Temecula Valley Astronomer

The monthly newsletter of the Temecula Valley Astronomers Oct 2020

Events:

Virtual meeting via Zoom on 5 October at 7PM. Join your fellow astronomers for What's Up, IFI and a Mission Highlight. 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.

Blue Moon 31 July 2015 - But it's not Blue????

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.

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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

September seems to be the month wherein George Ellery Hale received a lot of attention, some wanted and some maybe not…!!!

First off, the Yerkes Observatory north of Chicago has officially been rescued from the wrecking ball and will be operated as a non-profit museum going forward… hard to believe there were other considerations on the table. The 40 inch refractor was the world's largest at the time and opened the door for future "bigger is better" telescopes… and made several contributions to the science of its own.

Secondly, the Mt Wilson Observatories were saved from destruction by the stalwart efforts of firefighters, letting the flames get no closer than 500 feet… both the 60 inch Carnegie and 100 inch Hooker telescopes were the biggest telescopes in the world at the time of their construction, and both were instrumental in creating and developing the science of Cosmology. We advanced light years, literally, in our understanding of the Cosmos through the use of these instruments and the associated astronomers…

And it was all due to the vision and persistence of that one man, George Ellery Hale… yes, he had a lot of help in building the four largest and most effective telescopes in the world, but he was the catalyst that made it so. His crowning achievement, which he never saw completed, is of course, the 200 inch (5.1 meter) Hale Telescope at CalTech Palomar Observatories…

So whether it is good news or an anxious moment that brings his name to the forefront, all credit is fully deserved… and we haven't even talked about him being the preeminent solar astronomer of his time, the Father of Astrophysics, or the co-founder of CalTech!!! Thanks you, George…your legacy continues to bear fruit to this day.

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:

Thursday	**the 1st**	**@ 1406 FULL in CETUS**
Friday	**the 9th**	**@ 1740 THIRD QTR in GEMINI**
Friday	**the 16th**	**@ 1232 NEW in VIRGO**
Friday	**the 23rd**	**@ 0624 FIRST QTR in CAPRICORNUS**
Saturday	**the 31st**	**@0750 FULL in ARIES – BLUE MOON**

Apogee comes on 2020-10-03 @ **1724 – 406,319 km (252,475 mi)**
Perigee comes on 2020-10-16 @ **2348 – 356,912 km (221,775 mi)**
Apogee comes on 2020-10-30 @ **1847 – 406,392 km (252,520 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 Full on the 1st of the month. Luna is transiting at **2348** setting by **0453+**. Luna by mid-month is one day before New at 111% illuminated. Rising early at **0225** and setting in the at **1719**. By the-end-of-the-month Luna is again Full transiting by **0118+**.

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

October 1 - **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 **1406**. This full moon was known by early Native American tribes as the Hunters Moon because at this time of year the leaves are falling and the game is fat and ready to hunt. It has also been known as the Travel Moon and the Blood Moon. This full moon is also known as the Harvest Moon. The Harvest Moon is the full moon that occurs closest to the September equinox each year.

October 1 - **Mercury at Greatest Eastern Elongation.** The planet Mercury reaches greatest eastern elongation of 25.8 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the evening sky. Look for the planet low in the western sky just after sunset.

October 7 - **Draconids Meteor Shower**. The Draconids is a minor meteor shower producing only about 10 meteors per hour. It is produced by dust grains left behind by comet 21P Giacobini-Zinner, which was first discovered in 1900. The Draconids is an unusual shower in that the best viewing is in the early evening instead of early morning like most other showers. The shower runs annually from October 6-10 and peaks this year on the the night of the 7th. The second quarter moon will ensure dark skies in the early evening for what should be a good show. Best viewing will be in the early evening from a dark location far away from city lights. Meteors will radiate from the constellation Draco, but can appear anywhere in the sky.

October 13 - **Mars at Opposition**. The red planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Mars. A medium-sized telescope will allow you to see some of the dark details on the planet's orange surface.

October 16 - **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 **1232**. 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.

October 21, 22 - **Orionids Meteor Shower.** The Orionids is an average shower producing up to 20 meteors per hour at its peak. It is produced by dust grains left behind by comet Halley, which has been known and observed since ancient times. The shower runs annually from October 2 to November 7. It peaks this year on the night of the 21st and the morning of of the 22nd. The waxing crescent moon will set before midnight leaving dark skies for what should be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Orion, but can appear anywhere in the sky.

October 29, 30 - **Southern Taurids Meteor Shower.** The Southern Taurids is a long-running minor meteor shower producing only about 5-10 meteors per hour. This shower is, however, famous for producing a higher than normal percentage of bright fireballs. The Southern Taurids is produced by debris left behind by Comet 2P Encke. The shower runs annually from September 10 to November 20. It peaks this year on the the night of the 29th and morning of the 30th. The nearly full moon will block out all but the brightest meteors this year. If you are patient, you may still be able to catch a few good ones. Best viewing will be just after midnight from a dark location far away from city lights. Meteors will radiate from the constellation Taurus, but can appear anywhere in the sky.

October 31 - **Full Moon**, **Blue 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 **0751**. Since this is the second full moon in the same month, it is sometimes referred to as a blue moon. This rare calendar event only occurs every few months, giving rise to the term "once in a blue moon".

October 31 - **Uranus at Opposition.** The blue-green planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view Uranus. Due to its distance, it will only appear as a tiny blue-green dot in all but the most powerful telescopes.

Algol minima: (All times Pacific Time)

10/03/2020	2159
10/06/2020	1537
10/09/2020	1225
10/12/2020	0914
10/15/2020	0603
10/18/2020	0252
10/20/2020	2340
10/23/2020	2029
10/26/2020	1718
10/29/2020	1407

All times PDT

Ephemeris data for Sun

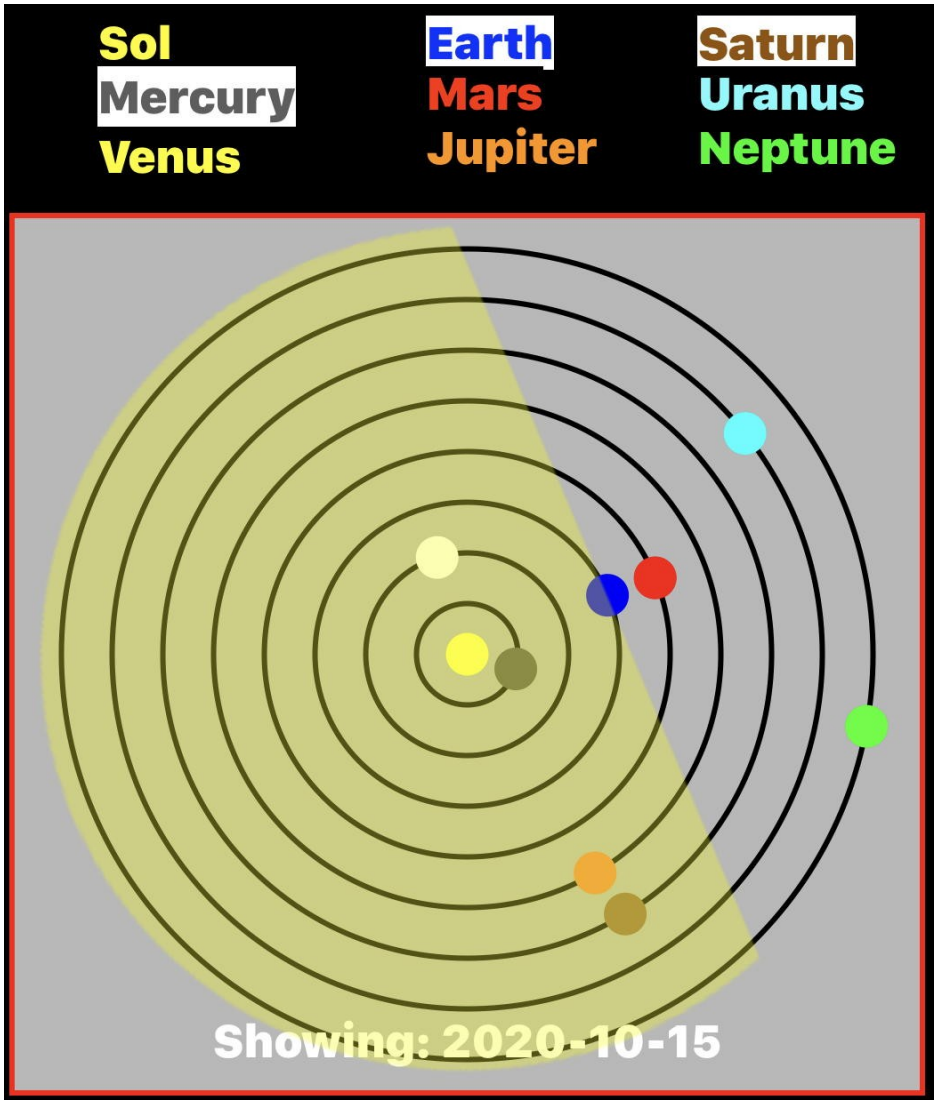
Local Time	Const.	Rise	Transit	Set	Distance
20201001T210000	Virgo	0642	1238	1833	1.000842361 au
20201002T210000	Virgo	0643	1237	1832	1.000556357 au
20201003T210000	Virgo	0643	1237	1831	1.000271293 au
20201004T210000	Virgo	0644	1237	1829	0.999987177 au
20201005T210000	Virgo	0645	1237	1828	0.999703982 au
20201006T210000	Virgo	0646	1236	1827	0.999421650 au
20201007T210000	Virgo	0646	1236	1825	0.999140091 au
20201008T210000	Virgo	0647	1236	1824	0.998859181 au
20201009T210000	Virgo	0648	1235	1823	0.998578770 au
20201010T210000	Virgo	0648	1235	1822	0.998298673 au
20201011T210000	Virgo	0649	1235	1820	0.998018684 au
20201012T210000	Virgo	0650	1235	1819	0.997738575 au
20201013T210000	Virgo	0651	1234	1818	0.997458119 au
20201014T210000	Virgo	0652	1234	1817	0.997177114 au
20201015T210000	Virgo	0652	1234	1815	0.996895415 au
20201016T210000	Virgo	0653	1234	1814	0.996612970 au
20201017T210000	Virgo	0654	1234	1813	0.996329841 au
20201018T210000	Virgo	0655	1233	1812	0.996046210 au
20201019T210000	Virgo	0656	1233	1811	0.995762364 au
20201020T210000	Virgo	0656	1233	1810	0.995478662 au
20201021T210000	Virgo	0657	1233	1808	0.995195504 au
20201022T210000	Virgo	0658	1233	1807	0.994913295 au
20201023T210000	Virgo	0659	1233	1806	0.994632431 au
20201024T210000	Virgo	0700	1232	1805	0.994353278 au
20201025T210000	Virgo	0701	1232	1804	0.994076173 au
20201026T210000	Virgo	0701	1232	1803	0.993801417 au
20201027T210000	Virgo	0702	1232	1802	0.993529278 au
20201028T210000	Virgo	0703	1232	1801	0.993259988 au
20201029T210000	Virgo	0704	1232	1800	0.992993743 au
20201030T210000	Libra	0705	1232	1759	0.992730704 au
20201031T210000	Libra	0706	1232	1758	0.992470993 au

