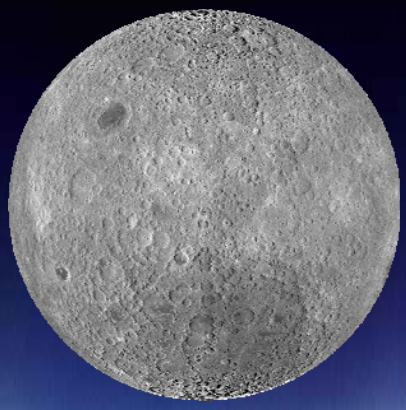
THE OBSERVER

The Astronomy Club of Tulsa's Newsletter Published Since 1937

RON WOOD BRAD YOUNG ANN BRUUN JOHN LAND
K.C. LOBRECHT STEVE CHAPMAN ROD GALLAGHER JERRY MULLENNIX

SPECIAL EDITION

MUSINGS ON ASTRONOMICAL CATOLOGS!



ADVENTURES IN OZ!

THE FAR SIDE OF OUR MOON LIKE NEVER BEFORE

www.astrotulsa.com

MAY 2011

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THE COVER

The cover: If your wondering what's wrong with the moon then you have a good eye, that's the back side of our moon over a distorted view from Mt. Everest.

The lunar farside as never seen before! LROC WAC orthographic projection centered at 180° longitude, 0° latitude. Credit: NASA/ Goddard/Arizona State University. Read more in this issue: The Far Side of the Moon— And All The Way Around.

Weather is warming up and spring summer star party's are about to fire up in the Tulsa area. Many of you have telescopes that have been in the dark of the closet biding there time until this moment. Well its time to attach all of the gizmos you have purchased through the long winter months and head up.

Weather your interest in astronomy is personal, casual or you are trying to achieve certificates or contribute to the science. My goal as the editor of the Observer is to provide as much useful information about astronomy in Tulsa as I possible can.

We added several new sections last month and will test some others over the summer. If you have an idea or a suggestion for the Observer by all means shoot me an email. jerrym@pantherenergy.us

ACT New Members

RECENT NEW MEMBERS

1. Kevin Pargeter
2. Kenneth Weikel
3. Cody Lawson
4. Jefferson Davis
5. Paul hailes
6. Eric Kingery

WELCOME BACK MEMBERS

1. Rick and Peggy Walker
2. Damon Green

THE OBSERVER IS EDITED & PUBLISHED BY: JERRY MULLENNIX

LETTER FROM THE EDITOR

By: Jerry Mullennix

I would like to carve out a little space in this months newsletter to say a few things. It wasn't easy to find space because we had more contributions to this months newsletter than we have had in a long, long time. WOW 40 pages this month and I cut 8 pages including my own four page article As The Dome Turns, (look for it in June) sorry John best I could do. I hope this is an indication of things to come for our club.

As 2011 rolled in our little newsletter had ceased to be published and things looked a little grim when I came back as the Editor with no schedules being met and interest in the Observer seemed like it had seen its best day. John Land was passing info on with a well thought out email but it was not a good substitute for a monthly newsletter.

I did a quick re-design and replaced the standard info we were publishing with what I hoped was things of interest to our club. In the beginning it was mostly John Land, Ann Brunn and myself trying to fill an entire newsletter because we believed even with all of the information on the internet our club needed a publication specific to our group.

Last Month Ron Wood from TUVA jumped on board as a regular with a style of writing only someone with Ron's years of astronomy could add. This month Brad Young brings Australia to Tulsa with a neat little article about his time down under.

John and Ann continue to make sacrifices of their time and have contributed much of what you read in the Observer and if you see any of these people on the observing field please join me in giving them a special thank you.

Others like K.C. Lobrecht and Steve Chapman have been instrumental with their contributions as well several others you will see in this issue.

With that said you should know there is still plenty of room for improvement and more contributions from you. Remember, the Observer is about you and by you so its only as good as those who contribute make it.

As the summer observing months creep in and you get a great night of viewing take a little time the next morning to write about your experience and shoot it to me in email form. jerrym@pantherenergy.us

Just like that you will find yourself in print. Don't be surprised at the next Star Party if people don't crowd around and ask you to elaborate and tell you how much they enjoyed your article. When you point something out in the sky folks will listen to what you say. After all you're a published astronomy writer, you must be right.

Since the Message From the President has traditionally been on this page I want to bring your attention to our meeting this month as it's the last for the summer season. If your looking for the Message From the President it has been moved to the back of the Newsletter with the rest of the club business information.

May 20th Meeting at TCC Metro Campus Astronomy club meeting Seismologist Austin Holland from OU will speak on "Past and Present Earthquakes in Oklahoma: recent observed increases in the number of earthquakes". He will be talking about new observations of seismicity patterns within the state and discussing the implications of the recently observed increase in the number of earthquakes within Oklahoma. " http://www.okgeosurvey1.gov/pages/home.php

MAY FEATURES

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Musings On Astronomical Catalogs By Ron Wood Page 10

John Land explains the motions of the Moon and the Sun Page 15

Ann Bruun battles with Sue French in Sextan Page 19

To make room for others I cut As The Dome Turns this month but look for my article in June when I give my interpretation of Eyepieces in As The Dome Turns

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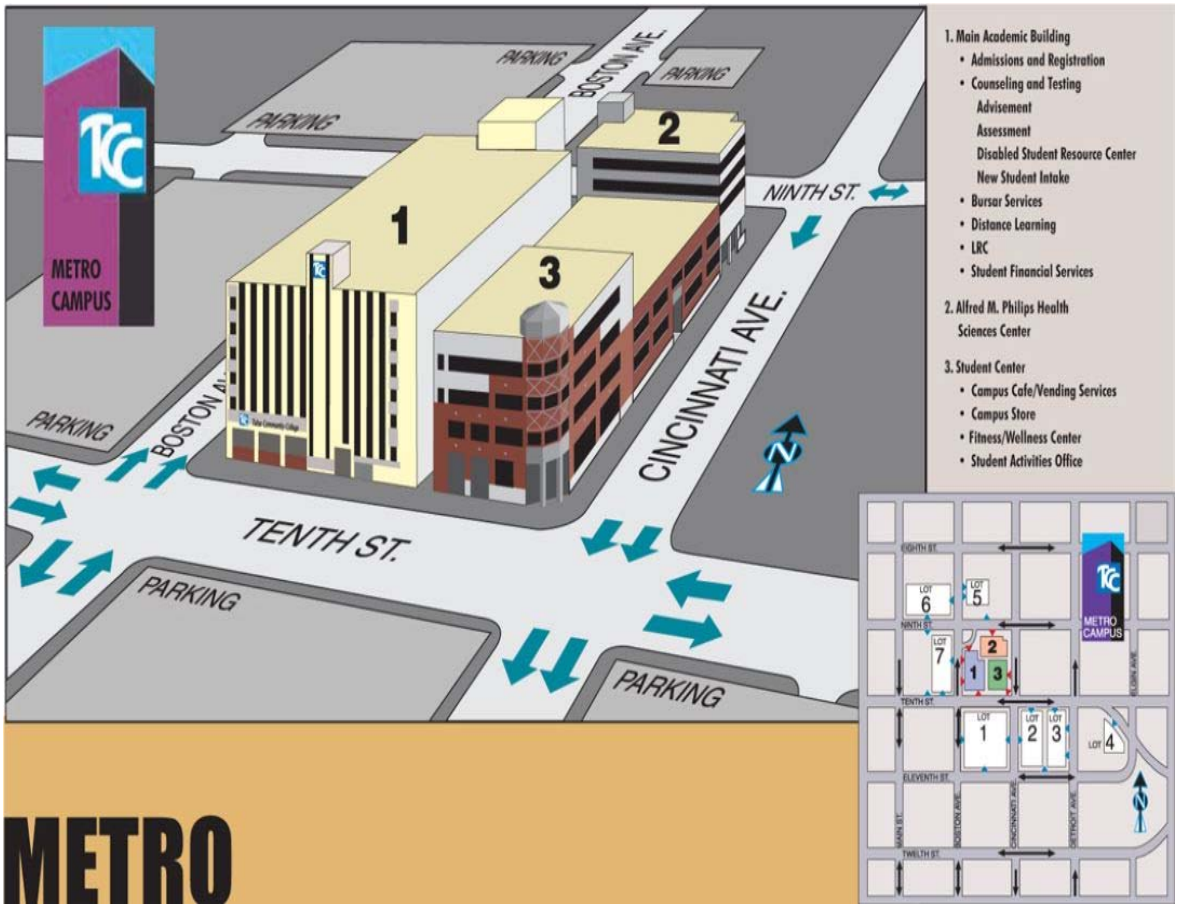
EVENTS

EVENT	PROGRAM	WHERE	DATE	TIME
May Meeting	Seismologist Austin Holland from OU will speak on "Past and Present Earthquakes in Oklahoma	TCC Metro Campus- Philips Auditorium	5-20-2011	7:00 PM
SideWalk Astronomy	Public	RiverWalk Crossing	5-21-2011	8:30 PM
May Star Party	Public	ACT Observatory	5-27-2011	8:30 PM
June Star Party	Members Only	ACT Observatory	6-3-2011	8:30 PM
SideWalk Astronomy	Public	RiverWalk Crossing	6-18-2011	8:30 PM

TCC Metro Campus - Philips Auditorium Located in Building 2 at the corner of 9th and Cincinnati. Park in Lot 5 to the north on Boston Ave.



NGC 3972

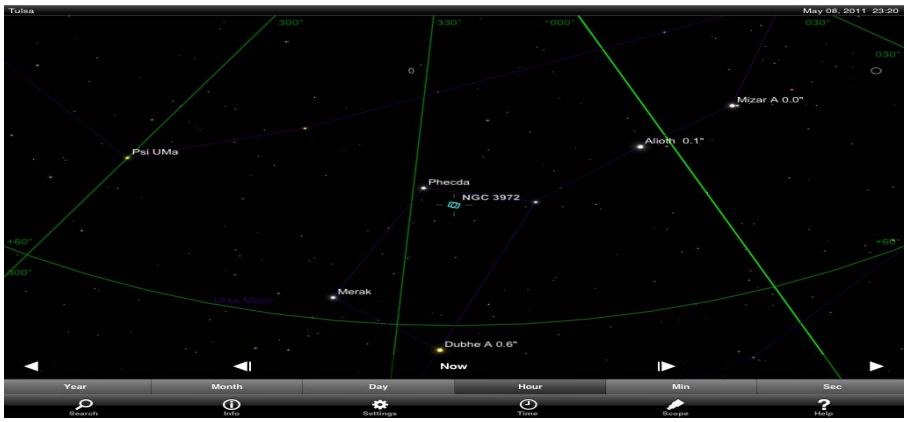
By: Jerry Mullennix

On 4-29-2011 a report of a super nova was filed:

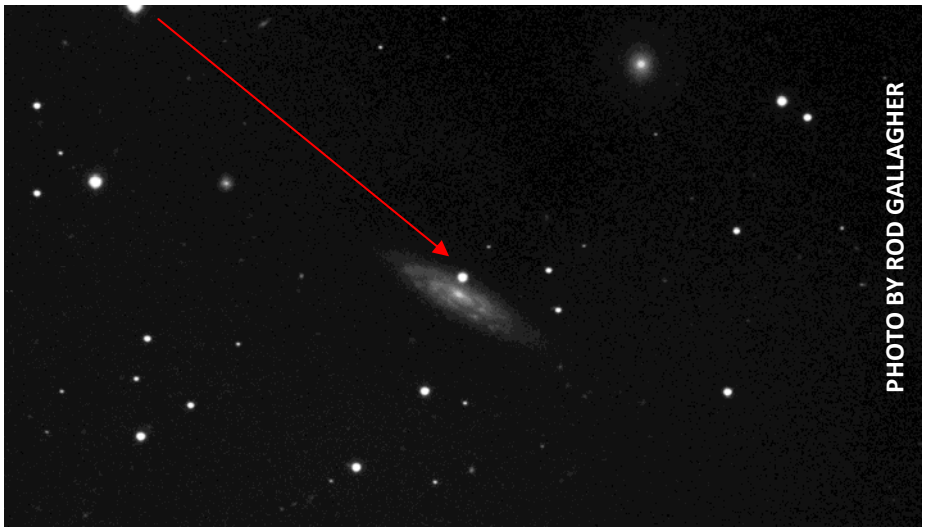
PSN J11554556+5519338, a possible Type Ia supernova, has been detected in NGC 3972, a 12th-magnitude galaxy in Ursa Major. It's currently magnitude 14.2 and brightening. (initial report)

Over the following week a flurry of emails went around several members of ACT (actually info went around the world on this one) and several of our group made attempts at seeing the super nova. K.C. Lobrecht made several gallant attempts from her house south of Tulsa as well as many others.

The problem for most was Mag 12 in Ursa Major was a near impossibility for visual through the Tulsa sky glow. For me it was living in Tulsa itself and most activity taking place during the work week. However, I followed K.C and Rod with great anticipation of any kind of report.



5-03-2011



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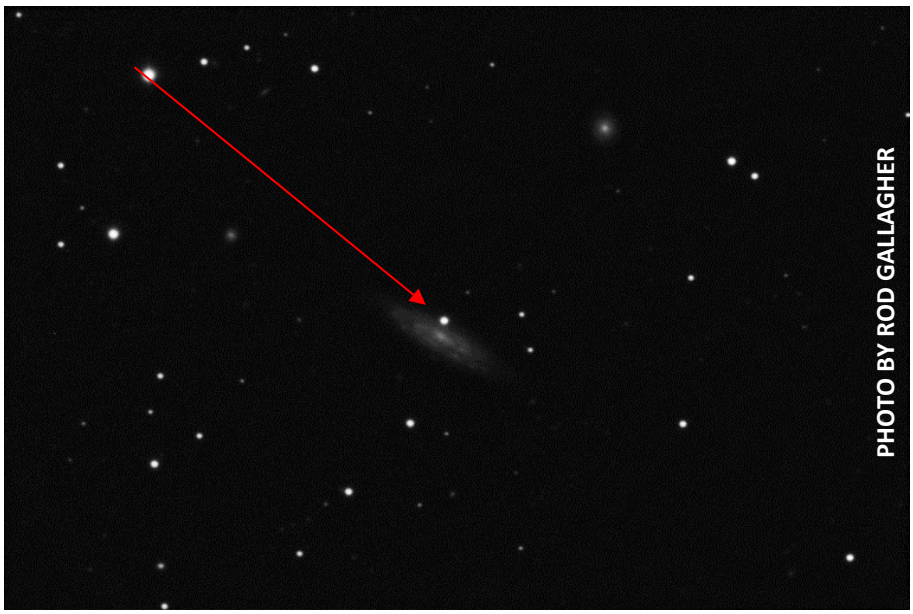


ROD GALLAGHER TO THE RESCUE

Rod Gallagher was able to photograph the SN and submitted these photos.

These were taken 3 days apart and without a doubt Rod captured the Super Nova PSN J11554556+5519338

These are great images with the Super Nova just above the galaxy Rod clearly caught these after it had brightened from the initial report of Mag 14 because in both photos the SN is brighter than the galaxy core itself.

NGC 3972 is a Spiral Galaxy in Ursa Major with a Visual Magnitude of +12.31 and Apparent Size of 3.6 X 1.0 at RA 11.939252h and Dec +55.255871 ^{0}

ADVENTURES IN OZ

BY: BRAD YOUNG

I've been asked a few times about my trips to Australia. The short version I have given so far is that there is no way to describe the beauty of the skies, the friendliness of the hosts, the seamless organization of the star party itself, and the substantial increase in my level of interest in the hobby. This short shrift treatment has not satisfied anyone. So here is a more detailed account, which pushes the Wizard of Oz allusion well past the breaking point.

The Black and White Portion of the Movie

Just like most folks, I had always dreamed of going to the southern hemisphere for astronomy. I had a taste on a business trip to Malaysia long ago, after which I tried to book a trip to Australia, but that didn't pan out. It is also daunting to ship equipment, and the rent-a-scope ideas looked iffy.

Luckily, in 2009, Tim Davis told me about a new amateur astronomy group ACT was working with called Three Rivers Foundation (3RF) in Crowell, Texas. In researching them, I noticed they are associated with 3RF Australia, which holds a star party specially designed for Northerners, called the OzSky Star Safari. Since the company I worked for had just gone belly up, I had the time and took a leap and went. I was just able to get in to a full tour and despite losing my passport a week before the trip (found, incidentally, preparing for this year's trip), I was able to go and had the time of my life.

I fell asleep on the plane to Sydney and woke up, like Dorothy, in a strange, wonderful place. Instead of lions, tigers, and bears, it had kangaroos, Tasmanian devils, and koalas.

It Kind of is Like Kansas, Toto

I won't spend too much time about the first three days, when you're adjusting to the time zone and seeing the plentiful sights in and around Sydney. For one thing, a lot of it is a bit blurry due to jet lag. Wisely, the Aussies keep you busy so you won't think about that and can get all you can out of being well immersed in another culture.

On the fourth day, you take a very comfortable train to Dubbo. This year, one of the guys in the tour even talked the engineer into letting us sit up in the cab with him for the trip! Then drive on about 2 hours to Coonabarabran, where the motel accommodations are located. The star party is on the grounds, right outside your back door.

Once you're in the bush, you will find things very familiar. I liken it to Okie-Tex; the accommodations are simple and comfortable, the people are wonderful, and the skies are spectacular. They do talk a bit funny, and they drive on the wrong side, but otherwise, it is a great mix of the familiar and novel.

The southern sky is purported to be better in DSO's than the northern, and I can't argue against that. At the least, it is as good, and there are singular objects such as the Clouds, the Sack, and the Eta Carinae nebula that are breathtaking. But even beyond the eye candy, seeing new constellations, familiar ones upside down, and the bright southern Milky Way overhead instead of lost in the muck is well worth the trip.

The sky darkness at Coona is also comparable to the Adams Ranch site or better, not quite Okie-Tex. The Aussies took sky meter readings, and apparently it was quite dark. I'd guess Bortle +2 sky. The best reported SQM at OzSky 2011 was 21.72 mag/arcsec^2 with an average of 21.68 mag/arcsec^2. The best ever seen there has been 21.92 mag/arcsec^2 which was seen in both 2009 & 2010. The motel has a lights out policy while we're there and we switched all the bulbs in our rooms to red.

Horsepower

The scopes available at the star party in 2011 are pictured below:

2009 had another 25" Obsession, a huge binocular scope, a binocular chair, and perhaps more I don't remember. The little 18" Ultra Compact in the foreground was new this year, and I used in extensively for satellites, as it had no motor or push-to capability. All the other scopes were full blown motor guided, push-to scopes with Argo Navis. Don't worry if any of this is gibberish, the hosts will train you on Argo Navis and it's a breeze to use. I didn't even complete the short training in 2009 and picked it up quickly, and I had never used push-to before and rarely use go-to. Incidentally, they have a great collection of eyepieces, all Naglers and Ethos, but bring your favorite along.


Lachlan MacDonald, 3RF Australia

For you imagers and computer nerds – remember, I am all visual and didn't bring a PC, but I did notice the hosts set up a wireless internet at the motel. Some folks in 2009 brought their own imaging equipment. Since I don't understand the dark side at all, I would guess the setups were limited by airline restrictions, but they took some dang good photos.

Hysterical Blindness

2009 was a wonderful trip, though there were sucker holes the first few nights and it got a bit cold near dawn, as late May there is similar to our Thanksgiving season. The temperatures and weather at the star party location in New South Wales is quite similar to Oklahoma, though they don't get snow and are drier in normal years. I came away from 2009 thinking that was once in a lifetime, and was quite content and fulfilled if it had been. But of course, it wasn't….

In 2009, the excitement of a new continent and unknown sky was a huge enticement to go. 2011 could not repeat the novelty, so I expected a bit of a letdown. That and the La Nina affect, with terrible floods north of the site, got me in full OCD mode, checking the rain forecasts every day leading up to the trip. Much like the Wicked Witch, I melt when it rains (or even is cloudy). The pleasant shock was that 2011 was an even better than once in a lifetime trip, for several reasons.

Home Run #1

The weather was nearly perfect, with only 1 night of 7 having a quick cloudburst rain that cleared up by midnight. Since my first trip, the dates have been moved back to March (2011) and February (2012), which means warmer and drier weather patterns.

I logged 52 hours in 7 nights – very comparable to my best week ever (June 2009, at ACT). Most "time off" was due to sheer exhaustion, dew, or the first night, after travelling all day. I was up until dawn 4 nights. As I often find at the end of a great star party, I suffered "hysterical blindness" after about 5 nights of relentless photon saturation. I had hoped for this, and had a Plan B involving the second reason.

Home Run #2

The 2011 trip was timed perfectly for the equinox, when geostationary satellites (e.g. DirecTV) are reflecting sunlight back to us just before and after they pass through the earth's shadow. So I was able to use both the southern and eastern advantage to the location, and add to my portfolio of satellites seen as well as deep sky objects, that I can never see at home.

Home Run #3

The 2011 group was small, only 7 compared to the usual 30 as in 2009. This led to even more eyepiece time – in fact – there was not one moment I did not either have a scope to myself or was next in line with willing partners as we ticked off our new objects or returned to a stunning piece of eye candy. But don't fret if the tour is full; even in 2009 I was able to observe with a partner (Mike Roos) and we got all the eyepiece time we wanted. 3RF will simply add scopes to suit the crowd at hand.

Getting there is, well, Kind of Fun

I'm not going to sugar coat the air leg of the trip. If you've never flown 14 hours, you will want to prepare with cushions, earplugs, etc. My solution is my wife's sleeping pills and the free booze. