Nightfall

Monthly publication of the Huachuca Astronomy Club

July 2013

President's Notes

With our HAC president and vice president away, it falls upon the secretary to pen this month's notes. I can't decide if the lack of events in July and August makes the task easier or harder. Monsoon is a time to make those scope adjustments and observatory repairs and to catch up on your reading. It is not, however, a busy time in terms of club activity. There are no events scheduled for the remainder of July and into August.

July was not totally devoid of opportunities to do a little outreach and promote the club. I had the good fortune to attend the "Rocketry Camp" held at Cochise College for entering 7th and 10th graders. I spoke to them about space exploration and then gave them a tour of the Patterson Observatory. Patterson was also the site of a reception held for area teachers attending a summer workshop. The University South Foundation provided them with some tasty snacks and Bob Hoover treated them to some fleeting views of the sun through the gaps in the clouds. I delivered a short talk on astronomy as a teaching resource and gave them a tour of the observatory. The University South Foundation's table at the Back to School Fair at the Sierra Vista Mall introduced scores of people to the Patterson Observatory, the club and the NASA Space Place.

September will see the clouds dissipate and the club return to full vigor. We should mark the end of monsoon with our next public night at the Patterson on September 12th.

Next Meeting

Our next meeting will be held on July 26 at 7pm, in the community room of the Student Union Building at Cochise college. Our own Tom Kaye will be the speaker.
Tom's talk is entitled Dinosaurs, Gamma Ray Bursts and Mass Extinctions

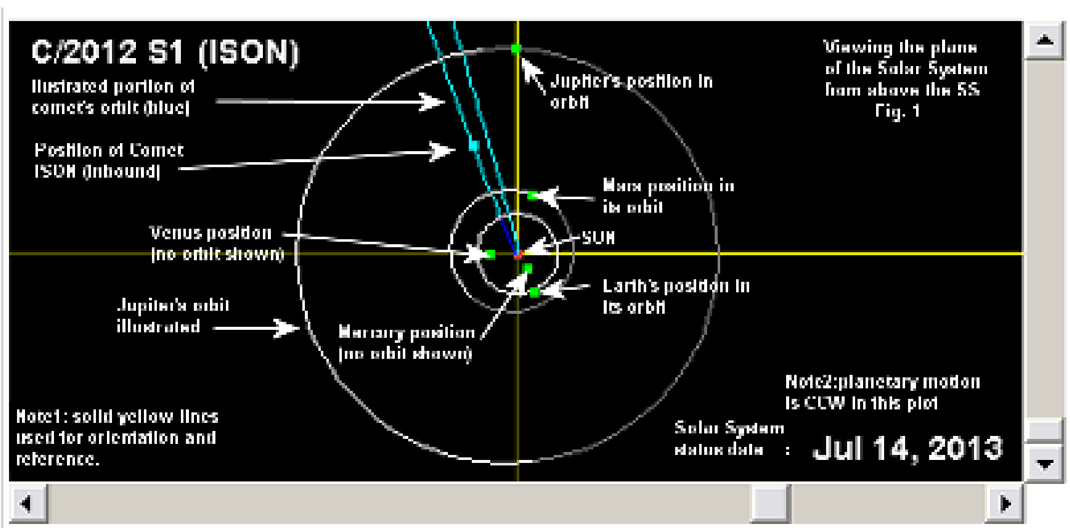
Although it is well established that the Chicxulub impact occurred at the end of the dinosaur's reign, many paleontologists are not comfortable with that scenario because it does not explain some of the unusual patterns of extinction. Strangely all land animals over 50 lbs died while small animals survived. In the oceans smaller surface dwellers like the plankton died but deeper dwelling animals survived. Gamma ray bursts are extremely powerful explosions capable of wiping out life on a planet if they were close enough. GRB's are relative newcomers to the astronomy scene and this talk will examine the links between GRB's and extinctions that could explain the pattern of extinctions and STILL involve a bolide impact.

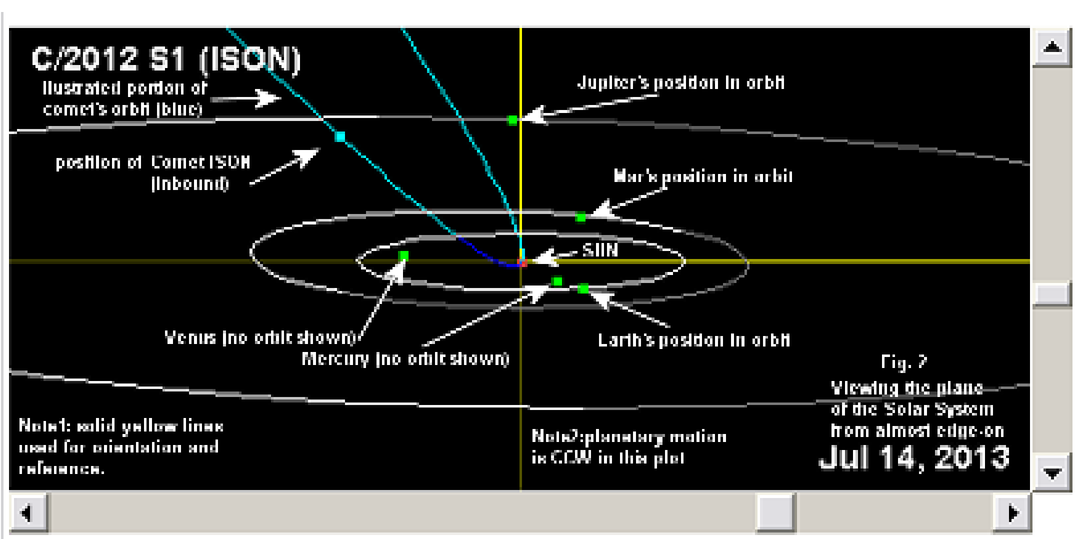
Tom Kaye is a paleontologist with the Burke Museum in Seattle and leads the Spectrashift Exoplanet Search Project. He is the only person that is a member of both the Society of Vertebrate Paleontologists and the American Astronomical Society giving him a unique view on this subject. He spends summers in the field hunting dinosaurs and winters running a large astronomical telescope. His work can be seen at tomkaye.com.

COUNTDOWN: JULY 14, 2013: COMET ISON, 137 DAYS UNTIL PERIHELION

This Comet ISON update is being drafted for both the July 2013 HAC Newsletter, and the club's online community, the HAC-LIST, found as one of the Yahoo Groups. If you don't subscribe to the 'HAC-List', please do so by simply sending an email to haclist-subscribe@yahoogroups.com . PLEASE, and we THANK YOU.

