemade eyepiece holder with a more modern one

Telescope Repair Parties

Mt. SAC Mountie MakerSpace
Building F7 (near the farm) – Free Parking Available
6:00 – 9:00 PM

October 11, 2022

November 8, 2022

December 6, 2022

Please let us know you're coming by emailing
Heather Rookhuyzen at planetarium@mtsac.edu in advance. Thank you!



PVAA General Meeting 10/07/22

We had four different presenters for this meeting. You can view their presentations on PVAA's YouTube channel.

The first presenter was Gary Thompson on the SpaceX proposal to use the Crew Dragon spacecraft to boost the Hubble Space Telescope back up to its original 600 km (450 mile) orbit. Jared Isaacman is the commander of the mission. Mr. Isaacman is paying for the proposed Hubble re-boost mission. Before this mission takes place, the 'Polaris Dawn' mission is scheduled to go up, (paid for by Jared) for a 5-day mission to the highest Earth orbit (higher than the current record of 1,369 km or 850 miles by Gemini 11's crew of Charles Conrad, Jr. and Richard F. Gordon, Jr.) It will also be the first civilian EVA (spacewalk). They will be trying out SpaceX's new EVA spacesuits.

You may remember Jared Isaacman as the commander of the Inspiration4 mission – the first truly civilian mission into orbit. He paid for that flight also which spent 3 days in space. That mission raised over \$240 million for St. Jude Children's Research Hospital. \$100 million was donated by Jared and \$50 million was donated by Elon Musk. Netflix has a 4-part documentary on this mission, titled 'Countdown'.

Jared Isaacman is the founder and CEO of Shift4 Payments and is obviously a billionaire. He has bought two crew Dragon flights and a crew Starship flight, in addition to his original Inspiration4 flight.

What brought about this was the Russia-Ukraine war when Dmitry Rogozin threatened to pull Russia out of the ISS and asked, 'Without us, how will you boost the ISS?' Elon Musk responded with the SpaceX logo. Then it was asked, if the Dragon spacecraft can boost the entire ISS, how about the Hubble Space Telescope?

Jared then proposed that the second flight of the Polaris mission would be dedicated to the Hubble re-boost, and it would be on his dime. (The launch and civilian crew would be paid for by Jared.) NASA would provide any equipment or modifications hardware. The study will also investigate adding to/updating the Hubble's components.

The NASA/SpaceX study will determine the capabilities of the Dragon; the ability to put Hubble on a 'boost mode;' the potential damage to Hubble; what if we do not do the re-boost. The only answer during the conference call was that, if the re-boost does not happen, Hubble has a 50% chance of re-entering the atmosphere in 2037.



The second presentation for the night was from Ken Elchert on the recent DART mission. DART stands for Double Asteroid Redirection Test. This was the first full-scale test of a kinetic impactor for asteroid deflection. An asteroid impact on Earth is the only natural disaster that we can currently prevent. The purpose of this mission was to demonstrate planetary defense technology, and to evaluate the effectiveness of the asteroid deflection by a kinetic impactor.

The project was managed by John Hopkins Applied Physics Laboratory (JHAPL) in Laurel, Maryland for NASA's Planetary Missions Program Office. It was launched on a SpaceX Falcon 9 on November 24, 2021, from Vandenberg Space Force Base. The costs (2106-2023) are

- Spacecraft development \$308 million
- Operations & data analysis \$ 16.5 million
- Total \$324.5 million

•\$68.8 million launch cost not counted in program cost due to NASA's on-going contract with SpaceX (Including the launch gives you a total of \$393.3 million)

When determining the amount of delta-v (momentum change) you must consider how much ejecta the impactor creates, as ejecta creates twice the delta-v as what is absorbed. You also need to consider:

- The impact speed
- The impact angle
- The mass of the spacecraft (the impactor)
- The geometry and size of the spacecraft
- The spacecraft attitude at impact
- The materials from which the spacecraft is made
- The location of the impact on the asteroid

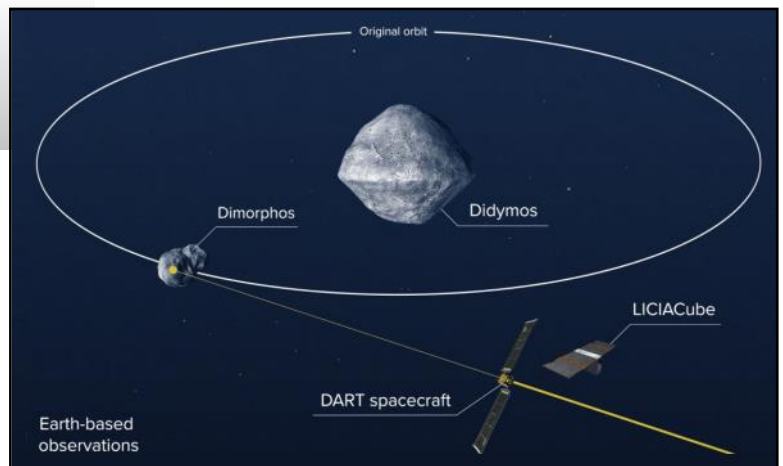
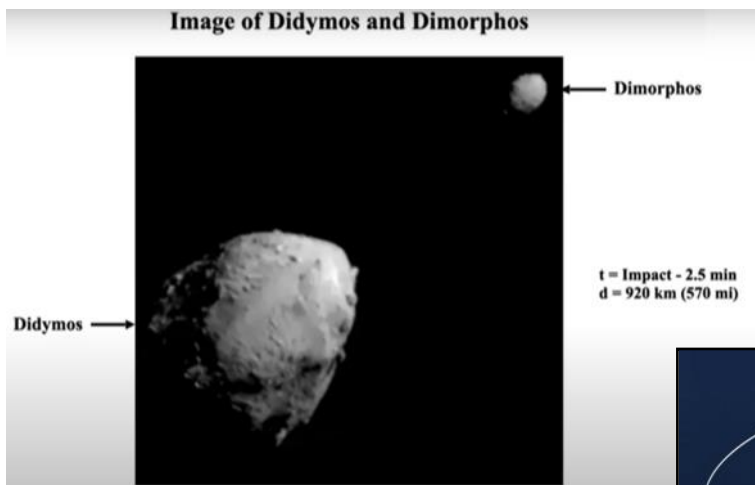
- The material composition of the asteroid
- Its compactness and porosity
- Its yield strength
- Its coefficient of friction
- Its shear modulus

This shows how hard it is to figure out the change the impact will make because we do not know about the surface structure of the asteroid.