All times PDT

Ephemeris data for The Moon

Local Time	Const	Rise	Transit	Set	Distance	Illumination
20201001T210000	Cetus	1852	0106	0722	402768.7 km	99.68%
20201002T210000	Pisces	1919	0146	0817	404034.0 km	98.23%
20201003T210000	Cetus	1946	0227	0912	404688.1 km	95.04%
20201004T210000	Aries	2016	0309	1008	404625.7 km	90.25%
20201005T210000	Taurus	2048	0354	1104	403735.4 km	83.99%
20201006T210000	Taurus	2125	0441	1201	401920.8 km	76.44%
20201007T210000	Taurus	2207	0531	1257	399124.3 km	67.81%
20201008T210000	Gemini	2256	0623	1351	395350.7 km	58.33%
20201009T210000	Gemini	2350	0717	1442	390690.4 km	48.26%
20201010T210000	Cancer	0051	0812	1528	385335.3 km	37.96%
20201011T210000	Cancer	0156	0906	1610	379585.7 km	27.85%
20201012T210000	Leo	0156	0906	1610	373841.1 km	18.47%
20201013T210000	Leo	0305	0959	1648	368570.9 km	10.42%
20201014T210000	Virgo	0414	1052	1725	364259.9 km	04.34%
20201015T210000	Virgo	0525	1144	1800	361335.9 km	00.82%
20201016T210000	Virgo	0637	1237	1836	360092.6 km	00.24%
20201017T210000	Libra	0749	1332	1914	360630.7 km	02.69%
20201018T210000	Libra	0903	1429	1956	362839.2 km	07.93%
20201019T210000	Ophiuchus	1015	1529	2042	366423.8 km	15.48%
20201020T210000	Sagittarius	1124	1629	2134	370971.3 km	24.69%
20201021T210000	Sagittarius	1128	1730	2231	376028.1 km	34.90%
20201022T210000	Sagittarius	1325	1808	2331	381169.1 km	45.49%
20201023T210000	Capricornus	1413	1923	0032	386045.6 km	55.96%
20201024T210000	Capricornus	1454	2013	0132	390408.0 km	65.89%
20201025T210000	Aquarius	1529	2100	0231	394108.1 km	74.96%
20201026T210000	Aquarius	1601	2143	0327	397086.7 km	82.89%
20201027T210000	Pisces	1629	2225	0422	399352.0 km	89.49%
20201028T210000	Cetus	1656	2305	0517	400954.1 km	94.58%
20201029T210000	Pisces	1722	2345	0611	401959.6 km	98.02%
20201030T210000	Cetus	1749	0026	0706	402429.0 km	99.70%
20201031T210000	Aries	1808	0108	0702	402399.3 km	99.59%

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



- **Mercury:** Mercury is an evening object in the beginning of the month. It is illuminated at 59% and 0.07 apparent magnitude. Mercury rises at: **0849** and sets by **1931** with sunset preceding at **1833**. It also is at Greatest Eastern Elongation. By mid-month the Winged Messenger sets at **1854**, preceded by sunset at **1815**. On the 31st Mercury has become a morning object rising at **0610** followed by sunrise at **0706**.
- **Venus:** Is the Morning Star in the beginning of the month, rising at **0331** preceding sunrise at **0642**. By mid-month Venus rises at **0354** followed by Sol at **0652**. By the 31st Venus is rising at **0422**. followed by sunrise at **0706.**
- **Mars:** Mars is rising at **2128** on the 1st of the month, transiting at **0139+**. There is a Full moon just 13.5° to the west however so viewing is going to be difficult. On the 13th Mars is in opposition and won't look this good again until 2035. Image! Image! Image! By mid-month Mars is rising at **2033** on the eve of a New moon, Mars transits just 27 minutes after midnight

and doesn't set until just before sunrise. End-of-month finds the Warrior rising early afternoon at **1552**, transiting at **2207**. and not setting until **0423**. There is a Full moon 29° to the East of Mars.

