Temecula Valley Astronomer

The monthly newsletter of the Temecula Valley Astronomers Aug 2020

Events:

Virtual meeting via Zoom on 3 August at 7PM. Join your fellow astronomers for What's Up, IFI and a Mission Highlight. Virtual refreshments provided by each participant. Watch your club email for meeting ID and password.

Until we can resume our monthly meetings, you can also interact with your astronomy associates on Facebook or by posting a message to our mailing list.

The Cowherd(Altair) and the Weaver Girl (Vega) – Chinese Folk Tale - Wikipedia

WHAT'S INSIDE THIS MONTH:

Send newsletter submissions to Mark DiVecchio <markd@silogic.com> by the 20th of the month for the next month's issue.

Like us on Facebook

General information:
Subscription to the TVA is included in the annual $25 membership (regular members) donation ($9 student; $35 family).

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Cosmic Comments
by President Mark Baker

Comet NEOWISE… I cannot think of any one object that has held me spellbound for so long a time (excluding my wife, of course!!!)

For over a week, we were up by 4:15am, taking it in… and Deborah got so many great pictures of it every day. And while she was at it, she took DSLR pix of the other objects of interest… one of my favorites is of NEOWISE, Venus, and the Pleiades in one picture!!!

And as of this writing, we are out every evening, showing it off to guests, and Deborah getting in more pictures…this is a memory that will stick with me the rest of my days!!!

I am also positive that I have never provided so much instruction and guidance about any one celestial object either… dozens and dozens of people, intrigued by all the “hub bub”, and curious to take it in for themselves. One young lady tried and tried to catch it, without success, until I suggested she go to an area I know of near her that had a very flat horizon…and sure enough, her efforts were rewarded!!! Her joy was ebullient and effusive…

We even had a good sized group at the South Coast Winery get a great view of it, including several TVA members that hadn’t seen it yet…combined with an ISS fly over, those people all left ecstatic!!!

In this case, Looking Up was its own reward, but I’m glad to associate with you all that do it on a regular basis, comet or no… ooh, the wonders that we see that others miss out on. But it’s not for trying to share…

So, keep looking up, and chatting to all that will listen about doing so themselves… the rewards are lasting and deep!!

Clear, Dark Skies my Friends…

Looking Up Redux
compiled by Clark Williams

from these sources:
SeaSky.org
Wikipedia.com
in-the-sky.org
The American Meteor Society, Ltd.
cometwatch.co.uk
NASA.gov
TVA App (2.0.1296)
FullAndNewMoon App (2.0)
Starry Night Pro Plus 7 (7.6.3.1373)
SkySafari 6 Pro (6.1.1)
Stellarium (0.18.2)
timeanddate.com/astronomy
https://www.fourmilab.ch/earthview/pacalc.html

ALL TIMES ARE LOCAL PACIFIC TIME UNLESS NOTED OTHERWISE

Times are given in 24-hour time as: (hh is hours, mm minutes, ss seconds)
- hh:mm:ss or hhmmss
- hhmm+ (time of the next day)
- hhmm− (time of the previous day)
- hhmm (seconds not shown)
- yyyymmddThhmmss (Full date as: year month day Time separator hours minutes seconds)

Moon Phases for the month by phase:

Tuesday	**the 25th**	**@ 1058 FIRST QTR in SCORPIUS**
Monday	**the 3rd**	**@ 0859 FULL in CAPRICORNI**
Tuesday	**the 11th**	**@ 0945 THIRD QTR in ARIES**
Tuesday	**the 18th**	**@ 1942 NEW in LEONIS**

Apogee comes on 2020-08-09 @ 1352 **– 404,657 km (251,442 mi)**
Perigee comes on 2020-08-21 @ 1100 **– 363,512 km (225,876 mi)**

2020 has: (12) new moons, (13) 1st Qtr moons, (13) Full moons, (12) 3rd Qtr moons
(1) Blue moon and (0) Black moons

Daylight Savings: Starts: 2020-Mar-08 : Ends: 2020-Nov-01

Luna: Luna is waxing gibbous on the 1st of the month. 89.2% illuminated Luna is transiting at **2206** setting by **0328+**. Luna by mid-month is a waning crescent, 21% illuminated. Rising early at **0220** and setting in the afternoon at **1637**. By the-end-of-the-month Luna is again waxing gibbous, 93% illuminated transiting at **2251** and setting by **0355+**.

Highlights: (distilled from**:** **SeaSky.org** and **Clark's planetary Orrey** program[s]**)**

August 3 - Full Moon. The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 15:59 UTC. This full moon was known by early Native American tribes as the Sturgeon Moon because the large sturgeon fish of the Great Lakes and other major lakes were more easily caught at this time of year. This moon has also been known as the Green Corn Moon and the Grain Moon.

August 11, 12 - Perseids Meteor Shower. The Perseids is one of the best meteor showers to observe, producing up to 60 meteors per hour at its peak. It is produced by comet Swift-Tuttle, which was discovered in 1862. The Perseids are famous for producing a large number of bright meteors. The shower runs annually from July 17 to August 24. It peaks this year on the night of the 11th and morning of the 12th. The second quarter moon will block out some of the fainter meteors this year, but the Perseids are so bright and numerous that it should still be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Perseus, but can appear anywhere in the sky.

August 13 - Venus at Greatest Western Elongation. The planet Venus reaches greatest western elongation of 45.8 degrees from the Sun. This is the best time to view Venus since it will be at its highest point above the horizon in the morning sky. Look for the bright planet in the eastern sky before sunrise.

August 19 - New Moon. The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 02:42 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

Algol minima: (All times Pacific Time)

08/01/2020	1659
08/04/2020	1347
08/07/2020	1036
08/10/2020	0725
08/13/2020	0413
08/16/2020	0102
08/18/2020	2150
08/21/2020	1839
08/24/2020	1527
08/27/2020	1216
08/30/2020	0905

All times PDT

Ephemeris data for Sun

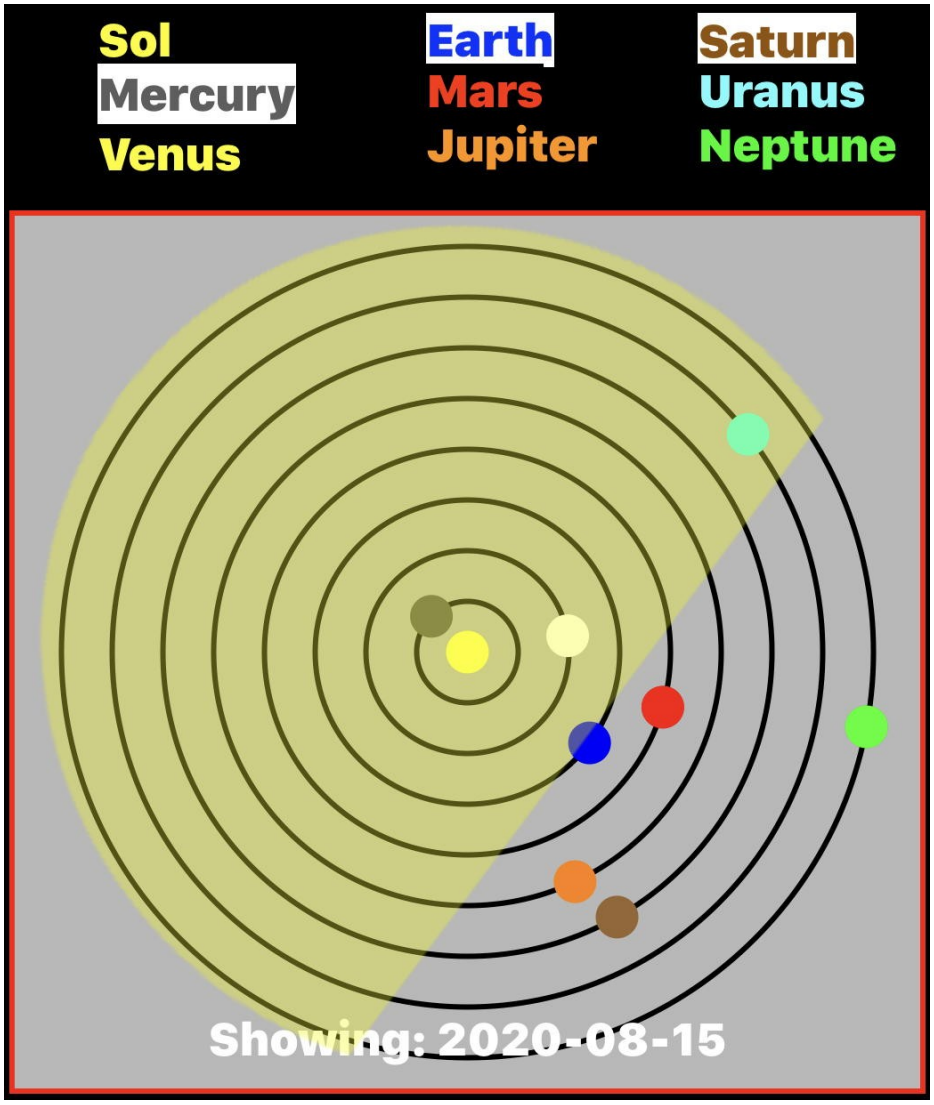
Local Time	Constellation	Rise	Transit	Set	Mag	Distance
08/01/20 06:00 PM	Cancer	06:00:00 AM	12:55:00 PM	07:50:00 PM	-26.86	1.014803401 au
08/02/20 06:00 PM	Cancer	06:00:00 AM	12:55:00 PM	07:49:00 PM	-26.86	1.014669229 au
08/03/20 06:00 PM	Cancer	06:01:00 AM	12:55:00 PM	07:48:00 PM	-26.86	1.014532187 au
08/04/20 06:00 PM	Cancer	06:02:00 AM	12:54:00 PM	07:47:00 PM	-26.86	1.014392288 au
08/05/20 06:00 PM	Cancer	06:02:00 AM	12:54:00 PM	07:46:00 PM	-26.86	1.014249492 au
08/06/20 06:00 PM	Cancer	06:03:00 AM	12:54:00 PM	07:45:00 PM	-26.86	1.014103717 au
08/07/20 06:00 PM	Cancer	06:04:00 AM	12:54:00 PM	07:44:00 PM	-26.86	1.013954848 au
08/08/20 06:00 PM	Cancer	06:05:00 AM	12:54:00 PM	07:43:00 PM	-26.87	1.013802745 au
08/09/20 06:00 PM	Cancer	06:05:00 AM	12:54:00 PM	07:42:00 PM	-26.87	1.013647252 au
08/10/20 06:00 PM	Leo	06:06:00 AM	12:54:00 PM	07:41:00 PM	-26.87	1.013488196 au