If you saw my first Comet ISON update last week on the HAC-List, you'll recall that it was strictly text. This time, let me try some 'crude' visualizations that include scaled down portions of our amazing Solar System. You may recall that the date that Comet ISON reaches perihelion (closest approach to the Sun) occurs on Thursday, November 28, 2013 (yes, that's America's Thanksgiving Day). The comet is expected to pass within 1,100,000 miles of the solar surface. If the comet survives this solar passage, then it will make its closest approach to Earth on December 26, 2013. Speaking of distances and such, on July 14, 2013, the comet will be 'within' 3.935 AU from Earth, and 2.923 AU from the Sun. You know that 1 AU is equivalent to a 'standard' Earth-Sun distance of 93 million miles, or 149 million kilometers. These are pictured in the included diagrams Fig. 1 and Fig.2. During the last HAC-List update, I mention the fact that due to the close S-O-T angle (Sun-Observer-Target), it was not possible to obtain visual or electronic images. On July 15, 2013, at 0100 hrs UT, that angle was at its smallest value of 4.55°; after that date, the angle will commence to increase, and will eventually allow observations to resume, mostly during local morning hours while the comet is in the constellation of Cancer.





Prepared by Doug Snyder (during a monsoon storm) on 13 July, 2013; email starhaven@palominas.com

METEOR SHOWER ACTIVITY IN LATE JULY & AUGUST 2013

by Doug Snyder

There sure are a fair number, (well, 3) of meteor showers during late July and August of each year, and here is a brief report on them for this year, 2013. Hey, I know what you're saying, " …*&^%#@....right at the height of the southwest monsoon season….! I certainly can't disagree with you, but we can sure anticipate, and hope for, some clear, dry skies with at least one or more events that are to follow in the next few weeks. I can't do much about any interfering moonlight though, so try to view from a dark site! Let us get started:

Delta (δ) Aquarids: Peaking on the morning of Tuesday, July 30, but active from mid-July to sometimes the third week of August. The ZHR (Zenithal Hourly Rate) ranges from 15 to 20 medium speed, but pretty faint meteors, although some leave 'trains'. The radiant often appears near the star Skat, or Delta Aquarii, but meteors can be seen in many areas of the sky, and the best viewing time is one to two hours prior to dawn. The approximate location of the radiant is RA 22.6 hrs. and Declination of -16°. If you can't place Skat in the sky, use your handy 'planisphere' (you do have one, do you not?) to center the constellation Aquarius. The parent comet is 96P/Machholz. Unfortunately, there will be a waning crescent Moon present (about 58%), but hey, there is no crying in astronomy; instead, shed tears of joy that we can even revel in these sometime visual phenomena and then just wait until next year!

Alpha (α) Capricornids: (minor shower); also predicted to peak on morning of July 30 and again on July 31, but active through most of July and into mid-August. Mostly slow (23 km/sec), but bright (many with fireball intensity); a quite low ZHR of 5 and the radiant is located within Capricornus, but close to the boundaries with Aquila and Aquarius. The RA (Right Ascension) appears to be at about 20.5 hrs., and a declination of about -10°. Same or more likely less moonlight on peak mornings as for the Delta Aquarids.

PERSEIDS: One of the premiere and favorite meteor showers of the year, we are again expecting this shower's peak on the morning of **Monday, August 12**. It is active from mid-July to third week August, and can, at times, exceed a ZHR of 100 during the peak times. An early setting waxing Moon will ensure that no interfering moonlight will hinder your viewing pleasure, although I can't say the same for any monsoonal activity – let's hope it has taken an astronomy break! Perseid's are fast (59 km/sec), many are bright, and are known for their lingering trains. The radiant for this shower is near the asterism known as 'The Double Cluster' in Perseus, and is near the coordinates of RA 3.2 hrs and a Dec. of +57° ; of course, viewing time can be most of the night, but the optimum times are closer to morning twilight. The parent comet of this shower is 109P/Swift-Tuttle.

METEOR PHOTOGRAPHY USING YOUR DSLR :

I highly recommend using a DSLR camera, a wide angle lens, and a stable tripod; shutter release cable, extra batteries or AC Adapter; dark skies, accurate manual focus, and high ISO!
Exposures should be 30 seconds or longer. Shoot, Shoot, and Shoot! For more, visit
http://www.realclearwx.com/m1.htm. Take pictures & Share! – Have Fun and Good Luck.

Astronomical League Observing Programs - Planetary Nebula
July Edition

by Ted Forte
(Captured from the HACList)

Welcome to the Monsoon edition of the PN Program Monthly Object Report! This month's list contains some really fascinating objects, so if I haven't grabbed your attention before now, these just might do the trick! Of course, you'll have to get lucky to find an observing window in July. Maybe you've followed my previous advice and have already checked off some of these objects. Most of them became accessible in May or June. They will all be viewable through September so don't despair if July's skies don't cooperate. And if they do, don't lose the opportunity to get as many of next month's objects as you can. It's a good idea to try and get all of the objects in Scorpius, Sagittarius and Aquila any opportunity you get.

We'll start our July tour in the Snake Holder, Ophiuchus. We have four objects to check off here. IC 4634 is an almost stellar planetary that can be a challenge to find. Imagine it as the apex of a triangle pointing toward Sigma Scorpii whose base is Eta and Theta Ophiuchi. The height of the triangle is one fourth the distance to Sigma Scorpii. Use a filter to blink the object and distinguish it from the surrounding stars. It is fairly bright, but challenging in an 8-inch scope.

Minkowski 2-9 is known as Minkowski's Butterfly and is arguably the most famous object in Rudolph Minkowski's PN catalog. It will be a challenge to see in an 8-inch scope, you'll need steady seeing and the darkest sky you can find just to detect it with averted vision. Larger scopes will detect an elongated object. If conditions allow however, you might be treated to a magnificent view of a bi-polar planetary - two opposing lobes extending north and south of a 14th magnitude central star. It lies 5 degrees, 42 minutes NNW of Eta Ophiuchi and 8 degrees east of Zeta Ophiuchi almost making a right triangle.

NGC 6309 is elongated in such a way as to appear somewhat rectangular, leading to its nickname of The Box Nebula. It is fairly large and reasonably bright; in good conditions, it should be easy to detect in an 8-inch scope. An OIII filter helps a great deal. Take the filter out to try and detect the vaguely green hue. Pump up the power and the central star should be visible. The Box is near Eta Ophiuchi. Extend a line through the 4th magnitude stars Omicron and Nu Serpentis about one and a half degrees to locate it.

NGC 6369 is known as The Little Ghost. As with many of our objects this month, you'll have to wait until about midnight for your best view. August will allow for a more reasonable time to catch it, but it will be a good deal lower in our sky then. It is detectable in an 8-inch. The 18-inch shows a remarkable object, a fine disk with a darkened center making the object annular. It lies in the foot of Ophiuchus about two degrees NE of 3rd magnitude Theta.

The scorpion holds two of our July objects. NGC 6302 is known as The Bug Nebula. What a great object this one is. It gets its name from the two wispy extensions that look like ragged wings . I can make out its bi-polar nature, a very definite waist between opposite bright lobes, in my 10-inch Dob. In my 30-inch, it is positively breathtaking. It responds well to the OIII filter. The bug lies between Shaula and Mu Scorpii in the scorpion's tail.

NGC 6337 is called The Cheerio Nebula. As you might guess, it can appear as an annular ring. The seeing has to be good to see a ring though - there are several stars involved that can blur into an extended object. This one might be difficult in an 8-inch, but certainly worth the effort. It too, lies in the scorpion's tail, two degrees SE of The Bug and about 6 degrees east of Mu Scorpi.

NGC 6545 lies just across the border in Sagittarius, almost exactly half way between Lamda Sagittarii and Eta Scorpii. It has a fairly low surface brightness making it a bit of a challenge. It is an elongated annular object with an outer halo that appears as a haze through the OIII filter.

Tiny IC 4670 will test your skills. This stellar sized planetary is not only difficult to find in the sky, it is difficult to find in the literature. Sky Tools users will have to remember the object as Henize 2-305. The best known name for this object is probably Hubble 6. Kent Wallace, a well-known amateur and PN aficionado discovered the equivalence of Hubble 6 and IC 4670. As is often the case, objects can be rediscovered after earlier discoveries are lost or ignored and that is what happen here evidently. You'll need to use a filter to identify the planetary. It lies a little more than 2 degrees NW of the Trifid nebula, M20. Your finder will help you follow a line of 6th and 7th magnitude stars leading away from M20 toward the PN which is about 20 minutes beyond the last star in the line.

The last object of this treatise is more than a worthy note to end on. The Cat's Eye Nebula, NGC 6543 in Draco is certainly one of the best loved planetaries in the sky. And for good reason! It seems to have everything necessary to qualify as an exceptional example of a planetary nebula including a magnificent Hubble Telescope image. Through the eyepiece, it has color, detail, and character; a bright central star, and a complex morphology that adds layers of visibility as the aperture of the scope used increases. An annular disk is surrounded by a crown of looping nebulosity embedded in an extended halo. In fact I'm so sure that this is one of the coolest PNe in the sky, if July is your starting point for the program, let me suggest that you start with the Cat's Eye. If this fine planetary doesn't do it for you, there is little point in pursuing planetary nebulae at all. NGC 6543 is circumpolar; it is constantly above our horizon and therefore visible all year but in winter will be low on our horizon. It makes the apex of a squat triangle pointing away from the bowl of the Little Dipper with Chi and Zeta Draconis. It is obvious in a 4-inch telescope.

Here are the objects I recommend for July:

IC 4634	Oph	17h02m10.1s	-21°50'28"
M 2-9	Oph	17h06m11.6s	-10°09'24"
NGC 6302	Sco	17h14m25.6s	-37°07'03"
NGC 6309	Oph	17h14m38.7s	-12°55'21"
NGC 6337	Sco	17h22m57.7s	-38°29'44"
NGC 6369	Oph	17h29m57.7s	-23°46'06"
NGC 6445	Sgr	17h49m51.4s	-20°00'47"
IC 4670	Sgr	17h55m43.8s	-21°44'48"
NGC 6543	Dra	17h58m36.4s	+66°38'00"

Inventing Astrophotography: Capturing Light Over Time

By Dr. Ethan Siegel

We know that it's a vast Universe out there, with our Milky Way representing just one drop in a cosmic ocean filled with hundreds of billions of galaxies. Yet if you've ever looked through a telescope with your own eyes, unless that telescope was many feet in diameter, you've probably never seen a galaxy's spiral structure for yourself. In fact, the very closest large galaxy to us—Andromeda, M31—wasn't discovered to be a spiral until 1888, despite being clearly visible to the naked eye! This crucial discovery wasn't made at one of the world's great observatories, with a world-class telescope, or even by a professional astronomer; it was made by a humble amateur to whom we all owe a great scientific debt.

Beginning in 1845, with the unveiling of Lord Rosse's 6-foot (1.8 m) aperture telescope, several of the nebulae catalogued by Messier, Herschel and others were discovered to contain an internal spiral structure. The extreme light-gathering power afforded by this new telescope allowed us, for the first time, to see these hitherto undiscovered cosmic constructions. But there was another possible path to such a discovery: rather than collecting vast amounts of light through a giant aperture, you could collect it *over time*, through the newly developed technology of photography. During the latter half of the 19th Century, the application of photography to astronomy allowed us to better understand the Sun's corona, the spectra of stars, and to discover stellar and nebulous features too faint to be seen with the human eye.

Working initially with a 7-inch refractor that was later upgraded to a 20-inch reflector, amateur astronomer Isaac Roberts pioneered a number of astrophotography techniques in the early 1880s, including "piggybacking," where his camera/lens system was attached to a larger, equatorially-mounted guide scope, allowing for longer exposure times than ever before. By mounting photographic plates directly at the reflector's prime focus, he was able to completely avoid the light-loss inherent with secondary mirrors. His first photographs were displayed in 1886, showing vast extensions to the known reaches of nebulosity in the Pleiades star cluster and the Orion Nebula.

But his greatest achievement was this 1888 photograph of the Great Nebula in Andromeda, which we now know to be the first-ever photograph of another galaxy, and the first spiral ever discovered that was oriented closer to edge-on (as opposed to face-on) with respect to us. Over a century later, Andromeda looks practically identical, a testament to the tremendous scales involved when considering galaxies. If you can photograph it, you'll see for yourself!

Astrophotography has come a long way, as apparent in the Space Place collection of NASA stars and galaxies posters at http://spaceplace.nasa.gov/posters /#stars.

Great Nebula in Andromeda, the first-ever photograph of another galaxy. Image credit: Isaac Roberts, taken December 29, 1888, published in *A Selection of Photographs of Stars, Star-clusters and Nebulae*, Volume II, The Universal Press, London, 1899.