- **Jupiter:** On the first of the month Jove rising at **1422** and transiting at **1922**. There is a Full Moon 89° to the east of Jupiter. Jupiter sets by **0021+**. By mid-month Jupiter is transiting at **1831** with no Earth Moon in sight. Saturn is about 6.5° to the east of Jupiter. Pluto is at 3° 27' to the east of Jupiter and Jupiter, Pluto and Saturn make a lovely little triangle in the sky. Come the end of month Jupiter is transiting by **1737**. The Moon is Full but it is a full 113° to the east of Jupiter so you may get some imaging.. You'll have a great grouping of Jupiter, Pluto and Saturn. Jupiter sets at **2238**.
- **Saturn:** Saturn is trailing Jupiter and Pluto; rising about **1449** on the 1st. The moon is Full and 77° east of Saturn. Saturn by mid month is rising by **1355**. You'll have a good grouping of Saturn, Pluto and Jupiter by **1925**, so cameras should be ready and working. By the end-of-the-month Saturn is rising at **1256** and transiting at **1759**. See Jupiter for the Moon interference.
- **Uranus:** On the first Uranus rises at **1950**. The Astronomer's Bane will be Full to the west so you may not be able to eek out a view. By the ides Uranus is rising at **1854** and transiting at **0135+**. End of the month and the “sky god” is rising at **1649** while a Full Moon glares away 7° to the east. However Uranus is at opposition on this Halloween night and if you are in rural dark skies you can even find its two brightest moons Titania and Oberon (magnitudes 13.9 and 14.1, respectively. Sky & Telescope suggests you use 250× or greater to pull these wonderful objects out of the glow of Uranus. Catch this in your bag list as you will be among the very few humans to have waked the earth and to have seen these two moons. You'll need something with at least 254mm (10 inches) aperture to pull off this feat. Worth every effort to pull this off.
- **Neptune:** Neptune is leading Uranus. Neptune is rising at **1735** in the beginning of the month. There is a Full Moon 24° eastward of Neptune. By the 15th Neptune is transiting at **2228** and not setting until **0416+**. By the end of the month Neptune is transiting at **2024**. The Moon is 7° eastward with 99% illumination.
- **Pluto:** On the first of the month Pluto is lost to the glare of them Moon. By mid-month Pluto is transiting by **1846** and is about half-way between Saturn and Jupiter (see Jupiter above) but the apparent magnitude 14.39 will make it difficult to see.. By the 31st Pluto is transiting at **1744** and not setting until **2244** but the pesky Full Moon is 112.5° eastward will be a pain.

Asteroids:

- Still a dearth of asteroids. I searched for asteroids in 2020 with a reasonable magnitude; say less than or equal to +10 in October 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

(1) Ceres Dwarf Planet in Aquarius 1st -- 30th rising: mag 7.7 – is the largest and most massive asteroid in the inner Solar System.
(2) Pallas Asteroid in Hercules 1st – 30th rising: mag 10.0 – 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 – 30th rising: mag 11.1 – 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:

- The Orionids are a result of earth passing through the detritus from Halley's (rhymes with valley, not hey-lee) Comet. The meteor shower will peak this year on the 21st of October.You should be ale to see from 12 to 15 meteors per hour. You'll need very dark skies and a comfy hammock for best viewing.

- 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 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

11P/Temple-Swift-LINEAR F3 (NEOWOSE)

October 01 Mag: 9.8 Rises: 1557 Sets: 0717+ comet in Pegasus

October 15 Mag: 9.2 Rises: 1517 Sets: 0613+ comet in Pegasus

October 30 Mag: 9.0 Rises: 1450 Sets: 0506 comet in Pegasus

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 October 2020 at 2100 PDT and you will have about 20 minutes of viewing time total.

- Caldwell 9

By Hewholooks - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=11434547

Sh2-155 (also designated Sharpless 155 or S155) is a diffuse nebula in the constellation Cepheus, within a larger nebula complex containing emission, reflection, and dark nebulosity. It is widely known as the Cave Nebula, though that name was applied earlier to

Ced 201, a different nebula in Cepheus. Sh2-155 is an ionized H II region with ongoing star formation activity, at an estimated distance of 725 parsecs (2400 light-years) from Earth. (Wikipedia)

- **Draco Dwarf**

NASA

- The Draco Dwarf is a spheroidal galaxy which was discovered by Albert George Wilson of Lowell Observatory in 1954 on photographic plates of the National Geographic Society's

Palomar Observatory Sky Survey (POSS).[5] It is part of the Local Group and a satellite galaxy of the Milky Way galaxy. The Draco Dwarf is situated in the direction of the Draco Constellation at 34.6°[6] above the galactic plane. (Wikipedia)

October is great for both viewing and imaging. Spend some time outside with your scope. Fall is here and Mars and Uranus are in opposition – what could be better?

For now – CAVU, calm winds and keep looking up.

Caveat Emptor! But Still Buy the Binoculars

by Chuck Dyson

Caveat Emptor is Latin for "buyer beware!" or buyer know that after you buy it even if it is defective you still own it. I will explain the reasoning behind the title later but for now let's look at why I want to talk about binoculars at all.