The target was the smaller of the two asteroids. Named Dimorphos which means "two forms" in Greek. Dimorphos was chosen for the target because:

- It is a very small asteroid which increased the magnitude of the effects of an impact (about the size of an Egyptian pyramid)
- It is very close to Earth & therefore easily observed by ground telescopes
- It orbits another asteroid and has a precisely known orbital period
- It is much easier to precisely determine the change in an orbital period than a change in speed amounting to less than 1mm/sec
- Significantly reduced mission cost by eliminating a second spacecraft
- The idea of impacting an asteroid orbiting another one for this test came from Andrew Cheng of JHAPL

A follow-on mission by ESA called Hera go back to this asteroid pair and examine the 'crime scene' of the DART mission. Hera will have the main spacecraft and two CubeSats to examine the results.



Sharol Carter was our next speaker. She has taken some truly fantastic Astro pictures. Her presentation was on some of her work. The first picture she shared was the 'Teddy Bear' Nebula. Taken on September 24th and 25th at GMARS. It is a compilation of 52-300 second exposures for a total of 2.6 hours exposure time. She showed her progress in taking pictures of the Orion Nebula with exposures from November 2019, and then from November 2021 she re-took Orion's picture with her new equipment and more experience. These pictures are more than a match of modern-day observatories. It is truly amazing what amateurs can do today when time and care are taken to produce the very best.



Teddy Bear Nebula by Sharol Carter



IC1805 by Sharol Carter



Orion Nebula by Sharol Carter



Sharol's favorite picture of Orion/Horsehead/Running Man Nebulas

Ron Ugolick was the final presenter of the night. He also was showing his amazing Astro photographs. Back in 2009 he took his first Astro photograph. He went from a Minolta DSLR, Alt-Azimuth mount, long focal length telescope to a GEM mount, cooled camera, from manual focus to auto focus. He also now starts with calibration frames to remove 'hot pixels' from the picture. The first picture he took has a combined 4-5 second exposure of the ring nebula, for a total of 20 seconds, which just barely showed a faint wisp of the Ring Nebula. (Very hard to see, but it was there.) Eight years later he took the Ring Nebula's picture again, with much better results. Then again, improving even more. He did the same for the Dumbbell Nebula. Ron showed us his pictures of the Sculptor Galaxy, Abell 39 which is

a planetary nebula in the Hercules constellation. It is estimated to be 3,300 light-years from earth and 4,600 light-years above the Galactic plane. It is almost perfectly spherical with a diameter of 2.6 light years. He then showed his 4.5-hour exposure picture of the Crab Nebula, followed by his favorite picture of the Cave Nebula in the constellation Cepheus. This was also taken from his backyard. The Sombrero Galaxy shows great detail in the dust lane and the rim. He saved his favorite target for last which is the Trifid Nebula, also known as M20 in the constellation Sagittarius. While it is not his favorite photograph, it is his favorite go-to target because of all the colors of the nebula.

Gary Thompson



Ring Nebula by Ron Ugolick



Ring Nebula by Ron Ugolick



Dumbbell Nebula by Ron Ugolick



Dumbbell Nebula by Ron Ugolick



Sculptor Galaxy by Ron Ugolick



Comet Lovejoy January 2015
by Ron Ugolick



Abell 39 by Ron Ugolick



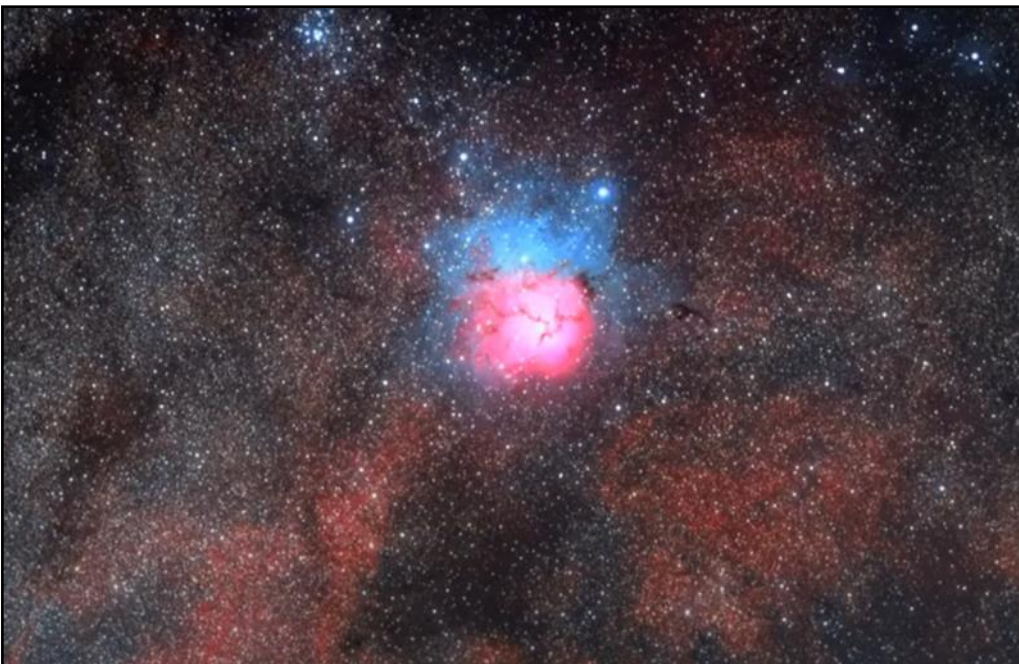
Backyard picture of the Crab Nebula
by Ron Ugolick



Cave Nebula by Ron Ugolick



Sombrero Galaxy Ron Ugolick



Trifid Nebula (M20)
Ron Ugolick

The nice thing about new moon in October this year is that it fell on Tuesday the 25th. This means the weekend nights of Friday and Saturday on either side are equally spaced from the new moon night, so two camping weekends were possible. But . . . I made a mistake and made alternate plans for the first weekend (it was cloudy anyway) and forgot that we already had plans for the second weekend! Luckily, being somewhat retired, we were able to go Wednesday and Thursday nights, October 26 and 27. The campground was nearly empty, so no campfires, flashlights, etc. to interfere with the imaging session. And even more importantly, the skies were clear!