East Stars, Zenith Stars and The Horizontal Pendulum (Part 2)

By Tommy Neyhart
Edited by Doug Snyder

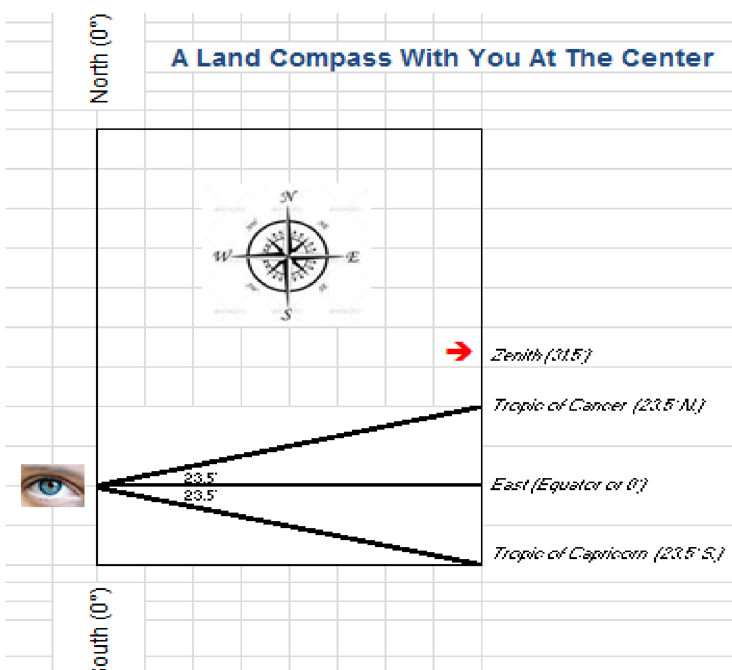
In Part 1, we discussed East Stars, Zenith Stars, West Stars, and the different points on your horizon where the Sun rises and sets, noting the two solstices and the two equinoxes. Here in Part 2, we'll expand on those topics.

A Huge Compass With You At The Center

I am extremely fortunate to live where my distant horizon is loaded with objects, including trees, chimneys, tall Century Plants, and mountains. These objects are conveniently used to first mark true north and south, then the Celestial Equator, the Tropic of Cancer, the Tropic of Capricorn, and the point on the horizon where Zenith Stars rise.

Like most of us, I have lived in many locations in North America. Wherever I've resided, topographical features, mostly on or near the horizon. have marked these many points. Where I lived during my formative years, Rolling Hills, south of Los Angeles, the Sun rose behind a distinctive oil storage tank in San Pedro on the Summer Solstice, behind Mr. Greene's house on the two equinoxes, and the flag pole that was in the center of our local shopping mall on the Winter Solstice. I was in elementary school when I made the next exhibit. It did well at the Science Fair that year.

On a normal sheet of white notebook paper and a protractor, start at the lower right hand corner and draw a line to the opposite side of the page that makes a 23.5° angle with the bottom edge. Next, at the point on the left hand side of the page where the first line you drew meets the left edge, draw a line to the right edge that is parallel with the top and bottom edges of the page ("the Equator Line"). Now return to the point on the left hand side where the two lines that you have drawn meet. Draw another line to the opposite that makes a 23.5° angle with the parallel line. Finally, draw a line with a 31.5° angle from the parallel line to the opposite side of the page. See the illustration below the finished page.



With your eye located on the left edge looking up the page, locate Plumb Bob north.

Now, switch your eye and down the left edge and locate a point of the opposite horizon that marks true south. Lay the page down on a flat surface keeping the same north/south alignment. Now look down the parallel line to a land feature that marks cardinal east. Similarly, look down both the Tropic of Cancer and the Tropic of Capricorn lines and note where they meet the horizon. Finally, mark the point on the horizon where Zenith Stars rise.

You now have a huge compass with you at the center!

The three points of the Tropic of Cancer, the Tropic of Capricorn, and the Equator play a fascinating role in watching where on the horizon the Sun rises daily. The sun breaks the day during the third week of June exactly behind the mark on your horizon that indicates the Tropic of Cancer. From that point it steadily marches to the point on your horizon that marks the Celestial Equator. Arriving there during late September, it not only marks true east but the Autumnal Equinox. By late December, the Sun touches the farthest south point, or the Winter Solstice. From that extreme point, it begins rising more and more to the north with each passing day, until it arrives at the Celestial Equator again, this time for the Spring Equinox. Approximately one quarter of the year later and the Sun returns to the Summer Solstice where the cycle begins again.

It takes the Sun approximately three months, or 90 days, to travel from one point to the next. Knowing where the key points are on your horizon, you can guess the date just knowing the above and extrapolating the distance between points.