08/11/20 06:00 PM	Leo	06:07:00 AM	12:54:00 PM	07:40:00 PM	-26.87	1.013325395 au
08/12/20 06:00 PM	Leo	06:07:00 AM	12:53:00 PM	07:39:00 PM	-26.87	1.013158654 au
08/13/20 06:00 PM	Leo	06:08:00 AM	12:53:00 PM	07:38:00 PM	-26.87	1.012987771 au
08/14/20 06:00 PM	Leo	06:09:00 AM	12:53:00 PM	07:37:00 PM	-26.87	1.012812538 au
08/15/20 06:00 PM	Leo	06:10:00 AM	12:53:00 PM	07:36:00 PM	-26.87	1.012632748 au
08/16/20 06:00 PM	Leo	06:10:00 AM	12:53:00 PM	07:34:00 PM	-26.87	1.012448208 au
08/17/20 06:00 PM	Leo	06:11:00 AM	12:52:00 PM	07:33:00 PM	-26.87	1.012258756 au
08/18/20 06:00 PM	Leo	06:12:00 AM	12:52:00 PM	07:32:00 PM	-26.87	1.012064288 au
08/19/20 06:00 PM	Leo	06:12:00 AM	12:52:00 PM	07:31:00 PM	-26.87	1.011864775 au
08/20/20 06:00 PM	Leo	06:13:00 AM	12:52:00 PM	07:30:00 PM	-26.87	1.011660285 au
08/21/20 06:00 PM	Leo	06:14:00 AM	12:51:00 PM	07:29:00 PM	-26.87	1.011450988 au
08/22/20 06:00 PM	Leo	06:15:00 AM	12:51:00 PM	07:27:00 PM	-26.87	1.011237152 au
08/23/20 06:00 PM	Leo	06:15:00 AM	12:51:00 PM	07:26:00 PM	-26.87	1.011019118 au
08/24/20 06:00 PM	Leo	06:16:00 AM	12:51:00 PM	07:25:00 PM	-26.87	1.010797274 au
08/25/20 06:00 PM	Leo	06:17:00 AM	12:50:00 PM	07:24:00 PM	-26.87	1.010572028 au
08/26/20 06:00 PM	Leo	06:17:00 AM	12:50:00 PM	07:22:00 PM	-26.87	1.010343781 au
08/27/20 06:00 PM	Leo	06:18:00 AM	12:50:00 PM	07:21:00 PM	-26.87	1.010112909 au
08/28/20 06:00 PM	Leo	06:19:00 AM	12:49:00 PM	07:20:00 PM	-26.87	1.009879747 au
08/29/20 06:00 PM	Leo	06:19:00 AM	12:49:00 PM	07:19:00 PM	-26.87	1.009644584 au
08/30/20 06:00 PM	Leo	06:20:00 AM	12:49:00 PM	07:17:00 PM	-26.87	1.009407657 au

