IO - February 2014

Issue 2014-02

Eugene Astronomical Society

Eugene Astronomical Society
Annual Club Dues $25
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Next Meeting Thursday, February 20th
The LADEE Mission
by Rick Kang

The LADEE (pronounced "laddie" like lassie) Mission is one of a series of spacecraft launched over the past several years by NASA to further explore our Moon. LADEE stands for Lunar Atmosphere and Dust Environment Explorer, and is currently orbiting the Moon, beginning to collect data on the composition of the weak lunar atmosphere, including a dust component.

I'll show a Powerpoint Presentation furnished by LADEE's Education/Public Outreach officer, Dr. Brian Day, based at the Ames facility in California, that he made available to the Astronomical Society of the Pacific for one of their recent webcasts.

The presentation covers data about lunar water and the lunar atmosphere. Much of Dr. Day's interest is in the low density of the lunar atmosphere; technically this condition is called a surface boundary exosphere. This means that unlike much of Earth's atmosphere, where air molecules are typically jostled by frequent collisions with one another, in an exosphere the low density effectively prevents collisions, and the air molecules/particles travel in ballistic trajectories. This condition exists from the very surface of the Moon upward, thus "surface boundary." We suspect that many of the Solar System's smaller objects (low gravity), like asteroids and moons, also have surface boundary exospheres.

The main difference between an object with a dense atmosphere versus a surface boundary exosphere is that external conditions exercise much more control and influence the surface environment in the latter case. We'll talk about this more at the presentation.

Due to a variety of reasons, the Moon also seems to have a component of its exosphere made up of tiny dust particles, probably lifted from the surface. One of the reasons might be impacts of varieties of sizes of meteorites.

Dr. Day is asking the Amateur Observing Community to assist the project by observing the dark limb of the Moon for evidence of impact flashes, and also counting meteors incoming to Earth during predicted showers over the next several weeks. I'll explain some of the details of his request and what systems he suggests observers use.

An interesting side project of the Mission was to test sending a data stream modulating a laser beam between the spacecraft at the Moon and a station on Earth, this experiment was completed successfully several weeks ago. The object of the experiment was to gain bandwidth.

I'll try to get a project update status from Dr. Day just prior to my presentation.

We also encourage people to bring any new gear or projects they would like to show the rest of the club. Remember we no longer meet at EWEB. The meeting is at 7:00 on Thursday, February 20th at the Science Factory planetarium. **Please arrive on time**; we can't leave the door open unattended, so someone would have to miss the meeting to stand around waiting for late arrivals.

January Meeting Report: Supernova Remnants

At our January 20th meeting, Bernard Bopp gave a wonderful talk on "What Could Possibly Be Left After a Star Explodes?" He started with a brief description of the supernova process, when the core of a massive star collapses and the outer layers crash down upon it and rebound in a huge explosion. Then we began to explore what that core looks like after the fireworks die away. Depending on the mass of the star, we wind up with one of two things: a neutron star or a black hole. Bernard showed us the difference between the two (you can see a neutron star, for one thing!) and described the various properties of both. He showed us how neutron stars become pulsars and how we can detect them when the geometry is right. You can even detect the Crab Nebula pulsar visually with a big enough telescope. (Challenge!) This was a great talk and sparked a lot of discussion afterward.

Next First Quarter Friday: February 7th

Our January First Quarter Friday was a squeaker. The forecast was promising but the sky clouded up just before dark. Jerry put up a cancelled notice on the website and went over to the reservoir to post one there, only to find the sky clearing and Frank setting up a telescope. Jerry and Kathy set up a scope, too, and shortly thereafter Colin and Casey showed up, and Shade not long after that. Add a dozen or so people who came to have a look through our scopes, and it was a star party. The Moon was just a 10%-lit sliver, so it didn't wash out the sky as badly as it usually does on our First Quarter Fridays, so we were able to show people more deep-sky objects like galaxies and nebulae and faint clusters. It was a great night!

First Quarter Fridays are laid-back opportunities to do some observing and promote astronomy at the same time. Mark your calendar and bring your scope to the College Hill Reservoir (24th and Lawrence in Eugene) and share the view with whoever shows up. Here's the schedule for 2014. Note that we've scheduled some of the star parties (May 2, August 29, and September 26) a week earlier than the calendar would normally dictate in order to have less moon in the sky.

February 7 (63% lit)	March 7 (46% lit)	April 4 (29% lit)
May 2 (15% lit)*	June 6 (63% lit)	July 4 (47% lit)
August 1 (32% lit)	August 29 (18% lit)*	September 26 (8% lit)*
October 31 (61% lit)	November 28 (46% lit)	December 26 (31% lit)

*These star parties are a week earlier than normal to provide less Moon glare.

Thank You Castle Storage

For the last six years, Castle Storage has generously provided EAS a place to store its telescopes and equipment. EAS would like to thank Castle Storage for their generosity and support for our group. Please give them a call if you need a storage space, and tell your friends. They are great people and offer secure and quality storage units.

Think You Know Who Invented the Reflecting Telescope?

By Mel Bartels

The problem with Isaac Newton's 1672 telescope is that he got the design wrong, didn't build a good model and didn't disclose his technique for decades. He wrote that his design of a telescope with a spherical primary and elliptical plane mirror was fully adequate. But it was not, as we now know.

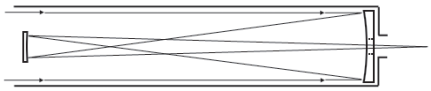
Newton's telescope

A telescope of his design of four foot focus was brought to the Royal Society's attention shortly after and was found wanting. The truth is that the spherical aberration present in his design rendered it unusable. He did not know how to make parabolic mirrors. Isaac Newton's model received much attention but ended up sitting on the shelf making not the slightest impact for half a century.

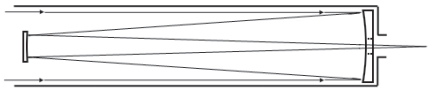
Gregorian telescope

Prior to Newton's design, John Gregory devised an all mirror design in 1663 with a perforated parabolic mirror and a smaller elliptical mirror at the front of the tube sending light back down the tube. But the parabolic curves were far too difficult for opticians of his era and attempts to build the telescope failed.

In the same year as Newton's telescope, 1672, Sier Guillaume Cassegrain, a sculptor (note the connection between his skill in casting metal sculptures and casting speculum mirrors), wrote of his design for a reflecting telescope, where Gregory's concave secondary mirror is replaced with a convex mirror. Today we judge Newton's invention as likely earlier than Cassegrain's, though it was hypocritical of Newton to criticize Cassegrain for using spherical mirrors. Regardless, the inventions of Newton and Cassegrain went nowhere.



Gregorian light path



Cassegrain light path

These designs languished partly because neither Newton nor Cassegrain gave information on how to cast the mirror or how to grind and polish the mirror, though Newton did describe his polishing technique thirty years later.

A hundred years later, in 1772, John Hadley unveiled the first reflecting telescope worthy of the name. Hadley had figured out how to parabolize his speculum mirrors. His telescope was a six inch f/10 on a solid altazimuth mount with slow motion controls. He had eyepieces that gave powers up to 230x.

His telescope was tested against a refractor of 123 feet focal length and found to be its equal in resolution though somewhat dimmer. With John Hadley's telescope, observers could see the five moons of Saturn, Cassini's Division and even Saturn's ring shadow on the planet itself. Unlike his predecessors, Hadley shared his polishing and parabolizing technique. His method of testing has been used ever since, particularly in modern times by John Dobson.

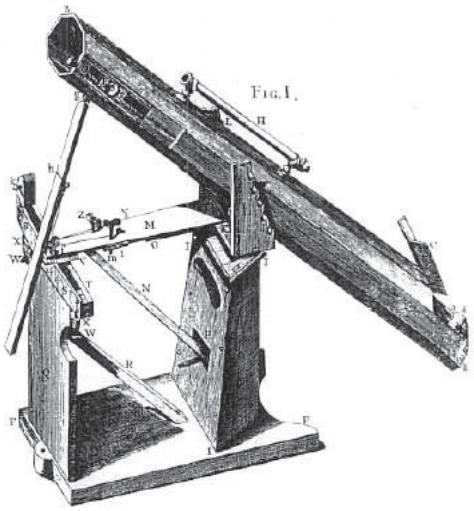
John Hadley

Thomas Edison is considered the inventor of the light bulb not because

he was first to demonstrate an incandescent light but because he developed the first practical and commercially viable electric light bulb. Karl Benz invented the automobile because he created the first true car though Leonardo da Vinci created the first designs. Galileo invented the telescope because he was first to grasp its astronomical potential and develop telescopes of increasing power even though Lippershey was first to publish and is accorded prime inventor status.

Similarly, John Hadley should be considered the inventor of the reflecting telescope.

The result of Hadley's invention cannot be understated. Once he showed his telescope and shared how to build it with others, opticians began making parabolic primary mirrors and the era of the reflector truly began.



Hadley's telescope

References:
Louis Bell's *The Telescope*, McGraw-Hill, 1922 (note that the publication date roughly coincided with the birth of amateur telescope making).
Henry King's *The History of the Telescope*, Charles Griffin and Co, 1955
John Hadley biography: http://www-history.mcs.st-and.ac.uk/Biographies/Hadley.html
Hadley's Reflector: http://amazing-space.stsci.edu/resources/explorations/groundup/lesson/scopes/hadley/
Scott Berkun's *The Myths of Innovation*, O'Reilly, 2007

John Dobson 9/14/1915 – 1/15/2014

by Jerry Oltion

Internationally renowned amateur astronomer and telescope builder John Dobson died on January 15th. He was 98. Dobson is best remembered for his passion for showing people the night sky, and for his telescope design that put large-aperture telescopes in the hands of amateur astronomers everywhere. Thanks to the Dobsonian telescope and John's outreach efforts, millions of people who might never have seen a galaxy or a nebula have had the chance to appreciate the splendors of the night sky at star parties and with their own telescopes.

John toured the country giving telescope-making classes. He came to Oregon several times, and taught many EAS members how to grind mirrors and build telescopes to put them in. John was a hard taskmaster, and blunt with his advice and opinions. Jacob Strandlien was one of his students, and he tells a story about the final exam where Dobson would examine the students' finished products and make his evaluation of them. When he came to Jacob's scope, a 12" f/8 monster

Jacob calls the "Smurf cannon" (it's blue), John had a look through the eyepiece and said, "Well, nebulae are fuzzy anyway." That comment spurred Jacob to spend two days correcting the mirror.

Mel Bartels, world-renowned telescope builder in his own right, credits a night at Crater Lake with one of Dobson's 24" scopes as the inspiration for his own interest in building large-aperture telescopes. See Mel's remembrance of John below.

I met Dobson not long after I built my first trackball telescope. I was excited about the design and told him that I hoped it could spark at least a minor revolution in telescope design like his own design had. John's response was, "Good luck with that. I was ignored for years."

Indeed he was, but he stuck with it and eventually his ideas caught on. How could they not? Dobson's ideas were truly revolutionary. John showed the world what we were missing, and he showed us how to see it for ourselves. We are all richer for his time spent here on Earth.

Ted Touw Remembers John Dobson

I met John a few times, but two stand out in my memory. The first time I met him was in the San Francisco botanical gardens on a bright sunny summer day. He was standing on the sidewalk with a small-ish solar telescope saying to everyone who passed "Hey, you want to see the sun?" The end of the telescope tube had a clear elliptical flat mounted at about a 45 degree angle to the tube axis to reflect a lot of the light toward the ground instead of down the tube. I suppose there was a filter in there somewhere, but I didn't ask, just trusted him to do it right. The view of the sun and sunspots almost filled the field of view, and sharp as a tack.

The other memory was at one of his unique cosmology lectures, this one at Western Oregon U. in Monmouth after his mirror-making class there. He had a stack of handout papers in his hand when he came into the lecture hall, so I expected him to hand the stack to someone in the front row to pass around to everybody, but instead he just walked up to front-and-center and threw the whole stack at the audience.

I heard maybe 3 years ago that he was the oldest person attending Stellafane that year.

Memories of John Dobson

by Mel Bartels

The phone was ringing; I had a grinding tool in my hands. Could I pull the tool off the mirror, throw some water on my hands and answer the phone in time? In those days there were no smartphones, no answering machines; phones were tethered to the wall with a cord.

I managed to grab the phone off the hook, my hands dripping with water and grit, and say, "Hello." It was Rob Adams on the other end, asking if I'd seen the article in the Register-Guard: something about telescopes and Crater Lake. News came by newspaper tossed on your doorstep by a delivery boy. This article was talking about "18 inch and 24 inch Sidewalk telescopes available for public viewing." Rob was pretty excited. The year was 1981 and I was skeptical (I guess some things never change).

"Yes, I saw the article. But Rob, there's no such thing as an 18 or 24 inch Sidewalk telescope. The reporter must be confused; he's talking about the length of the telescopes. These scopes must be small refactors, maybe two or three inches in aperture."

Telescopes were occasionally referred to by their length, since aperture very rarely exceeded several inches. Rob was insistent and besides, Crater Lake is a beautiful destination, he argued. So Saturday morning he swung by in his 1980's van equipped with the latest gadget, a miles per gallon sensor and display, for

us to play with on the drive. I said that some things never change. We talked telescopes on the way as the scenery changed from valley to forest, from fields to snow drifts, from valley air to crisp cool mountain air.

The final stretch into Crater Lake goes around breathtaking drop-offs and curves in the road, hiding our destination, the parking lot at the rim, until the final curve. I stopped talking in mid-sentence. "Rob, those are giant telescopes – look!" Pointing out the obvious is all I could do. Before Rob could park the van and come to a full stop, I swung open the door and jumped out, running.

Dobson's big scopes at Crater Lake

I couldn't believe it: giant telescopes in cardboard and wooden frames. How could this be? A thin wiry guy was in charge, showing people views of the Sun and sunspots. One visitor from Sweden was arguing that the sunspots were not real. The guy in charge was practically yelling, "Those are sunspots. Each one is bigger than the Earth!" The visitor left unconvinced.

I didn't quite catch the guy's name. Did someone say "John Dobson?" He was a force of nature though, a dynamic personality, and a way of talking that reminded me of cult leaders and gurus.

I could not stop looking, teasing details from the sleeping scopes. There was not a single machined bolt or adjustment screw and the thin mirrors looked to be from plate glass. On the upper end were sliding tubes for focusers and recycled eyepieces. Impossibly crude and contrary to received wisdom. Oh, and John's son was catching a nap in one of the giant telescope's tubes. John had named the telescopes with counterculture names like Delphinium and Stellatrope and "The Little One" (which wasn't so little). It was all so… different.

I felt tempted in a new way. I had the apple in my hand and couldn't wait to take that first bite. We got in line and waited our turn at the 24 incher. Decades later I still find myself at a loss for words at those first views. Perhaps Ellie's words from Sagan's *Contact*, "I didn't know, I didn't know" come closest. We got in line again and again.

I asked John Dobson about the telescope's details. He was more interested in talking about what we were seeing through the eyepiece and the universe we live in, though he did talk at length about the materials used for the telescope's motions. He didn't build the scope for the scope's sake; he built it to see the universe and to show the denizens of Earth our place in it.

Around midnight the crowd thinned. John suddenly announced that he was tired and going to bed. We could use the scope all night for ourselves as long as we locked it into position and aimed it away from the morning Sun. Are you kidding me? I thought of the contortions I had to go through for permission to use the 15 inch Cassegrain at Pine Mountain Observatory.

Rob Adams and John Dobson

I'd looked through a couple of 24 inch Cassegrains. The view in Dobson's 24 inch could not have been more different. The tiniest brightest colorful specks of light for stars, the dark field even though the Moon was rising. We stayed at the eyepiece all night, one person at the rear of the scope helping push it along and the other up at the eyepiece. It was our first introduction to the art of ladder observing. "A little more, yes… WOW!" This was quickly followed by the ladder shake from the person below. "Oh man, hurry up and look."

Before we could catch our breath the skies brightened – it was 4:30am. We locked up the scope and headed to the van for the drive back in the morning sunlight. "I have got to build a 24 inch," I kept repeating. Finally Rob slowed down and said, "If you say that one more time, I'll throw you out and you can find your own way home!"

Within weeks I had ordered a 24 inch Pyrex blank from Corning in New York and began corresponding by letter with Bob Kestner, one of John's protégés who would later, as a top professional optician at Tinsley, lead the effort to grind and figure the COBE corrective lenses for the Hubble Space Telescope.

John's telescope design was opposite to all that I had learned. He used simple non-precision recycled parts. Everything had to be push-pull adjustable. The scope didn't track; instead it used an altazimuth mount where the scope was pushed into position by hand and when let go, stayed put, even in the night breeze. There was no shaking at the eyepiece. The vast majority of scopes of that era quivered in the wind, shaking after touching the focuser. The Cave Astrola 12 inch f/8, a monster of a scope, the largest portable telescope that I had looked through, had a maddening dampening period at the eyepiece. One literally counted to twelve then looked through the eyepiece, being careful to not bump it with one's eye. But John's scope was nothing like that.

Moreover, his 24 inch, 18 inch and 12 inch mirrors were plate glass, a material that drew serious frowns from the experts. John had removed every item and accessory that was not absolutely essential to the task of viewing, simplifying the design and substituting stiff materials like wood and cardboard for metal. His mirrors floated on suspension arms, held in position with slings. Steve Jobs at Apple would become famous decades later for similar design aesthetics.

As I worked on my 24 inch, Mike and I planned a trip to Portland to scour the surplus ship yards for salvage plate glass. John had told me he got his glass from surplus ship yards. Mike and I hopped from place to place. They all told us the same story: "Some white haired hippie from San Francisco came through a few years ago and bought up all the glass." In desperation, we began looking around the yards, not taking the guy's word who stood behind the counter.

Finally near the end of one Saturday I spied some glass in the back of this joint – a lot of it. The guy up front didn't know about it, otherwise he would have sold it to John Dobson. We negotiated a price, $400 for a huge stack of glass weighing hundreds of pounds. We returned the next weekend with my station wagon. The guy had taken the least interesting half of the glass and moved it to the front, crossed his arms and insisted that this was all that there was the previous week. While Mike argued with him, I looked around and found the missing half in the back. I drove the station wagon to the back and loaded it up. On my return Mike's eyes widened when he saw the glass. We quickly began covering it with the glass stacked in the front as the guy tended to other duties. This guy was ex-Marine ex-fighter and could have pounded the living daylights out of us just by glaring at us. I knew this was true because his tattoos said so. I gave him the check saying, "$400 for all the glass in the station wagon — that was our deal, yes?" I pointed to the station wagon, weighed down with glass. With an evil smile on his face, the guy said, "Yep."

I drove out of there as fast as I could, the station wagon bouncing on its rear axle. Whew, we'd pulled off Mission Impossible. Jim Phelps would have been proud. At least until Mike said, "Say, Mel, that check you handed him. It had your address on it?" I lived in fear and closed the drapes and turned off the lights at night for several weeks until I was convinced the guy was not coming after me.

We had about 60 pieces of plate glass, mostly 12 inchers with a few 16 inchers. Mike immediately began a 16 incher — a size heretofore impossible to contemplate. Between what we turned into mirrors and what we sold, we kept busy for years, happily making mirrors with cheap materials that Mike would scrounge up: bags of titanium oxide for polishing compound and road tar for pitch. The thinnest glass served as tools.

My life would intersect with John's from time to time. The most memorable was a week spent with Dobson at John Casino's place in Seattle in 1989. Casino was finishing a 36 inch and needed help with the final tuning.

The mirror suffered from an overcorrected outer zone. Casino was experimenting with mirror mounts that warped the thin glass into a better figure.

Dobson in private was quiet, thoughtful and prone to thinking in long periods of silence. He talked about WWII, working for the war effort as a chemist, having his soul shaken when the atom bomb went off. He talked about China and his studies of eastern thought. He talked about sneaking out of the Vedanta monastery to get buckets of sand from the beach, sifting the sand into sizes to grind mirrors. I tried sand. It is tough going, grinding itself into mud almost instantly. What sheer determination John had to make mirrors from such crude materials.

Dobson testing 36-inch telescope

John also talked me into the star test. John could do that; he could be quite convincing. John's mirrors were outstanding; they gave superb star tests. They had rather long focal lengths, optimized to work with simple eyepieces to give the best magnification for sidewalk astronomy.

Later I found myself and my newly minted computerized telescope talking to John at an Oregon Star Party. He complimented me on my design.

John Dobson never strayed from his goal: showing as many people as possible the wonders of the Heavens so that they could first see, then understand. He was ignored by the establishment for years: Sky and Telescope's editor-in-chief famously writing that, "...your shortcuts...can hardly lead to satisfactory instruments of the kind most amateurs want in these large sizes. Porthole glass, makeshift wooden altazimuth mountings...are no longer suitable for telling thousands of other people who lack your knack of getting something 'passable.'" At the Riverside Telescope Makers Conference, a senior editor gave icy stares, refusing to look through Dobson's telescopes because of the wooden slatted spider vanes, un-machined construction and psychedelic paint schemes. It is a cautionary tale that expertise can be at a loss when confronted by invention. Even after his breakthrough, John spent years trying to get his book, *How and Why to Make a User-Friendly Sidewalk Telescope*, published. The book is unusual in that it combines product vision and simplified telescope making techniques, honed through the teaching of thousands of telescope and mirror making students.

What people failed to understand and sometimes do not understand today is the revolutionary nature of John Dobson's design, taking advantage of a mix of precision parts where it mattered (large aperture thin plate glass mirrors, mirror mountings with floatation levers and slings, stiction based Teflon, cork and Formica movements) and non-precision parts where it did not matter (cardboard tubes, slide focusers, wooden altazimuth mounts). Through his perseverance and intelligence, John gradually came to understand what it meant to support large thin mirrors, materials that led to smooth high powered motions at the eyepiece and a mounting design that was rock solid. Prior to the Dobsonian, there was hardly a single telescope that I can remember that didn't have some shake at the eyepiece, that didn't have trouble making small motions at high magnifications.

John radically removed features that were not essential to the mission of showing objects through the eyepiece of a large aperture telescope. In particularly, John eschewed tracking mounts, expensive eyepieces and focusers. This made his design all the more compelling for its single mission to show people the heavens through large aperture telescopes.

Further, John developed mirror making techniques for large diameter thin plate glass mirrors and their mounting in a telescope. John was first to widely disseminate large pitch lap making techniques. He brought back to life star testing, first used successfully by John Hadley in 1772 to make the first true reflecting telescope with a parabolic mirror. Along with his sidewalk astronomy, we must never forget the countless telescope and mirror making classes he conducted over the decades, particularly up and down the west coast. He made mirror making accessible for anyone.

Dobson and his 24--inch scope at Crater Lake

Further, it was a requirement of John's that the design use inexpensive recycled materials. Since John did not invent a gadget or material (as he sometimes pointed out), his design could have been built decades prior. But it wasn't, because no one thought of or put in the blood sweat and tears it took to create a revolutionary new design.

Today we celebrate design and understand its importance. Product design is the focus of individuals and companies worldwide. In John's time, it was novel and misunderstood. For example, look at the early copies of his telescope design by some amateurs. They tried to add precision back in, walking away from the compelling simplicity of the Dobsonian. It took years for amateurs to appreciate the design. John's students made numerous large aperture telescopes, introducing the era of the large aperture, low cost telescope in amateur astronomy. Through articles written by John's students in Richard Berry's *Telescope Making Quarterly*, the design and techniques spread like wildfire. Most popular was the 16 inch f/5, a size and focal ratio that continues in popularity today.

John would say that the value of a telescope is in how many people look through it, not how burnished the wood. He put his design in the public arena, eschewing financial reward. John was proud of his design and pleased with the growth of sidewalk astronomy, though the world didn't turn out exactly how he wanted: amateur astronomers too often focused on the telescope design rather than sidewalk astronomy; his cosmology fell into disfavor.

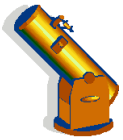
John was unfailingly kind to me over the years. John was a force of nature that comes along once every few generations. John will be missed; the Earth is a lonelier place without him. But like a great comet, John will not be forgotten.

– Mel Bartels, January 2014, upon John Dobson's death at 98.

Send Your Name To an Asteroid

NASA's OSIRIS-REx mission and The Planetary Society invite you to submit your name for a round-trip ride to asteroid Bennu. Your name will hitch a ride to the asteroid, spend 500 days there, and return in the Sample Return Capsule to Earth in 2023. Plus your name will be on the spacecraft, which will remain in space long after returning the sample return capsule to Earth.

Go here to participate: http://www.planetary.org/get-involved/messages/bennu/



Observing in February

New | 1st Q | Full | Last Q

January 30	February 6	February 14	February 22
Mercury Set: 6:56 PM	Mercury Set: 6:52 PM	Mercury lost in Sun	Mercury Rise 6:12 AM
Venus Rise: 5:30 AM	Venus Rise: 5:06 AM	Venus Rise: 4:48 AM	Venus Rise: 4:36 AM
Mars Rise: 11:22 PM	Mars Rise: 11:03 PM	Mars Rise: 10:40 PM	Mars Rise: 10:13 PM
Jupiter Set: 6:08 AM	Jupiter Set: 5:38 AM	Jupiter Set: 5:05 AM	Jupiter Set: 4:32 AM
Saturn Rise 1:59 AM	Saturn Rise: 1:33 AM	Saturn Rise: 1:03 AM	Saturn Rise: 12:32 AM
Uranus Set: 10:22 PM	Uranus Set: 9:56 PM	Uranus Set: 9:26 PM	Uranus Set: 8:56 PM
Neptune Set: 7:18 PM	Neptune Set: 6:52 PM	Neptune Set: 6:22 PM	Neptune lost in Sun
Pluto Rise: 5:46 AM	Pluto Rise: 5:19 AM	Pluto Rise: 4:48 AM	Pluto Rise: 4:18 AM

All times: Pacific Standard Time (Nov 3, 2013-March 8, 2014) = UT -8 hours or U.S. Pacific Daylight Time (March 9-November 1, 2014) = UT -7 hours.

Date	Moonrise	Moonset	Sunrise	Sunset	Twilight Begin	Twilight End
2/1/2014	08:17	20:12	07:30	17:23	05:51	19:02
2/2/2014	08:50	21:25	07:29	17:24	05:50	19:03
2/3/2014	09:23	22:35	07:27	17:26	05:49	19:04
2/4/2014	09:55	23:42	07:26	17:27	05:48	19:06
2/5/2014	10:29		07:25	17:28	05:47	19:07
2/6/2014	11:05	00:45	07:24	17:30	05:46	19:08
2/7/2014	11:45	01:46	07:22	17:31	05:44	19:09
2/8/2014	12:28	02:42	07:21	17:33	05:43	19:10
2/9/2014	13:15	03:33	07:20	17:34	05:42	19:12
2/10/2014	14:06	04:20	07:18	17:35	05:41	19:13
2/11/2014	15:00	05:01	07:17	17:37	05:40	19:14
2/12/2014	15:56	05:38	07:16	17:38	05:39	19:15
2/13/2014	16:54	06:12	07:14	17:39	05:37	19:17
2/14/2014	17:52	06:42	07:13	17:41	05:36	19:18
2/15/2014	18:52	07:11	07:11	17:42	05:35	19:19
2/16/2014	19:52	07:38	07:10	17:44	05:33	19:20
2/17/2014	20:53	08:06	07:08	17:45	05:32	19:22
2/18/2014	21:55	08:34	07:07	17:46	05:30	19:23
2/19/2014	22:59	09:04	07:05	17:48	05:29	19:24
2/20/2014		09:38	07:04	17:49	05:28	19:25
2/21/2014	00:03	10:16	07:02	17:50	05:26	19:27
2/22/2014	01:07	11:01	07:01	17:52	05:25	19:28
2/23/2014	02:09	11:54	06:59	17:53	05:23	19:29
2/24/2014	03:08	12:54	06:57	17:54	05:21	19:30
2/25/2014	04:01	14:01	06:56	17:56	05:20	19:32
2/26/2014	04:49	15:14	06:54	17:57	05:18	19:33
2/27/2014	05:32	16:29	06:53	17:58	05:17	19:34
2/28/2014	06:10	17:44	06:51	18:00	05:15	19:36

Items of Interest This Month

First week: good view of Mercury just after sunset.

Good month for zodiacal light on evenings when Moon isn't in the sky.

2/3 Io shadow transit next to Red Spot 9:19 – 11:35

2/7 First Quarter Friday Star Party

2/8 Ganymede shadow transit 6:08 – 9:22. Ganymede just exiting its own transit when shadow transit starts. Red spot centered at end of shadow transit.

2/12 Io shadow transit 5:42 – 7:59

2/15 Venus at brightest (-4.9) in morning

2/16 Europa shadow transit (the difficult one) 6:16 – 8:59

2/19 Io shadow transit 7:38 – 9:54

2/22 Callisto shadow transit (the rare one) 7:05 – 10:53 Red spot centered at end of transit

2/23 Europa shadow transit 8:52 – 11:35

2/26 Io shadow transit 9:33 – 11:49

For Current Occultation Information

Visit Derek C. Breit's web site: http://www.poyntsource.com/New/Regions/EAS.htm

Go to Regional Events and click on the Eugene, Oregon section. This will take you to a current list of Lunar & asteroid events for the Eugene area.

All times are for Eugene, Oregon, Latitude 44º 3' Longitude 123º 06' for listed date