In an article that I read on "*how to reach out to an audience*" the author stated that if you talk of things that you can see with your eyes you reach virtually 100% of the audience, if you talk about things that you can see with binoculars you reach about 50% of your audience, but if you talk about things you can see with a telescope you only reach about 25% of your audience. My goals for this paper will be to convince the 50% that have a pair of binoculars that you need more than one pair and to convince the 50% that don't have even one pair to buy that first pair.

"*Price is what you pay, value is what you get*" truer words were never spoken. Value, though, is not only the quality of the product but also how useful it is to you. I have always found binoculars to be really useful as they are great travel companions, up to a certain size, they just love going in my suitcase and yes I also have acquired a suitcase friendly tripod that is just tall enough to be astronomy use friendly and this combination is as about as a compact and travel friendly observatory as you can get.

Before we get into how to buy a binocular let us take a little look at the history of binoculars.

In 1608 when Hans Lippershey presented the Dutch officials with his patent request for the telescope, a device for seeing objects far away as if they were near, the officials said "*you know we are at war with most of Europe and a binocular seeing device would be better*" and in 1609 Herr Lippershey had a working model of a binocular; so, the binocular is at most only two years younger than the telescope. The first binoculars were actually two telescopes just bolted together by a rigid bridge, no adjusting for various intra pupillary distance here folks. The other "advantage" of binoculars was you got to look through two telescopes with narrow fields of view and very blurry edges, the edges being the outer 1/3 of the lens.

But, as binoculars became more popular, and the wars continued, improvements started to appear. The first was in 1684 when Christian Huygens put two pieces of lens glass in a separate tube and made a compound lens eyepiece, this eyepiece was only a little better at controlling chromatic aberration and giving the viewer a wider field of view but it was a start. This eyepiece design can still be found today in "toy" telescopes and in student microscopes.

The next advance came at the objective lens end, the big end, of the optical tube, a silk weaver turned optician named John Dollond in 1782 produced the first two element achromatic lens for telescopes and by extension for binoculars; but, the quality of the glass that he had, at this time, limits severely the usefulness of his design.

In 1817 Joseph Von Fraunhofer introduces his version of the achromatic lens and he does not change the design but uses glass of his own formulation, crown and flint, plus the quality of his glass is far superior to any other glass being produced. Because Fraunhofer's glass is so

superior and popular we call this refractor design the Fraunhofer design not the Dollond and everyone, and I do mean everyone, wants to buy his glass. This will prove to be a disaster for England.

In 1849 Carl Kellner designs and markets his Kellner eyepieces. This is a three element eyepiece, and the design is so successful, it is still used in telescopes and binoculars today. Now we are close to the modern binocular but the binocular is still an awkward miniature straight through telescope; fortunately, in 1854 just five years after Kellner's new eyepiece Ignazio Porro comes up with his prism design that allows the light path to be folded inside of the binocular tube and the modern compact binocular is borne.

At the close of the 19th century, 1897, Moritz Hensoldt produces the first commercially successful roof prism design binoculars. The roof prism binocular is harder to manufacture and assemble than the Porro but is a sleeker design and has slowly become a popular design.

As the twentieth century got under way, the world decides in 1914 to stumble headlong and drunkenly into WWI. Several months ago, on one of the astronomy forums, one person was wondering about a pair of antique binoculars that he had bought. The binoculars in question were marked "Made in France" on one barrel and marked "property of the Royal Navy" on the other. One reviewer wrote that this pair of binoculars was pre WWI and, as England was importing around 90% of its optical glass from Germany and in 1914 when war broke out the glass supply was cut off, England was forced to requisitioned all binoculars and telescopes in the country for the military use. 1914 and 1915 were boom years for the English glass business and that antique pair of binoculars were witness and part of an interesting part of history.

Did the English learn a lesson here? Sadly, not entirely. Although I have indicated that the binocular was now in its mature form it still had two major drawbacks. The first was because of the prisms and the need for them to be perfectly aligned for high power viewing, the binocular is best suited for low power viewing, not a huge problem actually but more of a limitation. The second one is that for every air to glass surface that the light encounters in the binocular about 5% is reflected away; so, as more and more glass pieces went inside the binocular the view got better but dimmer, much dimmer. In fact, if 55% of the incident light reached your eyes you had a great pair of binoculars.

One evening as the UCLA staff was saying good-by to yet another young anesthesia resident, I was hoisting a few beers with my friend Werner Flake, a research pharmacist. As we toasted to the young resident's good health, new job, bright future, and anything else we could think of, I mentioned to Werner that I had just bought a Russian finder scope for one of my telescopes that was a redesign of a telescopic sight for an artillery piece. Werner got a faraway look in his eyes and said, "*I just love the Russians*". Now I have worked with and collaborated with several people from across Europe and it is extremely hard to find anyone who even likes Russians let alone loves them, especially Germans. So I asked Werner, who had been "transferred" in 1939 from the university to the Luftwaffe and then in 1941 he was "transferred" to a Wehrmacht panzerjäger (armor-hunter) unit, why he loved the Russians and his reply was

"*The Russian optics were always so bad I always got to shoot first; but, there were so many of them I could never shoot that fast and we lost the war*".

Just like WWI, during WWII, the Germans had a secret optical weapon: optical coatings. Optical coatings greatly reduce the reflection of light at air to glass junctions and "yes" it made a great improvement in the performance of their optics especially when it came to twilight and night vision. In binoculars with optical coatings, up to 95% of incident light will reach your eyes instead of 55%. And except for ED glass, which we will discuss later, this brings us to the to the end of the development of the binocular.

If you get nothing else from this paper I hope that you understand that the average binocular may be small but inside it is still an extraordinarily complex piece of optical equipment. How do you ever find the right binocular for you?

First let's look at you.

All binoculars have two numbers on them i.e. 8 X 42, 10 X 50, 12 X 56 etc. and these numbers indicate the magnification of the binocular X the size of the objective lens (the binocular's big lens) and, yes, if you are interested only in astronomy the bigger the objective lens the more you are going to see at night; but, the heavier the binoculars are going to be, When you start your search for binoculars you may want to go to a store that lets you hold different size binoculars in your hands for several minutes to see just how heavy they become over time. Now you need to be honest with yourself and evaluate how you are going to use the binoculars; astronomy only or astronomy and daytime with some trail hikes thrown in for good measure? My hand held astronomy binoculars are 12 X 56 roof prisms. They are a touch heavy but because I mostly view from my back yard and can brace them on my fence or sit in a chair and brace them from the chair arms, the weight doesn't bother me that much during longer viewing sessions. You should also know that as you increase the magnification you increase the size of the shake that you see and 12 X is the highest magnification that I can reasonably control. So even if I got a lightweight pair of 15 X binoculars I would not be able to control the shaking enough to make them useful. I would not use my pair of 12 X 56 binoculars for day hiking and night viewing but instead a compromise pair of either 8 X 42 or 10 X 42 binoculars is what I would choose.

Arguably the most popular binoculars for astronomy are the 7 X 50 and the 10 X 50 Porro binoculars and in my younger days I could gladly use either for observing, but now, I can only use the 10 X 50. What has changed? I have gotten older and with age my eyes do not dilate as much as they use to. Young eyes, when fully dark adapted, would dilate to 7 millimeters in diameter but my older, over 50, eyes dilate only to 5 millimeters diameter when dark adapted. If we take the two numbers on our binoculars and divide the first into the second the resultant gives us the diameter of the light cone that will be generated by the binoculars at focus. The 10 X 50 binoculars produce a 5 millimeter cone of light and my eyes under very dark conditions will just dilate to this size the 7 X 10's will produce a cone of 7 millimeters and I will never be able to use all of the light. My 12 X 56 binoculars produce a 4.7 millimeter cone so even under less than ideal dark conditions I am still using all the light coming from the binocular.

The last personal thing we should consider is do you wear glasses? If you wear contacts just leave them in and we are good. If you use regular glasses and do not want to be taking them off and on all day or night long you will need at the very least 15 millimeters of eye relief. Eye relief is the distance from the back of the eye lens to the point that the cone of light comes to focus. If the eye relief is less than 15 millimeters with glasses you will never see the entire field of view of the binocular and 15 is the minimum 18 or 20 millimeters is better.

Now that we have looked at you, let us now look at the binocular and this is the fun part.

You should have some idea of what you want to buy; if you do not and want help, and I do mean lots of help, you can go to Best Binocular Reviews web site and dive in. This site has all types of binoculars reviewed and he also has a bit of advice that I really like; he advises that if you have a pair of binoculars that you are comfortable with and like, never get rid of them but always keep them and use them as your reference binoculars when buying a new pair. This way you are comparing the new binoculars against an item of known quality.

How do you judge the quality of the binoculars in the store that you are interested in? To a great degree you cannot and that is the reason for my warning of *caveat emptor* at the start of this paper. To a great degree you are relying on the manufactures desire to protect their good reputations. If you would like a good example of binocular quality, I recommend the Audubon Guide To Binoculars. The Audubon group does a really great job of reviewing 8 X 42 binoculars at all price ranges. The two take-a-ways from this site are that there are solid performing binoculars in the $100 to $500 range, if you know where to look, and if you want superior performing binoculars start at $1000 and go up.

What you can do to evaluate your binoculars in a store is wonderfully outlined in an article by EdZ in the Cloudy Nights Telescope Reviews, Binocular Forum titled: Testing Binoculars in the Store, tricky title. EdZ's article is great and I will summarize but I do recommend that you read it for yourself. Ed recommends:

> First, hold the binoculars in your hands and ask *are they comfortable*?
>
> Second, point the field lens at the ceiling and then at the floor several times, or you can just give them a good shake, and if you hear loose material rattling inside the binoculars reject them.
>
> Third, work the hinge in the binocular's bridge, the focus knob, and eye cup extensions. All should be stiff but have smooth actions, if they are loose or grind then reject this binocular.
>
> Fourth, look into the objective lens. *Do you see bright reflections*? If you do, the anti-reflection coatings are poor or absent, reject. A word about coatings; if the binocular says "**coated**" then only the first and last lens have a single layer of coating and all other lenses have none. If it says "**fully coated**" all lenses have a single coating. If it says "**multi-coated**" then only the first and last lenses have multiple layers of anti-reflective coating and all other lens can have one coat or none and unless the manufacture says which is the case, you cannot know what coating status is. If it says "**fully multi-coated**" then all lens

have multiple layers of coatings. If the coatings are of high quality, this is the best situation. Finally, if you are buying a roof prism binocular for astronomy viewing, you really want it to be fully multi-coated as-well-as having phase coatings of the prisms.

Fifth, you should look into the objective lens with light coming through the binocular and the light cone that you see should be perfectly round. Small irregularities are OK but major deviations from round spell viewing trouble - at the $1,500 price point demand round.

Sixth, hold the binoculars about one foot in front of you and look into the eyepiece. *Is the exit light cone round and evenly illuminated*? Irregular illumination could indicate a low quality glass used in the prism or an undersized prism with holding clips blocking still more light. The cheapest binoculars have BK-7 glass in the prisms the most expensive BAK-4 glass in between. Although the prisms are billed as BAK-4 glass it is actually a proprietary, more cost effective slightly different mix of components that are still billed as BAK-4 that is almost but not quite as good as the original. On some lower cost binoculars manufactures may install undersized prisms, more cost savings, and this will not degrade the image but reduces the light getting to the eyepiece so your 10 X 50 binoculars are actually 10 X 45 binoculars and the image that you see can still very good but just a little dimmer, this is very hard to detect.

Seventh, and finally we put the binoculars to our eyes, pick a target that is on the far side of the store and focus first the left eye side and then the right eye side, different binoculars will do this differently so you need to be clear on just how to do it. After you get focus take the binoculars from your eyes and then bring them back. If you momentarily see two images that then merge the binoculars are not well collimated and will produce the finest of headaches with use, reject. If the binoculars are well collimated then find a straight edge, store signs will often give you straight lines with color differences, and center the line in the eyepiece then move the line to the very edge of the field of view, if the line is sharp and shows no blue color fringing for 70 to 80% of the field of view then that represents a good pair of binoculars. The $1,000 pair of binoculars may go 90% of the way to the edge before the image starts to break down.

In order to get a little perspective and if the store has a display case full of binoculars you could have the sales person get out the cheapest pair and the costliest pair of binoculars and review them at the same time to compare and contrast them, If the binocular you are interested in passes all these tests you can, with some confidence, say yes to the binoculars.

Last thoughts. I mentioned ED glass, and this is a formulation and manufacturing process that reduces the scattering of light not by refraction but by the glass properties itself. The effect of ED glass is to reduce the color fringing that is even present in apochromatic lens arrangements. It is highly touted for birdwatchers who are looking at fine detail in bright light. I bought a pair of ED binoculars and thought they may have produced a sharper image of the moon but I did not notice any other effect. As the cost of ED binoculars is coming down, if you use your binoculars frequently for day viewing you may want it. Most binocular “manufacturers” are just importers of Chinese manufactured binoculars and have no or only a little in house repair facilities. Warranties are most often for one to two years and then you are on your own. Vortex, Oberwerk, Celestron, Meade, and Orion have warranties that are better than most and

have some repair capability once the binocular is out of warranty. Major manufactures: Nikon, Fujinon, Steiner, Zeiss, and others will always stand behind their products. The on line, multi brand retailers, if you are lucky, will stand beside the product and not as far away from it as they can get; so, know that when you buy from them you are own your own as far as the warranty goes. Should your binoculars go out of collimation and are out of warranty, Suddarth Optical Repair of Henryetta, OK at suddarthoptical.com can help you and he does repair work too. There is no reason to buy binoculars if you do not know what to look at. Gary Seronik to the rescue with his book Binocular Highlights available on Amazon. It has the best star maps and explanations of how to find things that I have seen. Now get out and OBSERVE!

Cheers, Chuck

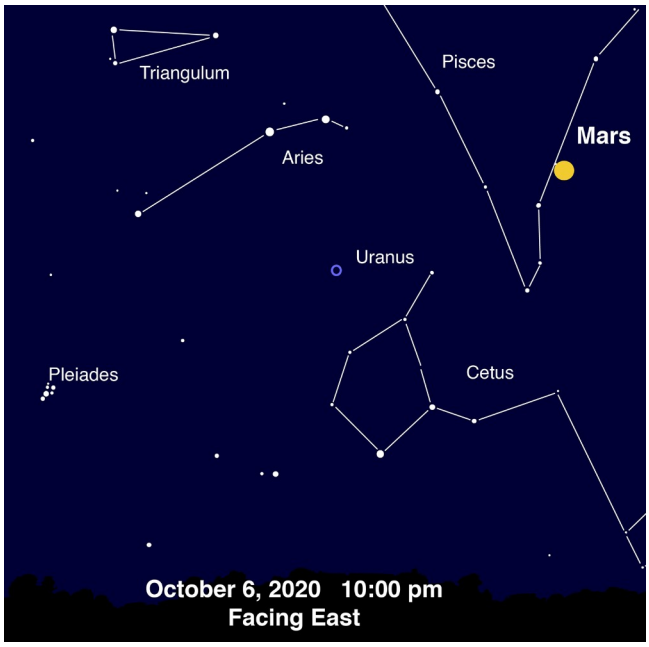
P.S. If there is someone in your life that you have a burning desire to bring low and make their life unbearable, I have the answer to how you may accomplish your dark desire. Buy and then give them a pair of zoom binoculars. All zoom binoculars are the work of the devil. Rather than producing viewing pleasure they produce viewing frustration and migraines of biblical proportions. All kidding aside Zoom binoculars are never, ever a binocular that you should buy.