A Calendar On Your Eastern Horizon

2013

January

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

February

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

March

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

April

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

May

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

June

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

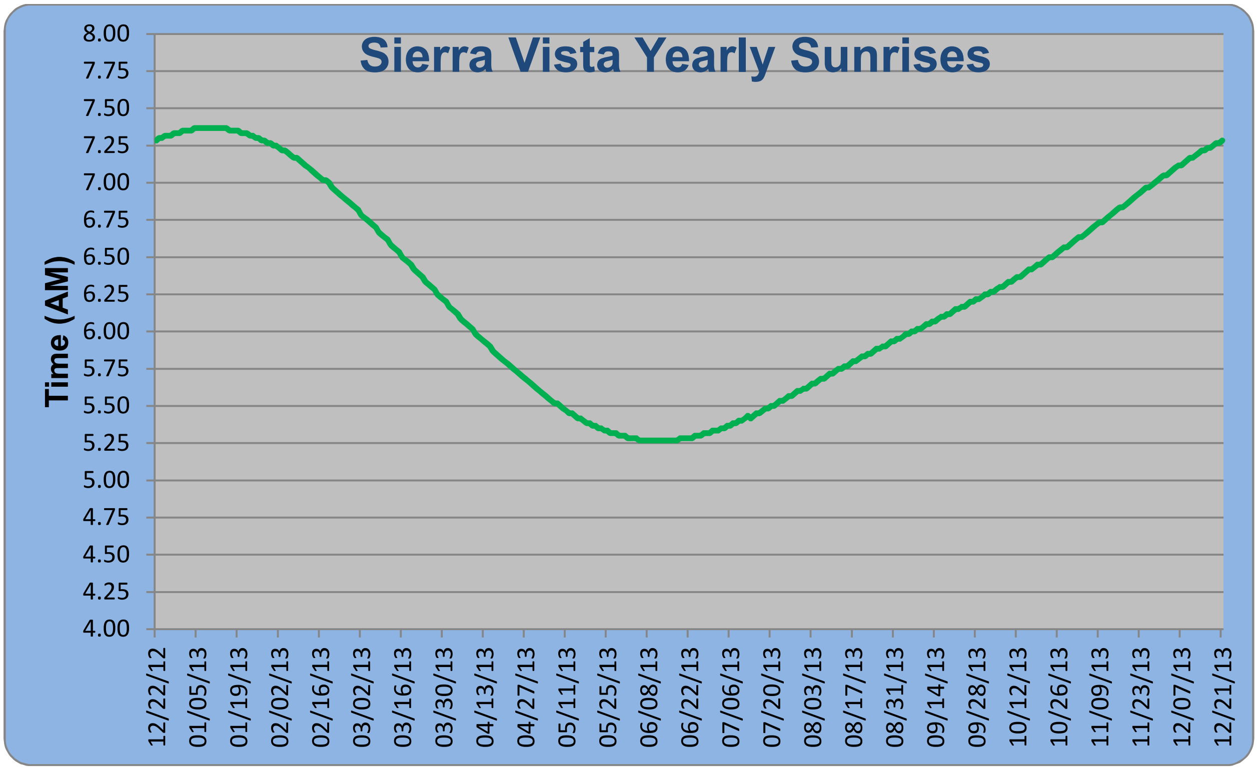
December

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

When you know the three points on your horizon, where it is intersected by the Tropic of Cancer, the Equator, and the Tropic of Capricorn, you have a yearly calendar. The rising sun swings from the Tropic of Cancer during the third week of June, crosses the Equator during late September, arrives at the Tropic of Capricorn just before Christmas, then reverses direction, again crossing the Equator in late March, before arriving back at Tropic of Cancer.

In time lapse photography, the point where the Sun rises would appear to be a strobe, swinging back and forth like a “horizontal pendulum”, with the most elegant precision, between the two extremes of the Tropic of Cancer and the Tropic of Capricorn, continually crossing the midway point of the Equator.

This graph shows the daily sunrise times from Sierra Vista and how they change throughout the year.



Of particular note is how the slope of the curve from January 1 to June 21 differs from the slope from June 21 to December 31. As the Earth gets closer and closer to the Sun in its annual elliptical orbit, it picks up speed. Conversely, as it moves increasingly farther from the Sun on its way to the Winter Solstice, its velocity decreases. Therefore, the daily differential between consecutive sunrises around the Summer Solstice is shorter than it is near the Winter Solstice.

The exact times of the rising sun on the two recent solstices and two upcoming equinoxes are:

Date	*Time*
December 21, 2012	7:28 AM
March 20, 2013	6:42 AM
June 21, 2013	5:28 AM
September 22, 2013	6:15 AM

Tropic of Cancer Stars

Here is a list of the most prominent Tropic of Cancer stars (23.5º ± 3º). They rise at the point on your horizon where the Sun rises on the Summer Solstice:

Star's Name	*Dec.*	*+/-*
The Sun (Summer Solstice)	23.5º	0.0º
Alpha Arietis	23.5º	0.0º
Alpha Coronae Borealis	26.7º	3.2º
Delta Leonis	20.5º	-3.0º
Beta Arietis	20.8º	-2.7º
Beta Herculis	20.5º	-3.0º
Eta Tauri	24.1º	0.6º
Mu Geminorum	22.5º	-1.0º

World map showing the Tropic of Cancer and the Tropic of Capricorn

Tropic of Capricorn Stars

Here is a list of the most prominent Tropic of Capricorn stars (-23.5º ± 3º). They rise at the point on your horizon where the Sun rises on the Summer Solstice:

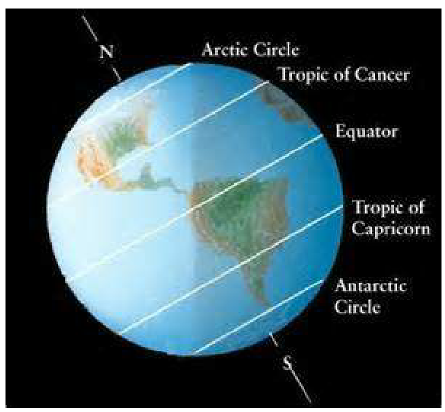
Star's Name	*Dec.*	*+/-*
The Sun (Winter Solstice)	-26.4º	-2.9º
Alpha Scorpii (*Antares*)	-26.4º	-2.9º
Delta Canis Majoris	-26.4º	-2.9º
Sigma Sagittarii	-26.3º	-2.8º
Delta Scorpii	-22.6º	0.9º
Beta Corvi	-23.4º	0.1º
Lambda Sagittarii	-25.4º	-1.9º

Extrapolating The Date From Where The Sun Rises

It is Fall. The days are becoming shorter. The nights are getting colder. The Sun rises half way between the points on the horizon marking the Celestial Equator and the Winter Solstice (Tropic of Capricorn). Because it takes about 90 days for the Sun to travel between the two points, it is about 45 days after the Autumnal Equinox (1/2 x 90 = 45). The Autumnal Equinox occurred on September 23rd, so the date must be about 45 days later, or about November 7th!

Wherever you are, a calendar is always with you. You are at the vertex of a 47º angle (23.5º + 23.5º), with the Tropic of Cancer 23.5º north of the Equator (0º), and the Tropic of Capricorn 23.5º south of the Equator. The Equator bisects the 47º angle. There are features on your horizon that mark these important points, you must now go out and find them.

When you do, your efforts will be rewarded. When the sun rises at either of the two extremes, either the Tropic of Cancer (mid-June) or the Tropic of Capricorn (mid-December), you can look to the point on the horizon that designates the other extreme and see how far the Sun has moved from one sunrise to the other. The span of distance will surprise you.



By the way, if the angle 23.5º looks familiar, it the angle of tilt of the Earth to its orbital plane of revolution around the Sun.

Summary

You've been in the middle of a giant compass your entire life. With the Earth's two poles pointing to the North Star, Polaris, and the Sun rising year after year in the same locations on your horizon on both the solstices and equinoxes, these become key observations. Stars with a declination equal to your latitude pass directly overhead. Your night sky is filled with Tropic of Cancer Stars, Zenith Stars, East Stars, West Stars, and Tropic of Capricorn Stars, which guide you to a daily observation of sunrise and sunset in terms of a calendar, one that is stretched across part of your eastern and western horizons. Together, this all adds yet another dimension to your viewing of each day's sunrise and sunset, and the celestial dome as it progress throughout the year.

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Out of the Darkness: The Planet Pluto

By Clyde W. Tombaugh and Patrick Moore

Reviewed by Cindy Lund

A few months ago, I read Astronomical Enigmas, which had a chapter about whether Pluto should be considered a planet. The chapter mentioned that Clyde Tombaugh, the discoverer of Pluto, had written a book about his discovery called "Out of the Darkness: The Planet Pluto". I decided that I would read that book and review it for the club.

Out of the Darkness starts with a forward by James W. Christie, who discovered Pluto's moon, Charon. On April 13 and 20 and May 12, of 1978, Christie had plates of Pluto taken. When he examined them on June 22, he found that the image of Pluto was elongated, but the stars in the back ground were not. He noticed that the elongation was to the north on May 12th and to the south on April 13th. This made him think Pluto might have a moon. The plates on which Charon was discovered were exposed only four miles from Lowell observatory, where Pluto had been discovered almost 50 years earlier.

The first chapter is a brief autobiography by Tombaugh, telling about his life before he began working at Lowell Observatory. He was born in Illinois in 1906, and moved to Kansas in 1922. Tombaugh's Uncle Lee was an amateur astronomer and would loan him his telescope and astronomy book. When he wasn't working on the farm, Tombaugh spent hours studying the sky and reading about astronomy. In 1926 he began making his own telescopes. In late 1928 he drew pictures of his observations of Jupiter and Mars, and sent them to Lowell observatory, the only planetary observatory he had heard of. Since the director of Lowell Observatory, Dr. V. M. Slipher was looking for an amateur to work the new 13 inch telescope, he hired Tombaugh. Tombaugh was thrilled, accepted the job and moved to Flagstaff.

The next few chapters are by Patrick Moore. They describe the solar system, and the discoveries of Uranus, the asteroids and Neptune. Then Tombaugh writes about the beginning of the search for a Trans-Neptunian planet, especially the work done by Percival Lowell. Percival Lowell, who founded Lowell Observatory in Flagstaff, began his search for Planet X in 1905, but failed to find anything.

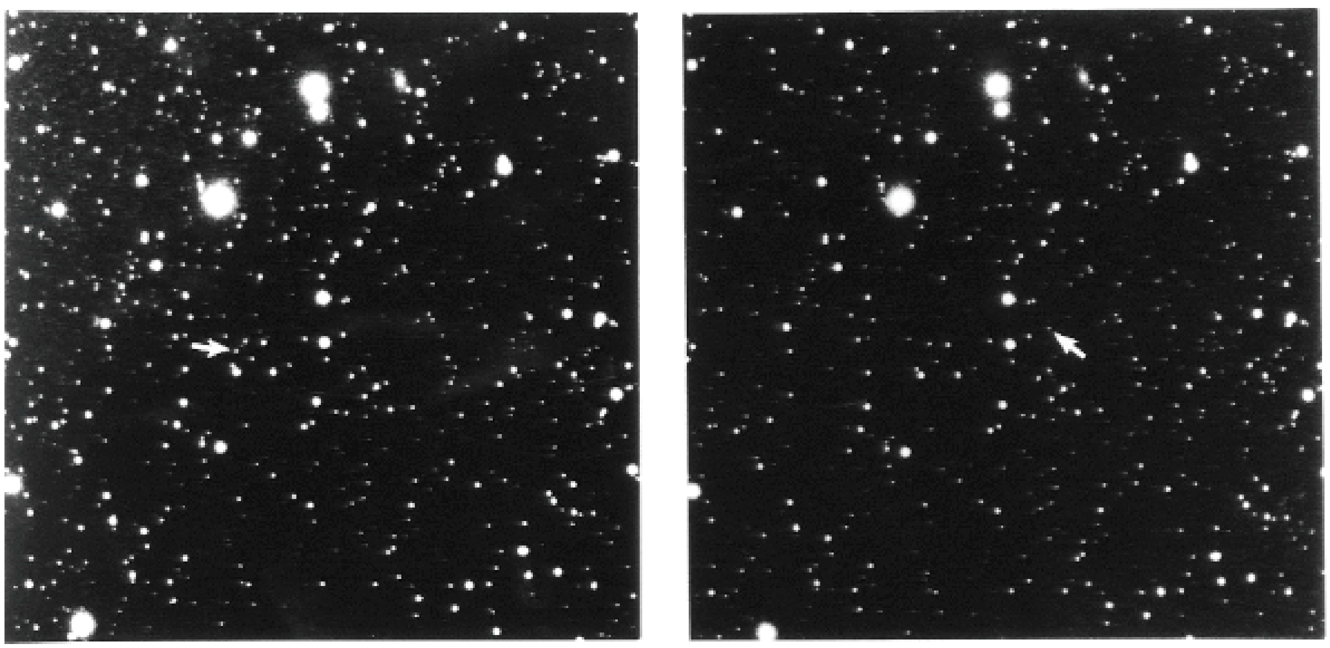
Tombaugh explained the best practices for finding a planet. The best place to look is within 20 degrees of the opposition point. This is because the tell-tale shift used to detect a planet is not due to that planet's motion, but is actually due to the Earth's motion. What a planet hunter looks for is a westward retrograde shift as the Earth passes the distant planet. This also avoids asteroids at their stationary points, which could be confused with a Trans-Neptunian planet.

Tombaugh then writes about his work at Lowell Observatory. Tombaugh ran the daily visitor tours, banked the furnace and shoveled snow off the telescope domes. His main job, however, was to set up the plates on the 13 inch telescope and guide it for two hour exposures. He would take a plate of a certain area of the sky, wait a few days and then take another plate of the same area. Lowell observatory had a blink comparator, which rapidly shifted views between the plates. Any planet, asteroid or comet would jump back and forth, while the stars stayed still.

Tombaugh did not expect to have to blink the plates. He wrote that he felt sorry for whoever was going to, but in June, Dr. Slipher assigned the task to him. He had to blink the 14 by 17 inch plates. The easier plates, taken in regions away from the Milky Way, had about 50,000 stars and took three days to blink. The plates in the Milky Way regions had about 400,000 stars. He found the work very tedious. He was also frustrated because some of the plates were taken near asteroid stationery points and he didn't know how to tell which slightly shifted object was a new planet. However, after studying the apparent motion of the known planets he figured out what to look for. He became hopeful and enthusiastic, and resolved to search the whole zodiac.

On February 18, 1930, Tombaugh started blinking plates he had taken in Gemini on January 23 and 29. He noticed two images blinking in and out. This was a possible planet. He then made sure it appeared to be going west, and used a plate he had taken on January 21 to double check. The he went to Dr. Slipher's office and told him, "Dr. Slipher, I have found your Planet X". The Lowell Observatory team made more observations before announcing the discovery on March 13.

DISCOVERY OF THE PLANET PLUTO



January 23, 1930 January 29, 1930

From the beginning, Pluto was controversial. It was much fainter than expected and had an eccentric orbit. Some thought it was actually a comet, others a large asteroid. Harlow Shapely and A. O. Leushner proposed that Pluto was the first of a new class of objects in the Solar system.

Since Pluto was too small to fulfill Lowell's Prediction, the observatory team decided to continue searching for more planets. Tombaugh continued searching until he was drafted in 1943. He blinked 338 pairs of 14 by 17 inch plates and covered 30,000 of the 41,253 square degrees of the sky. He found, in addition to Pluto, a globular cluster, a super cluster of galaxies, several smaller clusters of galaxies, five open clusters, a comet, and 775 asteroids. Meanwhile, in 1931, Tombaugh began taking classing at the University of Kansas, where he met Patricia Irene Edson. He married her in 1934. In 1939 he got his Master of Arts degree.

Tombaugh discusses the discovery of Pluto's Moon, Charon, and what was known about Pluto when *Out of the Darkness* was written in 1980. He mentions that using Kepler's third law, astronomers were able to determine that the mass of Pluto and Charon when combined is only 1/400th the mass of the Earth. He also predicted that Pluto's methane frost would sublimate into a thin methane atmosphere as it moved closer to its perihelion in 1989. This atmosphere was detected in 1988. Tombaugh called Pluto the strangest as well as one of the most interesting objects in the solar system.

Tombaugh ends the book, (except for the appendices) with a discussion of the possibility of planets beyond Pluto and the difficulty of finding them. He spent 7,000 hours to search for planets down to magnitude 16.5. To search down to 20th magnitude would require 50,000 hours.

I really enjoyed *Out of the Darkness*. It was fascinating to read about a discovery as told by the person who actually made it. I found I could sympathize with Tombaugh's frustrations and share in his joy at the discovery of Pluto. I was impressed by all the work he did searching the sky with the telescope and the blink comparator.

(The Pictures of Clyde Tombaugh and the Pluto discovery plates are from Wikipedia. The urls are http://en.wikipedia.org/wiki/Clyde_Tombaugh and http://en.wikipedia.org/wiki/Pluto respectively)

New Members Corner

We would like to welcome our newest member, Mike Davidson of Sierra Vista. Welcome to the club, we are glad you joined!

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2013—ARIZONA's Astronomically Handy Sky Calendar from Doug Snyder & the H.A.C.—2013

ARIZONA Observers SKY EVENTS Calendar for 2013 —All Times shown are MOUNTAIN STANDARD TIME*

January 2013

HIGHLITE1: Moon & Jupiter on 21st
HL2(month)**: Saturn's Rings open to 18°**
Note: **HAC** = **H**uachuca **A**stronomy **C**lub
03 Th Quadrantids Meteor Shower -
unfavorable year due to Moon light! 04
Fr ☾ Last Quarter Moon 2058 hrs.
11 Fr ● **NEW MOON** 1244 hrs.(lunation#1114)
12 Sa **HAC** Member **S**tar **P**arty (S.P.)
17 Th **HAC** Pub. S.P.;P.O.; SS@1743h.
18 Fr ☽ First Quarter Moon 1645 hrs.
21 Mo MOON & Jupiter v. close, 2000h
25 Fr **HAC Meeting**, Cochise College, 1900 hrs
26 Sa ○ Full Moon, 2138 hrs.
29 Tu Zodiacal Lt. in W., pm, next two
weeks after evening twilight.

February 2013

HIGHLITE: Merc. & Mars close on Feb. 8th
03 Su ☾ Last Quarter Moon 0656 hrs.
09 Sa **HAC** Member **S**tar **P**arty (S.P.)
10 Su ● **NEW MOON** 0020 hrs.
14 Th **HAC** Pub. S.P.; P.O.; SS@1808hrs. 15
Fr **NEA** 2012 DA14; to mag.12 in
evening hrs.; size= 57meters;
visit spaceweather.com
16 Sa Merc. evening planet in W., 7"
17 Su ☽ First Quarter Moon 1331 hrs. 22
Fr **HAC Meeting,** Cochise College
25 Mo ○ Full Moon 1326 hrs.
27 We Zodiacal Lt. in W., pm, next
two weeks after evening twilight

March 2013

HIGHLITE: Messier Marathon S.P. 04
Mo ☾ Last Quarter Moon 1453 hrs. 09
Sa **HAC Messier Marathon S.P.**
09 Sa **Comet Pan-Starrs** (C/2011 L4);
2100hrs, at Perihelion—Mag. 0?
11 Mo ● **NEW MOON** 1251 hrs.
14 Th **HAC** Pub. S.P.; P.O.; SS@1829h.
16 Sa **KartchnerCavernsStatePark**SP.
17 Su Moon&Jup. close;1900hrs; 1.4°
19 Tu ☽ First Quarter Moon 1027 hrs.
20 We **Vernal Equinox**, 0402 hrs.
22 Fr **HAC Meeting**, Cochise College
27 We ○ Full Moon 0227 hrs.
31 Su• Merc. morning planet in E. size 9"
Easter Sunday

April 2013

HIGHLITE: Saturn Opposition, 4/28
HL2: Comet Pan-Starrs (early in month & bright?)
02 Tu ☾ Last Quarter Moon, 2137 hrs. 06
Sa **HAC** Member S.P.
10 We ● **NEW MOON** 0235 hrs.
14 Su Jupiter within 4° of crescent Moon
18 Th ☽ First Quarter Moon 0531 hrs.
Th **HAC** Pub. S.P.; P.O.; SS@1852h.
20 Sa **ASTRONOMY DAY—Global**
22 Mo Lyrid Meteors—v. unfavorable
due to moonlight; peak 0400?
25 Th ○ Full Moon, 1257 hrs.
26 Fr **HAC Meeting,** Cochise College
28 Su Saturn at **Opposition,** 0100 hrs.
mag. +0.1, size 18.8", 8.82 AU

May 2013

HIGHLITE: Merc., Venus, Jup. Conjunction! 02
Th ☾ Last Quarter Moon, 0414 hrs.
05 & 06 Su & Mo **η Aquarid Meteors**; favorable;
pk@4am each morning; possibly 40 per hr.
09 Th ● **NEW MOON** 1728 hrs.
11 Sa **HAC** Member S.P.
16 Th **HAC** Pub. S.P.; P.O.; SS@1912hrs.
17 Fr ☽ First Quarter Moon 2134 hrs.
24 Fr ○ Full Moon, 2125 hrs.
very shallow penumbral Lunar Eclipse, 1.5%;
mostly undetectable, starts at 2053hrs.
24 Fr **HAC Meeting,** Cochise College
24-29 Planetary Conjunction, **best** of 2013;evening
twilight line up of Merc.,Venus,Jup.;26th is !!
31 Fr ☾ Last Quarter Moon, 1158 hrs.