Wednesday, I received an alert that a SpaceX rocket launch was scheduled for the following day just after sunset from Vandenberg Space Force Base, about 235 miles away. We figured out which way to look and at the designated time, we started hunting. Cindy saw it first and it was incredible. I watched through binoculars and she took videos and stills from an iPhone. The attached first image is one that she took about a minute or two after launch. We could clearly see the top-most stage and the lower stage. In between were two occasional flashes that I couldn't identify.



For the nights of October 26 and 27, my target was M74, a large spiral galaxy in Pisces. The galaxy is also known as NGC 628 and the Phantom Galaxy. I chose the target because of its beautiful, face-on spiral and pinkish H-alpha regions. It's located about 30 million light years away spanning a roughly round area about 10 arcminutes in diameter, making it about 95,000 light years across. Although it glows at magnitude 9-10, it has very low surface brightness due to its size, making it difficult to observe visually and somewhat difficult to photograph. The galaxy consists of about 100 billion stars which may be about the same number as the Milky Way (but some reports have the Milky Way as large as 400 billion stars).

The first night I managed 1 hour each of red, green, and blue frames of 5-minute exposures and 30 minutes of H-alpha frames of 10-minute exposures each on M74. Afterward, I set up for 5 hours of 5-minute exposure luminance frames, but I lost the guide star at some point and only managed 15 frames instead of 60! The second night, I made some adjustments to improve the chances of not losing the guide star and got 95 5-minute exposure luminance frames (7 hours, 55 minutes) without losing the guide star. Total integration time was 12h, 40m. Calibration was done with 12 dark, 21 flat, 21 flat dark, and 150 bias frames stacked in PixInsight. Processing was done in PixInsight as well except for final background correction. H-alpha was layered in with the red channel to enhance the pink nebulae in the galaxy. It would have been better if I had been able to get more H-alpha frames, but it did bring out more than was there initially. I'm not terribly happy with the final result and will most likely revisit the data again, but in the meantime, this is a good start.



I hope you all enjoy the images and clear skies!

Ron Ugolick

<https://www.astrobin.com/users/rucdu/>

Another Look - November 2022

On November 8th, the full Beaver Moon will undergo the last eclipse of 2022. In the Pacific Time Zone, the eclipse will start for us (penumbral) at 0002 hrs. Totality is at 0259 hrs and eclipse end at 0556, almost 6 hours of eclipse.

Other names for the November moon are Digging/Scratching Moon, Freezing Moon, Frost Moon and Whitefish Moon

Celtic and Old English names are Mothers' Moon, Bright Moon, Hare Moon, and Grass Moon.

New moons for November are Oct. 25 and Nov. 25.

It has been my honor over my lifetime to have had associations with some astronomy Titans. Msgr Ronald Royer has spent a lifetime developing new astrophoto techniques, chasing total solar eclipses and making thousands of variable star observations as a senior member of the AAVSO.

Leslie Peltier, the sine non qua, also contributed thousands of variable star observations from his famous "Merry-Go-Round" observatory. I have spent many nights at the 18" telescope at Ford Observatory on Mr. Peltier outside Wrightwood, now under the aegis of the Los Angeles club.

One of my proudest possessions is a little blue postcard with the picture of a slightly tubby man looking up through a telescope. Walter Scott Houston wrote a deep sky column for Sky and Telescope for 46 years. I met Twinky years ago at a meeting of the Riverside Astronomers. He was a delightful person. Why the postcard? He wrote me to tell me how much he enjoyed my column on Barnard's ring that I wrote for the PVAA'S Nightwatch.

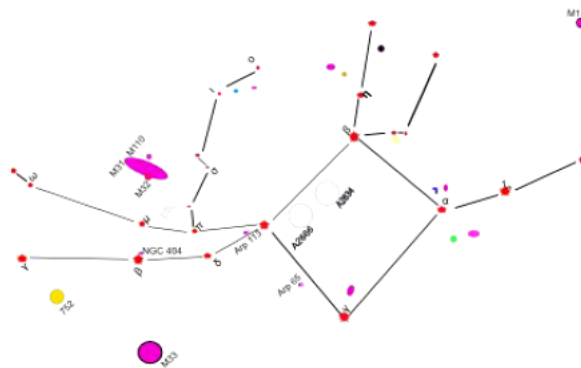
It was typical of Walter to challenge his readers in his "Deep Sky Wonders" column. Someone always responded and Walter would include them in later articles. Two of his challenges were about globular clusters around M31 and counting naked eye stars in the square of Pegasus.

"Within the area of this Square
Argelander counted only about 30
naked-eye stars, but in the clearer sky
of Athens Schmidt saw 102."

Star Names and their Meaning.
1899, **Richard H. Allen**

Pegasus

" The poetic steed With beamy
mane, whose hoof struck out from earth
The fount of Hippocrene. ' **Bryant**



I have never taken up the challenge to count stars in the square of Pegasus. Houston cites several accounts from his correspondents. In one a correspondent reports 38 stars, in another, a correspondent took special care in his preparations and reported seeing down to magnitude 8.3. Perhaps even more stunning, he writes that there are 100 deep sky object within reach of the larger amateur telescope within the square. Sadly, Scotty isn't here for our revolution in astrophotography, but I am sure he would appreciate the instrumentation and techniques in use today.