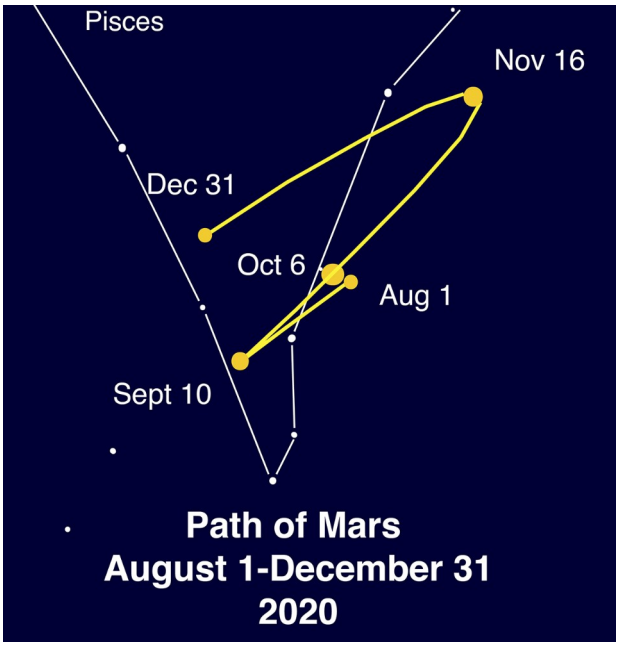
Observe the Skies Near Mars
by David Prosper

October is a banner month for Mars observers! October 6 marks the day Mars and Earth are at closest approach, a once-every-26-months event. A week later, on October 13, Mars is at opposition and up all night. Mars is very bright this month, and astronomers are eager to image and directly observe details on its disc; however, don't forget to look at the space around the planet, too! By doing so, you can observe the remarkable retrograde motion of Mars and find a few nearby objects that you may otherwise overlook.

Since ancient times, Mars stood out to observers for its dramatic behavior. Usually a noticeable but not overly bright object, its wandering path along the stars showed it to be a planet instead of a fixed star. Every couple of years, this red planet would considerably flare up in brightness, for brief times becoming the brightest planet in the sky before dimming back down. At these times, Mars would also appear to slow down its eastward motion, stop, then reverse and head westward against the stars for a few weeks, before again stopping and resuming its normal eastward movement. This change in the planet's movement is called "apparent retrograde motion." While all of the planets will appear to undergo retrograde motion when observed from Earth, Mars's retrograde appearances may be most dramatic. Mars retrograde motion in 2020 begins on September 10, and ends on November 16. You can observe its motion with your eyes, and it makes for a fun observing project! You can sketch the background stars and plot Mars as you observe it night after night, or set up a photographic series to track this motion. Does the planet move at the same rate night after night, or is it variable? As you observe its motion, note how Mars's brightness changes over time. When does Mars appear at its most brilliant?

NASA has tons of great Mars-related resources! Want to know more about apparent retrograde motion? NASA has an explainer at: bit.ly/marsretromotion. Find great observing tips in JPl's "What's Up?" videos: bit.ly/jplwhatsup. Check out detailed views with NASA's HiRISE satellite, returning stunning closeups of the Martian surface since 2006: hirise.lpl.arizona.edu. NASA's Curiosity Rover will be joined in a few months by the Perseverance Rover, launched in late July to take advantage of the close approach of Mars and Earth, a launch window that opens two years: nasa.gov/perseverance. Calculate the ideal launch window yourself with this handy guide: bit.ly/marslaunchwindow. The Night Sky Network's Exploring Our Solar System handout invites you to chart the positions of the planets in the Solar System, and NSN coordinator Jerelyn Ramirez recently contributed an update featuring Mars opposition! You can download both versions at bit.ly/exploresolarsystem. Young astronomers can find many Mars resources and activities on NASA's Space Place: bit.ly/spaceplacemars. Here's to clear skies and good seeing for Mars's best appearance until 2033!





(left) If you are paying this much attention to Mars, you're likely curious about the skies surrounding it! Find Mars in the constellation Pisces, with constellations Aries, Triangulum, and Cetus nearby. Aries may be the only one of these dimmer patterns readily visible from light-polluted areas. The Pleiades rises shortly after Mars. Dim Uranus is found close by, in Aries. If you are observing Mars up close, use the same eyepiece to check out Uranus's tiny blue-green disc. If you are uncertain whether you spotted Uranus, you didn't see it! Unlike stars, Uranus doesn't resolve to a point at high magnifications.

(right) The path of Mars during the last five months of 2020. Notice the retrograde motion from September 10 to November 16, with prime Mars observing time found in between. October 6 is the day of closest approach of Earth and Mars, "just" 38.6 million miles apart. Images created with help from Stellarium: stellarium.org

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The TVA is a member club of The Astronomical League.