All times PDT

Ephemeris data for The Moon

Local Time	Constellation	Rise	Transit	Set	Mag	Distance	Illumination
08/01/20 09:00 PM	Sagittarius	06:43:00 PM	11:48:00 PM	04:53:00 AM	-12.68	382199.4 km	97.59%
08/02/20 09:00 PM	Capricornus	07:32:00 PM	12:43:00 AM	05:54:00 AM	-12.68	386466.5 km	99.66%
08/03/20 09:00 PM	Capricornus	08:14:00 PM	01:35:00 AM	06:55:00 AM	-12.66	390886.6 km	99.52%
08/04/20 09:00 PM	Aquarius	08:51:00 PM	02:23:00 AM	07:54:00 AM	-12.61	395246.3 km	97.33%
08/05/20 09:00 PM	Aquarius	09:23:00 PM	03:07:00 AM	08:52:00 AM	-12.54	399295.0 km	93.31%
08/06/20 09:00 PM	Aquarius	09:53:00 PM	03:49:00 AM	09:47:00 AM	-12.46	402765.8 km	87.71%
08/07/20 09:00 PM	Cetus	10:20:00 PM	04:30:00 AM	10:42:00 AM	-12.36	405399.4 km	80.81%
08/08/20 09:00 PM	Cetus	10:47:00 PM	05:10:00 AM	11:36:00 AM	-12.24	406968.8 km	72.88%
08/09/20 09:00 PM	Pisces	11:15:00 PM	05:51:00 AM	12:31:00 PM	-12.1	407301.5 km	64.17%
08/10/20 09:00 PM	Aries	11:44:00 PM	06:33:00 AM	01:27:00 PM	-11.94	406299.0 km	54.95%
08/11/20 09:00 PM	Taurus	12:16:00 AM	07:18:00 AM	02:24:00 PM	-11.74	403951.5 km	45.45%
08/12/20 09:00 PM	Taurus	12:53:00 AM	08:06:00 AM	03:23:00 PM	-11.51	400348.0 km	35.95%
08/13/20 09:00 PM	Taurus	01:35:00 AM	08:57:00 AM	04:21:00 PM	-11.22	395680.2 km	26.77%
08/14/20 09:00 PM	Gemini	01:35:00 AM	08:57:00 AM	04:21:00 PM	-10.83	390238.2 km	18.27%
08/15/20 09:00 PM	Gemini	02:25:00 AM	09:51:00 AM	05:19:00 PM	-10.3	384395.9 km	10.88%
08/16/20 09:00 PM	Cancer	03:21:00 AM	10:48:00 AM	06:12:00 PM	-9.51	378582.6 km	5.08%
08/17/20 09:00 PM	Cancer	04:25:00 AM	11:45:00 AM	07:01:00 PM	-8.53	373241.7 km	1.35%
08/18/20 09:00 PM	Leo	05:32:00 AM	12:42:00 PM	07:45:00 PM	-8.56	368778.2 km	0.10%
08/19/20 09:00 PM	Leo	06:42:00 AM	01:36:00 PM	08:25:00 PM	-8.58	365504.7 km	1.59%
08/20/20 09:00 PM	Virgo	07:52:00 AM	02:29:00 PM	09:02:00 PM	-9.75	363599.6 km	5.85%
08/21/20 09:00 PM	Virgo	09:02:00 AM	03:21:00 PM	09:36:00 PM	-10.6	363088.5 km	12.67%
08/22/20 09:00 PM	Virgo	10:10:00 AM	04:12:00 PM	10:11:00 PM	-11.17	363858.3 km	21.59%
08/23/20 09:00 PM	Libra	11:19:00 AM	05:03:00 PM	10:47:00 PM	-11.58	365696.3 km	32.00%
08/24/20 09:00 PM	Libra	12:27:00 PM	05:56:00 PM	11:25:00 PM	-11.89	368343.5 km	43.20%
08/25/20 09:00 PM	Ophiuchus	01:34:00 PM	06:51:00 PM	12:08:00 AM	-12.13	371544.4 km	54.55%
08/26/20 09:00 PM	Ophiuchus	02:40:00 PM	07:48:00 PM	12:56:00 AM	-12.3	375082.8 km	65.43%
08/27/20 09:00 PM	Sagittarius	03:42:00 PM	08:45:00 PM	01:49:00 AM	-12.44	378798.1 km	75.35%
08/28/20 09:00 PM	Sagittarius	04:39:00 PM	09:42:00 PM	02:46:00 AM	-12.53	382582.6 km	83.89%
08/29/20 09:00 PM	Capricornus	05:29:00 PM	10:37:00 PM	03:45:00 AM	-12.59	386366.9 km	90.76%
08/30/20 09:00 PM	Capricornus	06:13:00 PM	11:29:00 PM	04:46:00 AM	-12.63	390097.1 km	95.75%

Planets:
Planetary Positions August 2020: (from TVA App iOS version)



- **Mercury:** Mercury is a morning object in the beginning of the month. It is illuminated at 71.29% and -0.85 apparent magnitude. Mercury rises at: **0442** and sets by **1854** with sunset following at **1950**. By mid-month the Winged Messenger has become lost to the glare of the sun. Sunrise will be at **0553**. On the 31st Mercury is an evening object setting at **1953** preceded by sunset at **1916**.
- **Venus:** Is the Morning Star in the beginning of the month, rising at **0245** preceding sunrise at **0600**. On the 13th Venus reaches greatest western elongation of 45.8 degrees from the Sun. By mid-month Venus rises at **0242** followed by Sol at **0610**. By the 31st Venus is rising at **0250**. followed by sunrise at **06021.**
- **Mars:** Mars is rising at **2304** on the 1st of the month, transiting near sunrise. By mid-month Mars is rising at **2350**. End-of-month finds the Warrior rising at **2132**, transiting at **0353**.

- **Jupiter:** Jupiter is back in the sky at a reasonable hour. On the first of the month Jove rising at **1830** and transiting at **2330**. There is a Waxing Gibbous Moon rising at 97% illumination 2° to the east of Jupiter, rising 13 minutes after Jupiter. By mid-month Jupiter is rising at **1729** with no Earth Moon in sight. Saturn is less than 9° to the east of Jupiter. Pluto is less than 4° east of Jupiter. Come the end of month Jupiter is peaking above the horizon by **1623**. However the Moon is Waxing gibbous at 99% illumination. But you'll have a great grouping of Jupiter, Pluto and Saturn – you just won't be able to see it.
- **Saturn:** Saturn is trailing Jupiter and Pluto; rising about **1858** on the 1st. The moon is only 6° west and Waxing gibbous at 98% illumination. Saturn by mid month is rising by **1759** and is within 8° of Jupiter and 4° of Pluto. Its a good grouping so cameras should be ready and working. By the end-of-the-month Saturn is rising at **1653** and transiting at **2157**. See Jupiter for the Moon interference.
- **Uranus:** On the first Uranus rises at **2352**. The apparent magnitude is 5.78 so we're on the ragged edge of being naked-eye visible. The Astronomer's Bane will be 98% illuminated but 106° to the west so you should be able to eek out a view. Sunrise follows at **0600**. By the ides Uranus is rising at **2258**. End of the month and the "sky god" is rising at **2154** while a Waxing gibbous 99% illuminated Moon glares away 72° to the west.
- **Neptune:** Neptune is leading both Uranus and Mars. Neptune is rising at **2139** in the beginning of the month. There is a 98% illuminated Moon 57° westward of Neptune. You should be able to squeeze in a peek. By the 15th Neptune is rising at **2043** and transiting at **0233+**. By the end of the month Neptune is rising at **1939**. The Moon is 22° westward with 89% illumination.
- **Pluto:** On the first of the month Pluto is lost to the glare of them Moon. By mid-month Pluto is rising by **1748** and is very close to Jupiter . Pluto transits at **2248** (see Jupiter above) but the apparent magnitude 14.29 will make it difficult to see.. By the 31st Pluto is transiting at **2144** but the pesky Moon is right where you do not want it to be, shinning at 97%.