An interesting place to start this month is two degrees south of Alpheratz, Alpha α Andromedae, is NGC 1. You will need a 12" or larger scope to see detail on N1; it is a face on 13th magnitude spiral. I've never looked for it, but the images show faint spiral arms and a brighter nucleus. NGC 7840, the last item in the NGC catalogue is just over the boundary into Pisces about 20 degrees further south.

Houston, using the references he had at the day, decided that NGC 7840 was an error and that NGC 7839 was a faint >15th galaxy. Current references name NGC 7839 as a double star.

We have one Messier, three Caldwell objects, one Arp object, and a couple of galaxies Burnham thought we should look at in Pegasus. We also have two Abell clusters and a slew of double and multiple stars in Pegasus.

Up near the top of the square are two Abell galaxy clusters: Abell 2666 and Abell 2634. The clusters are far flung and its not easy to pick out individual members, though each has an anchor galaxy that we can find. Abell 2634 has NGC 7720. N7720 is a 12th magnitude elliptical with a very close background galaxy giving it a double appearance. Abell 2666 also has a large elliptical, NGC 7768, also 12th magnitude with a scattering of smaller galaxies around it. Images you can use as finders can be found on the internet. APOD has a particularly nice Abell 2666 in March, 2017 and Simbad has a terrific NGC 7720 with scattered galaxies all around.

George Abell has two catalogues named after him. He used the Palomar sky survey plates to identify galaxy clusters of a particular size and red shift. His later catalogue is of planetary nebula and was also compiled from the Palomar plates with additions from his own and others observations.

NGC7814 is also *Adam Block/Mount Lemmon SkyCenter/University of Arizona*, number 43 on the Caldwell list. It looks like the Sombrero, though not as bright at 11th magnitude. You can find it in the left hand corner of the square about 2 degrees from Algenib, Gamma, γ , meaning a wing tip. It has decent dimensions, 5' across and half that thick.

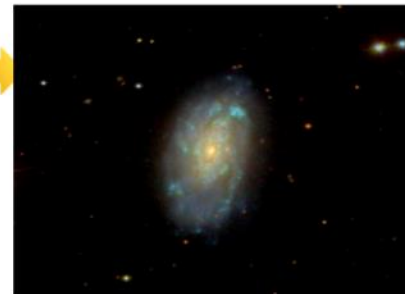
Move next to the other side of the square to Alpha, α , Markab, meaning Saddle. At 2.5 degrees, a medium Telrad circle from Markab, you will find NGC 7448, a rather small tilted spiral odd enough to find a itself #13 in Arp's catalogue. Its bright at 11th magnitude, but wonder of wonders it is right next to a cluster of galaxies, of 12th and 13th magnitude, dominated by NGC 7463. You may also be able to put NGC 7464 and NGC 7465 in the same field. N7463 was named a galaxy of the month. Go to the Webb Deep Sky page for a finder chart. *Sloan Digital Sky Survey*



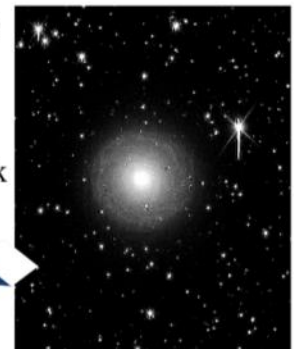
NGC 7479 is also number 44 on the Caldwell list. Its 11th, almost 12th magnitude with wild sweeping arms and a frenetic nucleus. It is also just a degree away from Palomar 13, 13th magnitude and a real ghost. Look up the APOD 2003 Christmas image of Pal 13. That bright star is 7th or 8th magnitude so it would be easily visible in your finder.



NGC 7448

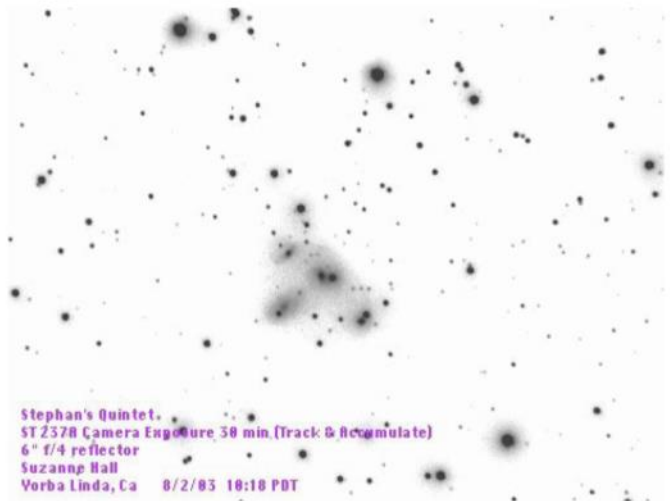


Up by the left knee of Pegasus are several deep sky objects made famous over the years. Start by finding Eta η Pegasi. Before you head up to NGC 7331 and Stephan's Quintet, move to your east and look for NGC 7217. It is at 11th magnitude, but it is such a tightly wound spiral you probably won't see a trace of the arms. Check out the image taken by **OCA astronomer Chuck Edmonds** back in 2005 as an example of what I mean. https://ocastronomers.org/user_images/ngc-7217/



West of Chuck Edmonds's beautiful image of NGC 7217 is the NGC 7331 group including (probably) Stephan's Quintet consisting of NGC 7317 through NGC 7320. NGC 7318 is an A and B which brings the count up to 5.

This awesome image of Arp 213/Stephan's Quintet was taken by Suzanne Hall of the OCA back in 2003. I massaged the image slightly to bring out the nebosity around the galaxies.



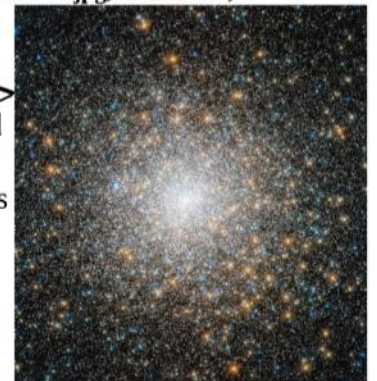
The image of NGC 7331 and its companion galaxies NGC's 7337, 7335 and 7340 can be found in the OCA gallery. It was taken on November 26, 2013 and is unattributed



Credit: NASA, ESA <http://www.spacetelescope.org/images/heic1321a/> <http://www.spacetelescope.org/static/archives/images/large/heic1321a.jpg>, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=29625944>

<https://esahubble.org/images/heic1321a/>

M15 is awesome. It is almost visible to the naked eye, its 6th magnitude and a fuzzy star in your 7x50's, pretty decent in your 4" APO, and blows out in a 13.1 Dob. Scientifically it's a beast. That bright nucleus is a collapsed core of thousands of stars. It has blue new stars, golden older stars and a planetary nebula. Check out the Hubble link then go look at it in your eyepiece.

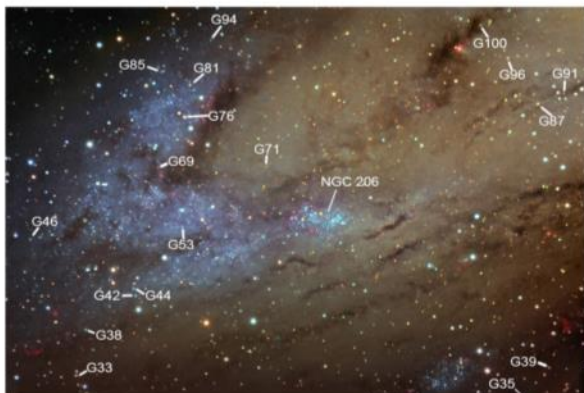


Sidney Hall - Urania's Mirror - Pegasus and Equuleus



This image of M31, M32, m110 and NGC 206 was taken last month at the Dark Sky Festival in Joshua Tree by Rick (Speedy) Gonzalez. Rick is a member of the Temecula Valley Astronomers and is, as you see, a very accomplished amateur astrophotographer.

<https://skyandtelescope.org/online-gallery/globular-clusters-in-m31/>



Another query that seemed to interest Scotty was the number of globular clusters around M31 that could be seen visually. He had correspondents who were able to identify a couple with instruments as small as a 6" Newtonian. One gentleman with a 12.5" homemade Newtonian was able to observe all 15 that had been cataloged at that time.

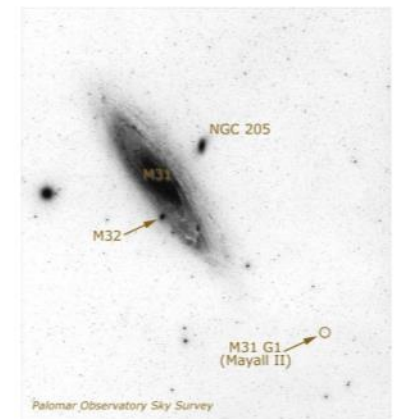
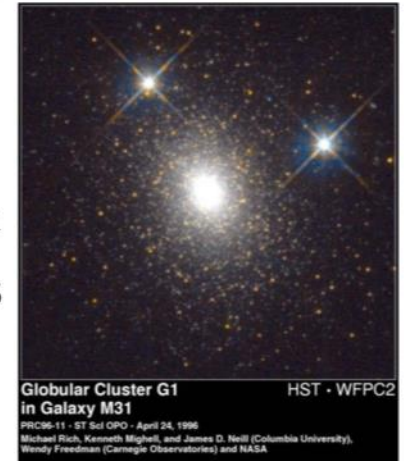
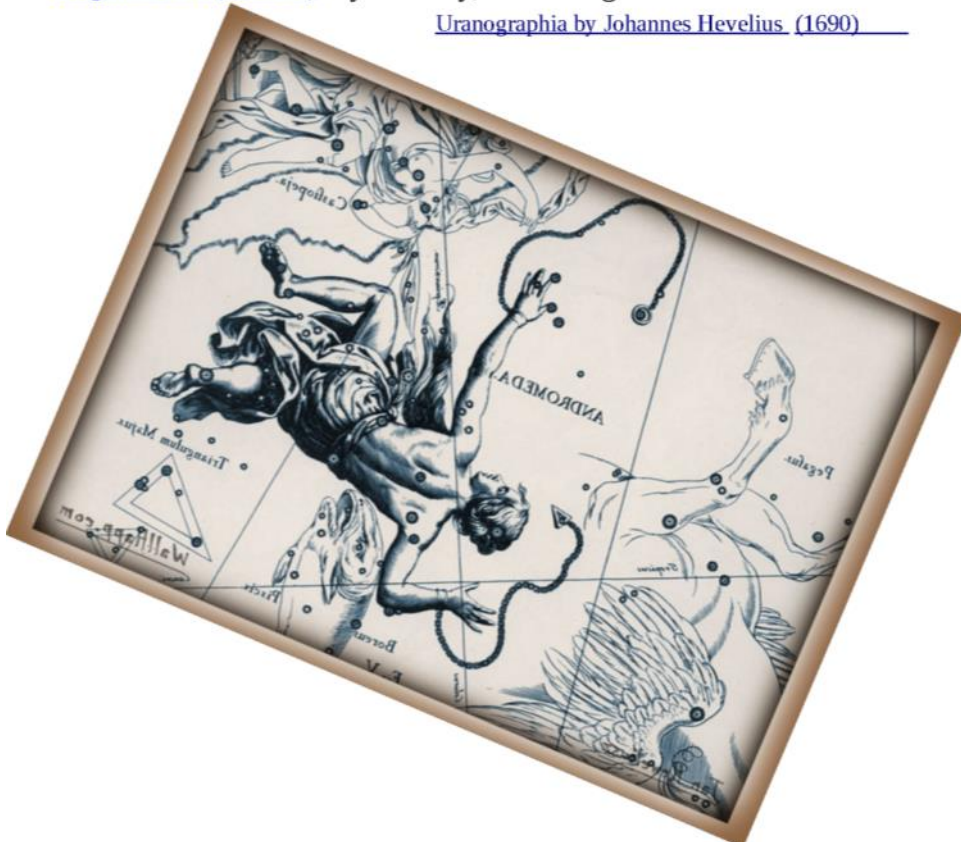
Early last century Edwin Hubble and Walter Baade compiled a catalog of 250 possible globular clusters around M31. The suspects were cataloged with HB numbers. Now the globulars are simply noted with a G(#) and a magnitude. There are plenty of web pages that will show the location of M31 globulars. A good one to start with is the link to: [Imgur: The magic of the Internet](#). Also check out [Cosmic Challenge: Globular clusters in M31 - Phil Harrington's Cosmic Challenge - Articles - Articles - Cloudy Nights](#).

I don't know what list Scotty was using back in the 70's. I could not find any reference to a HB catalog. There are dozens of globulars that are a part of the M31 gravity sink, some dwarf galaxies are even as far as Cassiopeia; the most famous of which is M110. Two dwarf galaxies that are worth looking for are just across the boundary into Cassiopeia. NGC 147 Caldwell 17 and NGC 185 Caldwell 18 are two 10th magnitude dwarf galaxies orbiting M31. Another good reference to extra-galactic clusters is the Sky and Telescope link: <https://skyandtelescope.org/sky-and-telescope-magazine/extragalactic-globular-clusters/>

I have never looked for G1, NGC 224-G1, also known as Mayall II. It is the brightest of the extra-galactic clusters and the first found by Nicholas Mayall and O.J. Eggen in 1953 off of a plate from the Schmidt.

Your 8" can find it but probably as a fuzzy dot. The specs tell us that the 14" can resolve .33". G1 is .28" so your everyday 14" Schmidt-Cass should spread it out a bit. Steve Gottlieb of Sky and Tel. Has compiled an Excel spreadsheet of the 75 brightest M31 globulars. You will find it at [M31GC-Brightest75.xls \(live.com\)](#). By the way, Gottlieb gives a dimension of 36" to G1.

[Uranographia by Johannes Hevelius \(1690\)](#)



(Hevelius' Andromedae has been manipulated to mimic correct sky orientation)
[Sobiescianum hi-res stock photograph images - Alamy \(1690\)](#)

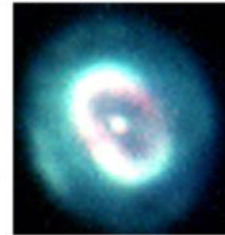
Another astronomy hero of mine, a friend, is Joe Neu. Joe lives up in Idyllwild and has been an amateur astronomer his whole life. Joe worked for Coulter Instruments up until the founder, Jim Jacobson died. Joe's favorite galaxy is NGC 4565, a spectacular edge on galaxy in Coma Berenices. We have our own beautiful edge-on galaxy in Andromeda. Its NGC 891 and Caldwell 23. Its 10th magnitude and almost 14 minutes-of-arc long. [Chuck Edmonds & Bill Hall](#) have both produced excellent images of NGC 891. Control-Click on their name to be taken to the OCA website.

Our other Caldwell object is NGC 752, Caldwell 28. It is a big sprinklings of bright stars some naked eye bright. Its an old cluster, easily seen with you 7x50's. Using your binoculars are good. When I pointed the 17 at it it blew right through it.

There is a fun galaxy to look for next in the same neighborhood. Go to second magnitude Beta β Andromedae, Mirach, which means the Girdle. Easily making the same field as β is NGC 404, an 11th magnitude face on spiral that can be difficult unless you move β out of your eyepiece. Its fairly big, almost 4x4 minutes. Take your time, I would like to see any image you take.

You are going to enjoy NGC's 752, 892 and 404. Starting at β and moving along the left to Gamma γ Andromedae, Almach, Arabian for desert lynx. γ is a beautiful, bright double star of golden and blue colors. It is not that far from Alberio, so you can check them out together. γ B, the smaller, blue companion is also a multiple star system with a 5th and 6th companions and even a couple orbiting γ C2. This is also interesting because Almach is your finder for NGC752 and NGC891. While in the area you can slip across the boundary line into Perseus and find M34, another open star cluster with interesting components. I remember two bright stars shining out of its middle.

On the other hand, the left hand of the "Hevelius" Andromedae is defined by the naked eye stars ι Iota, κ Kappa, λ Lambda and, \omicron Omicron. Three of which can be seen on the Hevelius rendering. These stars are your finder for NGC 7662, Caldwell 22 and nicknamed the Blue Snowball, its 8th magnitude, but tiny in your smaller telescope, belying its nickname. This image was taken by another OCA

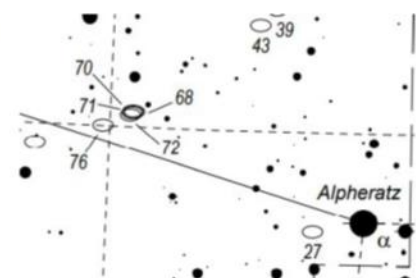
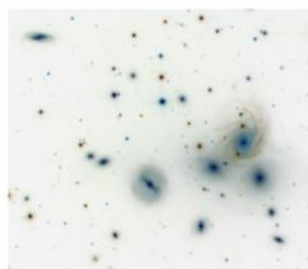


astrophotographe, Arnie Roser. Copy and paste his address to find his image or just Ctrl-Click on the hyperlink. <https://ocastronomers.org/wp-content/uploads/2019/01/n7662-01.jpg>

While up near the hand of Andromeda, follow the line made by kappa and lambda to NGC 7686, another open cluster punctuated by a bright 6th magnitude star shining from the middle and several 9th(?) magnitude stars framing the cluster.

Harlan Arp (d. 2013) compiled the [Atlas of Peculiar Galaxies](#) a catalog of unusual galaxies. He was trying to provide other astronomers with images that would help them study galaxies and their evolution. The atlas is especially useful when looking at odd and interacting galaxies, like the two examples in Andromeda.