June 2013

HIGHLITE: ■(Gamma) Delphinids?
04 Tu Venus in **M35**, pm, low in NW
08 Sa ● **NEW MOON** 0856 hrs.
HAC Member S.P.
11 Tu **Meteors-■Del.**; 0100-dawn?
v. favorable year, activity is ??
12 We Merc. G. Elong. 24°, pm planet
13 Th **HAC** Pub. S.P.; P.O.; SS@1927hrs.
16 Su ☽ First Quarter Moon 1024 hrs. 20
Th Merc. 2° S. of Venus, pm
20 Th Summer **Solstice** 2204 hrs. 23
Su ○ Full Moon,0432h.largest of 2013 28
Fr **HAC Meeting,** Cochise College
29 Sa ☾ Last Quarter Moon, 2153 hrs.

July 2013

HIGHLITE: Mars, Jup., Merc., am, E., July **22nd**
01 Mo Pluto at Opposition,1800 hrs.
06 Fr Moon/Mars close; . low in E.,0430h.
08 Mo ● **NEW MOON** 0014 hrs.
15 Mo ☽ First Quarter Moon 2018 hrs.
22 Mo ○ Full Moon, 1116 hrs.
26 Fr **HAC Meeting,** Cochise College
29 Mo ☾ Last Quarter Moon, 1043 hrs.
29-30 Mo-Tu: **Meteors:** Delta(δ)Aquarids;
am hrs.; favorable year

August 2013

HIGHLITE1: Perseid Meteor Shower
HL2: Moon/Planet pairings, am! & pm during month
06 Tu ● **NEW MOON** 1451 hrs
11-13 Su-Tu; **Perseids**; Pk. am of 12th; fast, bright
14 We ☽ First Quarter Moon 0356 hrs.
20 Tu ○ Full Moon, 1845 hrs.
23 Fr **HAC Meeting,** Cochise College
26 Mo **Neptune** at Opposition, 1900 hrs.
28 We ☾ Last Quarter Moon, 0235 hrs.

September 2013

HIGHLITE: Moon&Venus close, pm, 8th
03 Tu Zodiacal Lt. in E., am, next two
weeks before twilight.
05 Th ● **NEW MOON** 0436 hrs.
12 Th ☽ First Quarter Moon 1008 hrs.
HAC Public S.P., P.O.;SS@1830hrs.
19 Th ○ Full Moon (Harvest), 0413 hrs.
22 Su Fall **Equinox**,1344 h. (Aurora?)
26 Th ☾ Last Quarter Moon, 2055 hrs.
27 Fr **HAC Meeting,** Cochise College

October 2013

HIGHLITE: Jup. Dbl Shadow Transits (3)
17th, 18th, 26th; details online
03 Th Zodiacal Lt. in E.,am, next two wks.
Uranus at Opposition, 0700 hrs.
04 Fr ● **NEW MOON** 1734 hrs.
HAC Member S.P.
05 Sa **Kartchner Caverns StatePark** S.P.
10 Th **HAC** Public S.P., P.O.;SS@1755hrs.
11 Fr ☽ First Quarter Moon 0402 hrs.
12 Sa **Astronomy Day** (Autumn)
18 Fr ○ Full Moon,1638h.; Lunar eclipse @MR
25 Fr **HAC Meeting,** Cochise College
26 Sa ☾ Last Quarter Moon, 1640 hrs.

November 2013

HIGHLITE: Comet ISON (C/2012 S1) !!!! ??? 01
Fr Venus G. Elong. E.(47°),0100hrs., **pm** planet
02 Sa **HAC** Member S.P.
Jup., dbl. Shadow Tr., 0414hrs., I & Eu;
03 Su ● **NEW MOON** 0550 hrs.
05 Tu S. Taurid meteors Pk., 0400 hrs.; favorable;
07 Th **HAC** Public S.P., P.O.; SS@1727 hrs.
09 Sa ☽ First Quarter Moon 2257 hrs.
17 Su ○ Full Moon, 0816 hrs.; Merc. **am** planet 22
Fr **HAC Meeting,** Cochise College
25 Mo ☾ Last Quarter Moon, 1228 hrs.
28 Th **Comet ISON**, **Perihelion** @ 1600hrs.
30 Sa **HAC** Member S.P. (for **December**)

December 2013

HIGHLITE: Comet ISON ??? !!!!
02 Mo ● **NEW MOON** 1722 hrs.
06 Fr Venus@greatest illumination, mag.
-4.9, 26% illuminated, size 41" 09
Mo ☽ First Quarter Moon 1008 hrs. 12
Th **HAC** Public S.P., P.O.;SS@1714h. 13
Fr Geminid Meteors Pk. 2300h., fair? 14
Sa **HAC Meeting/XMAS Party** 17
Tu○ Full Moon,0413h.(smallest 2013)
21 Sa Winter **Solstice,** 1011 hrs.
22 Su Ursid Meteors Pk., 0700 hrs.
25 We ☾ Last Quarter Moon, 0648 hrs.
26 Th **C/ISON:** closest to Earth, 0300h.

*Times/Dates= ARIZONA Mountain Standard Time (NO DST; UT-7hrs); **updates/ details,** see**:** www.hacastronomy.com or http://skycalendar.blackskies.org;
Abbr: Tr=Transit; Pk=Peak; Merc=Mercury; E=East W=West; S=South; N=North; J, Jup.=Jupiter; V=Venus; v. = very; "=arc seconds; SS=SunSet; S.P.=Star Party;
h., hrs.=hours (24 hour time system); MP=Minor Planet; MS=Moon Set; MR=Moon Rise; wks=weeks; Lt=Light; pm=evening; @=at; Pub.=Public ; NEA= **N**ear **E**arth **A**steroid; am=morning; mag.=magnitude; **meteor dates reflect predicted Peak Morning, but Moon may still be present; P.O.=Patterson Observatory; ; I=Io; Eu=Europa; G=Ganymede; C=Callisto; UT=Universal Time; **bold text**=possibly a promising/worthy event, activity or object; G_Elong=Greatest Elongation; dbl= double; AU=Astronomical Unit; °= degrees; *compiler*: **Doug Snyder** (C/2002 E2, MP15512); V1.1.2013