Asteroids:

- Still a dearth of asteroids. I searched for asteroids in 2020 with a reasonable magnitude; say less than or equal to +10 in August there are a few beyond the regulars: Juno, Vesta. Hebe, Eros and Herculina. So consult your local planetarium software for more or try: https://www.asteroidsnear.com/year?year=2020

  (7) Iris Asteroid in Sagittarius 1st -- 31st rising: mag 9.6 – the fourth-brightest object in the asteroid belt.
  (2) Pallas Asteroid in Hercules 1st – 31st rising: mag 9.7 – the second largest asteroid in the inner Solar System and the largest body in the Solar System not to be rounded by its own gravity.
  (129) Antigone Asteroid in Sagittarius 1st – 31st rising: mag 10.3 – orbiting the sun every 4.9 years at an average distance of 2.9 AU. Antigone is a large object at 125km in diameter and is a main belt asteroid orbiting the Sun between Mars and Jupiter.

Meteors:

- August 11, 12 - Perseids Meteor Shower. (See Highlights above)

- See Highlights above for more details. (SeaSky.org) (American Meteor Society)

Comets: come in various classifications:

- 1) Short Period comets – further broken down into:
  - Halley Type: The Halley Types are believe to come from the Kuiper Belt and have periods in excess of 20-years.
  - Jupiter Type: The Jupiter types have a period less than or equal to 20-years.
  - Short period comets August have a near circular orbit or an elliptical orbit. The latter being far more common.
- 2) Long Period comets – thought to originate from the Oort cloud these comets have periods of over 200 years and have random inclinations around the celestial sphere.

ESTIMATES ONLY

Local time 2100 PDT

C/2020 F3 (NEOWOSE)

August 01 Mag: 6.2 Rises: 0925 Sets: 2106 comet in Berenices

August 15 Mag: 8.6 Rises: 1037 Sets: 2321 comet in Virgo

August 30 Mag: 10.7 Rises: 1038 Sets: 2225 comet in Virgo

289P/Blanpain

August 01 Mag: 9.3 Rises: 1031 Sets: 2238 comet in Virgo

August 15 Mag: 9.6 Rises: 1000 Sets: 2156 comet in Virgo

August 30 Mag: 10.0 Rises: 0924 Sets: 2108 comet in Virgo

Deep Sky:
Notes:

L/Z abbreviation for ALT/AZ
R/D abbreviation for Right Ascension/Declination
α is right ascension
δ is declination
In each case, unless otherwise noted, you should look for the following on or about the 15th Day of August 2020 at 2100 PDT and you will have about 20 minutes of viewing time total.

- VdB 26 **EmissionNebula in Taurus**

credit © dcrowson Dan Crowson

- van den Bergh 26 (DG 28, LBN 828 and others) is a reflection nebula illuminated by star HD 26676. The nebula is located closer than 471 light-years away in Taurus. Luminance – 24x600s – 240 minutes – binned 1x1RGB – 10x300s – 50 minutes each – binned 2x2390 minutes total exposure – 6 hours 30 minutesImaged February 15th, 16th, 17th, 19th and 24th, 2020 from Dark Sky New Mexico at Rancho Hidalgo (Animas, New

Mexico) with a SBIG STF-8300M on an Astro-Tech AT12RCT at f/8 2432mm.LRGB - https://www.flickr.com/photos/dcrowson/49653526861/sizes/l/

- **M77**

© 2020 Peter Goodhew FRAS – StDr-1; Equipment: APM TMB 152 LZOS Refractors10Micron GM2000 HPS mountQSI6120wsg8 cameras; Exposure: Astrodon Blue: 17x300" Astrodon Green: 18x300" Astrodon Red: 18x300" Astrodon Lum: 21x300" Astrodon OIII: 8x1800s bin 3x3 As – ***Used by permission.***

- **Messier 77** or **M77**, also known as **NGC 1068**, is a barred spiral galaxy about 47 million light-years away in the constellation Cetus. Messier 77 was discovered by Pierre Méchain in 1780, who originally described it as a nebula. Méchain then communicated his discovery to Charles Messier, who subsequently listed the object in his catalog. Both Messier and William Herschel described this galaxy as a star cluster. Today, however, the object is known to be a galaxy.

  The morphological classification of NGC 1068 in the De Vaucouleurs system is (R)SA(rs)b, where the '(R)' indicates an outer ring-like structure, 'SA' denotes a non-barredspiral, '(rs)' means a transitional inner ring/spiral structure, and 'b' says the spiral arms are moderately

wound. Ann et al. (2015) gave it a class of Saa, suggesting a non-barred spiral galaxy with tightly wound arms. However, infrared images of the inner part of the galaxy reveal a prominent bar feature not seen in visual light, and for this reason it is now considered a barred spiral. (Wikipedia)

August is great for both viewing and imaging. Spend some time outside with your scope. Summer is here.

For now – Keep looking up.

The Other George Ellery Hale (Part II)
by Chuck Dyson

Back to Hale and Mt. Wilson.

By the time Hale gets to Mt. Wilson there is a chartered toll road company, The Mt. Wilson Toll Road Co., that has made the trail into a four foot wide graded road and is developing the Mt. Wilson area into a resort destination. They think an observatory would be a big draw. The toll road company gives Hale free land for the observatory and free use of the toll road. Compared to the Harvard people Hale has it easy. Hale wastes no time in developing the site. Hale, it turns out, is not only an effective fund raiser he is also a contract writer par excellence and the Snow telescope is his to do with as he sees fit, when Hale goes to Mt. Wilson the scope does too. While installing the Snow solar scope on the mountain in 1905 Hale also builds a small roll off roof observatory for E. E. Barnard who brings his astrophotography gear to continue working on photos of the milky way for his seminal book "An Atlas of Selected Regions of the Milky Way" Barnard is terrified to be alone on the mountain and his notes are full of his concerns of being eaten by mountain lions or bitten by a snake. Nevertheless, Barnard takes forty of the fifty photos that will comprise his book on the mountain. Barnard will work on his book until his death in 1923 and then others will finish the two book set and publish it in 1927, today a first edition copy of the two book set in poor condition will go for $4,500 and a copy in good condition will fetch $8,500, it is that good.

In 1906 with work started on the observatory and mount for the 60 inch mirror, Hale orders the casting of the 100 inch mirror blank, this guy is not wasting any time. In 1907 a 1907 Franklin motor car leaves Pasadena and drives to the summit of Mt. Wilson. It is the first car to do so, I just put this in for the car buffs.

In 1908 two monumental events occur. The first is the 60 inch telescope sees first light and although it is the worlds largest operational telescope it is not the largest, the nonfunctional Leviathan of Parsonstown at Birr castle in England is 72 inches, nor is it the only 60 inch mirror. Andrew Ainslie Common buys two 60 inch glass blanks that he intends to configure and for various reasons fails and drops the project. After his death in 1903 the blanks and other equipment are sold to Harvard University and transported to America where they are figured and put into operation, it looks like the Harvard motto is "if you cannot beat Hale at least keep up with him". In 1933 the operational mirror is re-figured, given a new mount and then shipped to, you guessed it, the Harvard Boyden observatory in South Africa. It is actively used for research until the 1960's.

The second great event of 1908 is a result of Hale's repeated failed attempts to get the Snow to operate at the quality level that he needs for his research. Despite his frustrations of not being able to eliminate or greatly reduce the thermal issues that plague the scope, Hale, with Walter Adams, is able to measure the rotational speed of the sun and is able to show that it does not rotate as a solid body but as a gaseous body. The sun's rotation period at the equator is 25 days but at the poles it is 36 days. Hale is also able to get some spectrographic detail from the Snow images and notes that the line strengths are different over the sunspots when compared to the rest of the sun. A team of researchers at the Troop physics lab is able to show

that the line strength differences are because sunspots are cooler than the rest of the solar surface. But the image distorting air currents generated by the Snow telescope will not let Hale go any further than this. Hale decides if horizontal solar scopes won't cooperate fully with him the he will try vertical solar scopes and the 60 foot solar tower is constructed. The author requests that the reader remember that at the same time funding for the solar towers is being sought, Hale is also arranging funding for the 100 inch mirror project.

As-soon-as the 60 foot tower is fully operational it is evident that a vertical tower is vastly superior to any horizontal solar scope and Hale almost immediately makes his first great discovery with the new solar scope. Every element has a unique set of absorption lines and these lines are only several wavelengths of light wide, so we see them as a very narrow, sharp dark line lines but when they go through a strong magnetic field they split into three bands. When Hale sees the spectral lines split over sunspots he knows that the that the sunspots are areas of strong magnetic activity as well as being cooler than the average sun surface temperature. Hale is also able to see doppler shifts in the spectral lines in different areas. Spectral shifts occur when the object that emitting the photons of light are moving toward or away from you; Hale can now measure the speed of the winds, the temperature, and the magnetic field strength of different areas of the sun.

Is Hale happy? No! Hale realizes that with an even bigger scope he could do so much more. Time to go after more donors. In 1912 the iconic Mt. Wilson 150 foot solar tower becomes operational; this will be the worlds largest solar tower until 1962 and with it Hale will earn the title of "sunspot wizard" by discovering that sunspots come in pairs and like magnets one spot is positive and the other is negative and if the leading sunspot in the northern solar hemisphere is positive then the leading spot in the southern hemisphere is negative. Hale also discovered that at the end of the eleven year sunspot cycle the polarity of the north and south sunspots reversed themselves and so an entire solar cycle was 22 years this is also called a Hale cycle.

Even after Hale's death groundbreaking solar research continued at Mt. Wilson until the Carnegie Institute, for financial reasons, withdrew its funding of the mountain in 1985. On the lighter side of science, the history of Mt. Wilson also mentions that in 1915 a billiard table was finally installed in the astronomers dormitory as this was apparently a really big deal.

1917 is actually a really big year for Hale's Mt. Wilson observatory as three major events occurred. The first event was the first daily drawing of sunspots in the 160 ft solar tower and this would continue until 2004. That is 87 years of sunspot history. The second event was Harlow Shapley, using the 60 inch reflector, published his seminal paper on the distances to globular clusters. What's the big deal you ask? I'll tell you. Prior to Shapley's paper, we had no idea how big our galaxy is and had no means to measure it. Henrietta Leavitt, who was working at Harvard and cataloging stars as to brightness and color, noticed that some stars were variable and a few of the variables were regularly variable. In 1904, Leavitt publishes her first paper noting that there appears to be a relationship between the star's period and its absolute brightness. Leavitt then focuses on the Small Magellanic Cloud because she reasons that this small irregular collection of 6.5 billion stars is far enough from us that the differences in the stellar distances from each other is very small compared to the total distance of the stars from us, good thinking Henrietta. At Harvard Leavitt has access to all of the photographic

plates coming from those wandering telescopes, including the 60 inch reflector, at the Boyden observatory in South Africa. Using the 60 inch reflector and with the Small Magellanic Cloud "only" 199,000 light years from us, Leavitt is able to identify and measure the light curves of 25 Cepheid variables and indeed there is a very tight correlation between the cycle period and the absolute brightness of the star. The paper is submitted in 1912 and in 1913, the Cepheid variable is recognized as a valid distance measuring technique, astronomers have a new "standard candle".

Using this new "standard candle" Shapley postulates if globular clusters are uniformly distributed around the galaxy and they have Cepheid variables in them he will be able to determine the galaxy's size and our place in it. Shapley was successful in his search for Cepheid variables and correct in his assumption. At the end of his study we knew the size of the galaxy, 100,000 light years in diameter, the center of it, in the constellation Sagittarius, and our place in it, 25,000 light years from the center.

The third and almost final 1917 event was on the night of November 1st the 100 inch telescope sees first light; this will be the world's largest telescope until January 26 1949 when the 200 inch Palomar scope sees first light. I say the 100 inch first light may be the last 1917 great event because another item is still under investigation. In 2014 a professor at UCLA preparing a talk on irregular white dwarf stars notes that a star identified in the 1917 survey of white dwarfs conducted by Mt. Wilson is a very highly irregular star and asks the astronomers at the Carnegie Institute, who has the original photo plate of the star, to take a fresh look at the plate and low and behold there is strong circumstantial evidence that there is a planet orbiting the star, but because the planet has not yet been confirmed we can only say that this could be 1917's fourth great event.

As-soon-as the bugs, and there are always bugs, in the 100 inch scope are worked out, Hale and Albert Michelson, of speed of light measuring fame, build a 20 foot long beam with mirrors on each end to create a high resolution interferometry pattern and with this pattern they are able to determine the actual physical of stars, Betelgeuse is the first of many. Stars are now real physical objects and not just points of light in telescopes.

In 1920 as Hale and Michelson are working on measuring stellar sizes, there is a new kid, who has joined the staff in 1919, looking over their shoulders, Edwin Hubble. When he gets his hands on the 100 inch, scope he goes looking for Cepheids in what are called nebulae because many think that these are gas clouds in our galaxy condensing into planetary nebulae that then go on to form new solar systems. Hubble thinks that they are other galaxies and he is looking for Cepheids in them. In 1923 he finds and verifies his first variable star in the Andromeda nebula, but it is not until 1925 that he has enough data to publish, this is really hard work at the edge of what is just possible. Overnight we go from a universe with one galaxy and objects a hundred thousand light years away to a universe with many galaxies hundreds of millions of light years away, just a little scary.

In 1923, with declining health, Hale retires from Mt. Wilson and Caltech but is still active in fund raising projects of all sorts. I say this because Hale had cajoled his pal Henry Edwards

Huntington into making his gardens and art and library a public trust and today we know this little place as the Huntington Gardens.

Hale realizes two things; the first is that light from Los Angeles is slowly brightening the skies over Mt. Wilson and secondly there is a great need for an even bigger telescope than the 100 inch one. The “retired” Hale goes to work. First he gets San Diego county to agree to build a road to the very remote and dark location of Palomar mountain, it helps to understand just how remote this place was if you know that in 1925 the population of the city of San Diego was only 100,000 people. Hale then convinces the Carnegie Institute to fund the mirror part of the project and as it is 1928 and at the height of the roaring 20’s the stock market is way up and everyone has plenty of money why not. One year later the stock market has crashed and no one has any money. Although Hale’s funding is secure, he realizes that now is not the time to run a big publicity campaign telling people in soup lines how much money you have to construct a grand new telescope; therefore, work on the project progresses but quietly and slowly. In 1934 Caltech purchases 120 acres on the mountain and in 1936 the mirror blank is finally delivered to the Caltech optics lab. Hale will die in 1938 and because of World War II, work on the mirror and the mountain will be halted until 1945. Mt Wilson in the 1930’s will be where Fritz Zwicky will discover that galaxies are moving much to fast to be in stable clumps unless there is extra matter that we cannot see, dark matter. In the 1940’s Walter Baade, with the help of war time blackouts of Los Angeles, will discover the different types of star populations in our galaxy. With the end of the war and the rapid growth of the city and increasing light pollution Mt. Wilson’s days were truly numbered. On January 26 1949, Edwin Hubble takes the first photograph with the 200 inch telescope, he chooses NGC 2261 also known as Hubble’s Variable nebula, modest to the end that Hubble.

How did the staff of Mt. Wilson, after being the premier observatory in the world from 1908 to 1949, take to becoming number two? Over the door to the machine shop on Mt. Wilson there is a sign and it says “*I do not give a damn how they do it at Palomar*” - enough said.

Tycho Brahe built his Uraniborg, star city, but he was so nasty to the local people that when he left, under pressure from the king, the locals destroyed his Uraniborg completely. Hale built three Uraniborgs and they are all still standing and working in science and public outreach, a better legacy I think.

Cheers, Chuck

Technical note: If you are a stickler for detail, you may be wondering if the original road up Mt. Wilson was only four feet wide and wagon widths are generally six feet, or more, how did the wagons not slide off the road? Simple, the Mt. Wilson wagons were built with two foot wide beds and steerable back wheels to make the tight curves. Small loads and many trips were the order of the day.

Summer Triangle Corner: Deneb
by David Prosper

The Summer Triangle is high in the sky after sunset this month for observers in the Northern Hemisphere, its component stars seemingly brighter than before, as they have risen out of the thick, murky air low on the horizon and into the crisper skies overhead. Deneb, while still bright when lower in the sky, now positively sparkles overhead as night begins. What makes Deneb special, in addition to being one of the three points of the Summer Triangle? Its brilliance has stirred the imaginations of people for thousands of years!

Deneb is the brightest star in Cygnus the Swan and is positioned next to a striking region of the Milky Way, almost as a guidepost. The ancient Chinese tale of the Cowherd (Niulang) and the Weaver Girl (Zhinü) - represented by the stars Altair and Vega - also features Deneb. In this tale the two lovers are cast apart to either side of the Milky Way, but once a year a magical bridge made of helpful magpies – marked by Deneb – allows the lovers to meet. Deneb has inspired many tales since and is a staple setting of many science fiction stories, including several notable episodes of *Star Trek.*

Astronomers have learned quite a bit about this star in recent years, though much is still not fully understood – in part because of its intense brightness. The distance to Deneb from our Sun was measured by the ESA's Hipparcos mission and estimated to be about 2,600 light years. Later analysis of the same data suggested Deneb may be much closer: about 1,500 light years away. However, the follow-up mission to Hipparcos, Gaia, is unable to make distance measurements to this star! Deneb, along with a handful of other especially brilliant stars, is too bright to be accurately measured by the satellite's ultra-sensitive instruments.

Deneb is unusually vivid, especially given its distance. Generally, most of the brightest stars seen from Earth are within a few dozen to a few hundred light years away, but Deneb stands out by being thousands of light years distant! In fact, Deneb ranks among the top twenty brightest night time stars (at #19) and is easily the most distant star in that list. Its luminosity is fantastic but uncertain, since its exact distance is also unclear. What is known about Deneb is that it's a blue-white supergiant star that is furiously fusing its massive stocks of thermonuclear fuel and producing enough energy to make this star somewhere between 50,000 and 190,000 times brighter than our Sun if they were viewed at the same distance! The party won't last much longer; in a few million years, Deneb will exhaust its fuel and end its stellar life in a massive supernova, but the exact details of how this will occur, as with other vital details about this star, remain unclear.

Discover more about brilliant stars and their mysteries at nasa.gov.

Long exposure shot of Deneb (brightest star, near center) in its richly populated Milky Way neighborhood. Photo credit: Flickr user jpstanley.

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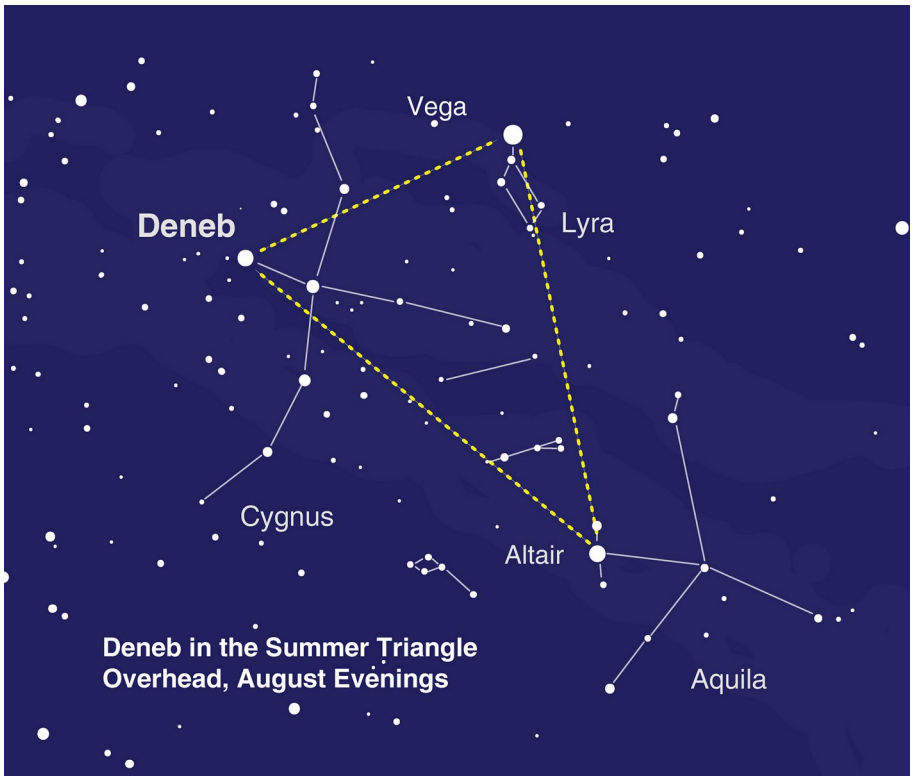

Spot Vega and the other stars of the Summer Triangle by looking straight up after sunset in August!

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