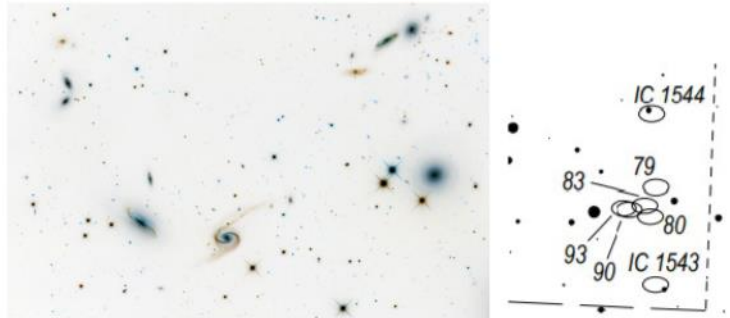
Arp 113 is the NGC 68 group close to Alpheratz on the line to delta δ . NGC 68 is the anchor to Arp 113. It's 12th magnitude while N70 thru 76 fall into the 13th magnitude. NGC 68 is the elliptical at the bottom right of the group. NGC 70 is the spiral above it and the third member if the triangle is NGC 71.



Arp 65 is the NGC 90 group located in the Pisces, Pegasus, Andromeda corner south of Alpheratz. It is anchored by 13th magnitude NGC 90 and the companions range 13th magnitude and lower. NGC 90 is the spiral at the bottom of the image.

Both images credit: Adam Block/Mount Lemmon

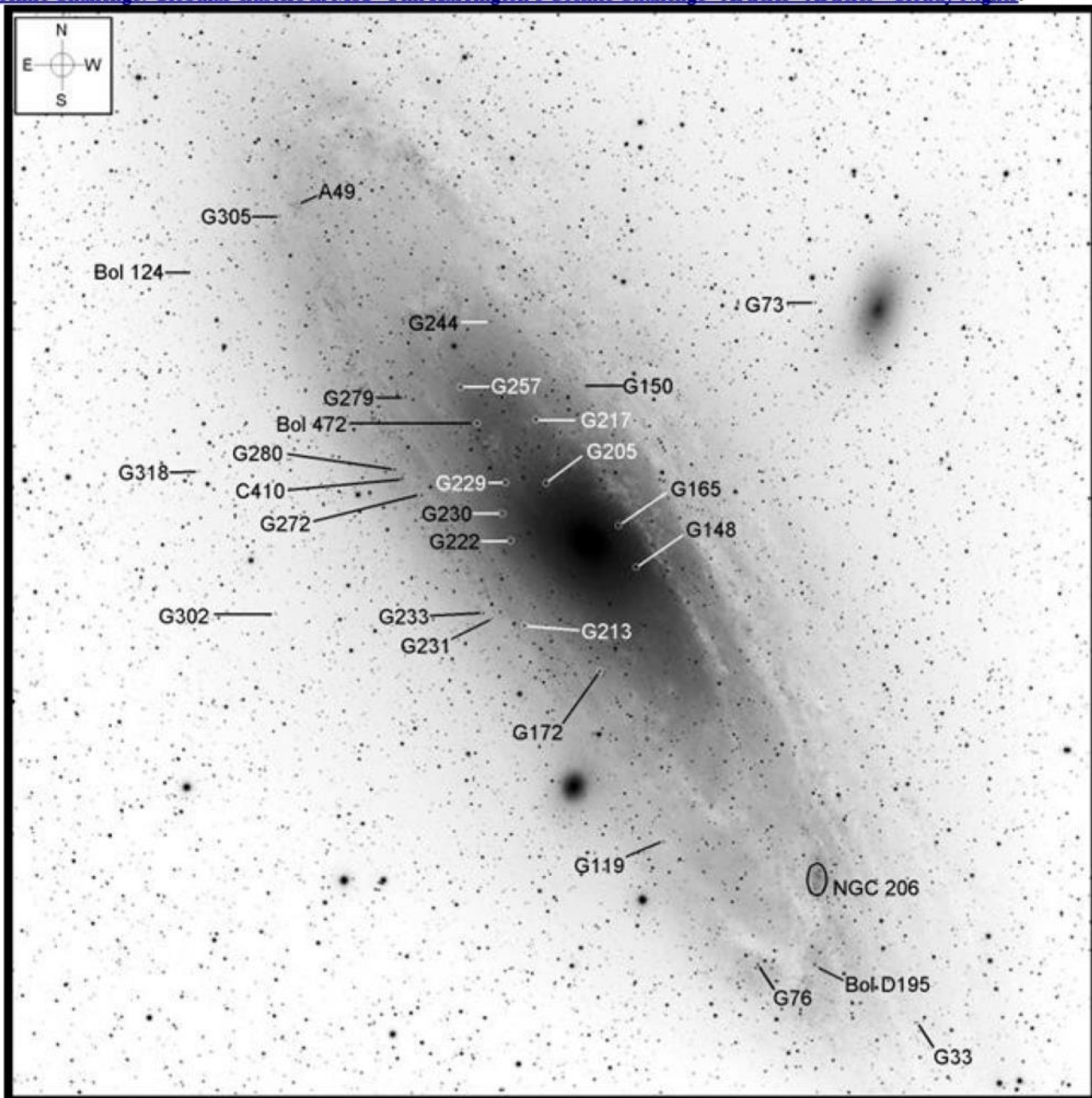
SkyCenter/University of Arizona - <http://www.caelumobservatory.com>



Dark Skies

Dave Phelps

Cosmic Challenge: Globular clusters in M31 - Phil Harrington's Cosmic Challenge - Articles - Articles - Cloudy Nights.





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Cepheus: A House Fit for a King

David Prosper

Sometimes constellations look like their namesake, and sometimes these starry patterns look like something else entirely. That's the case for many stargazers upon identifying the constellation of Cepheus for the first time. These stars represent Cepheus, the King of Ethiopia, sitting on his throne. However, many present-day observers see the outline of a simple house, complete with peaked roof, instead – quite a difference! Astronomers have another association with this northern constellation; inside its borders lies the namesake of one of the most important types of stars in modern astronomy: Delta Cephei, the original **Cepheid Variable**.

Cepheus is a circumpolar constellation for most observers located in mid-northern latitudes and above, meaning it does not set, or dip below the horizon. This means Cepheus is visible all night long and can be observed to swing around the northern celestial pole, anchored by Polaris, the current North Star. Other circumpolar constellations include Cassiopeia, Ursa Major, Ursa Minor, Draco, and Camelopardalis. Its all-night position for many stargazers brings with it some interesting objects to observe. Among them: the "Garnet Star" Mu Cephei, a supergiant star with an especially deep red hue; several binary stars; several nebulae, including the notable reflection nebula NGC 7023; and the "Fireworks Galaxy" NGC 6946, known for a surprising amount of supernovae.

Perhaps the most famous, and certainly the most notable object in Cepheus, is the star **Delta Cephei**. Its variable nature was first discovered by John Goodricke, whose observations of the star began in October 1784. Slightly more than a century later, Henrietta Leavitt studied the variable stars found in the Magellanic Clouds in 1908 and discovered that the type of variable stars represented by Delta Cephei possessed very consistent relationships between their luminosity (total amount of light emitted), and their pulsation period (generally, the length of time in which the star goes through a cycle of where it dims and then brightens). Once the period for a Cepheid Variable (or **Cepheid**) is known, its luminosity can be calculated by using the scale originally developed by Henrietta Leavitt, now called "Leavitt's Law." So, if a star is found to be a Cepheid, its actual brightness can be calculated versus its observed brightness. From that difference, the Cepheid's distance can then be estimated with a great deal of precision. This revolutionary discovery unlocked a key to measuring vast distances across the cosmos, and in 1924 observations of Cepheids by Edwin Hubble in what was then called the Andromeda Nebula proved that this "nebula" was actually another galaxy outside of our own Milky Way! You may now know this object as the "Andromeda **Galaxy**" or M31. Further observations of Cepheids in other galaxies gave rise to another astounding discovery: that our universe is not static, but expanding!

Because of their importance as a "standard candle" in measuring cosmic distances, astronomers continue to study the nature of Cepheids. Their studies revealed that there are two distinct types of Cepheids: Classical and Type II. Delta Cephei is the second closest Cepheid to Earth after Polaris, and was even studied in detail by Edwin Hubble's namesake telescope, NASA's Hubble Space Telescope, in 2008. These studies, along with others performed by the ESA's Hipparcos mission and other observatories, help to further refine the accuracy of distance measurements derived from observations of Cepheids. What will further observations of Delta Cephei and other Cepheids reveal about our universe? Follow NASA's latest observations of stars and galaxies across our universe at nasa.gov.



The stars of Cepheus are visible all year round for many in the Northern Hemisphere, but fall months offer some of the best views of this circumpolar constellation to warmly-dressed observers. Just look northwards! Image created with assistance from Stellarium: stellarium.org.

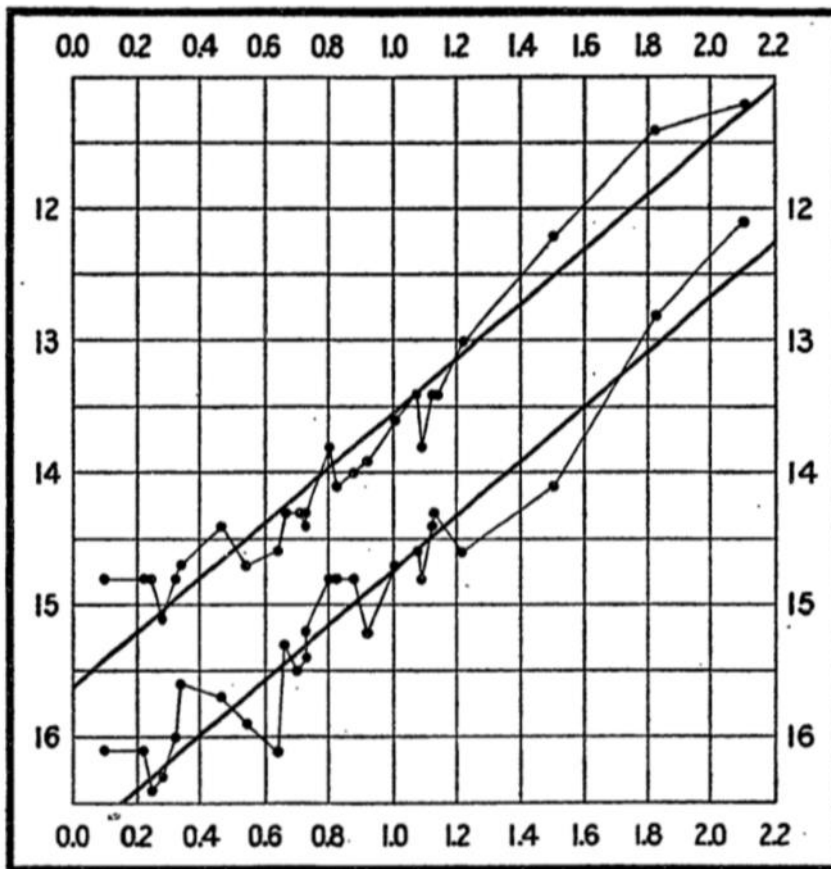


FIG. 2.

This historical diagram from Henrietta Leavitt's revolutionary publication shows the luminosity of a selection of Cepheid Variables on the vertical axis, and the log of their periods on the horizontal axis. The line drawn through these points shows how tight that relationship is between all the stars in the series. From Henrietta Leavitt and Edward Pickering's 1912 paper, "Periods of 25 Variable Stars in the Small Magellanic Cloud," a copy of which can be found at: <https://ui.adsabs.harvard.edu/abs/1912HarCi.173....1L/abstract>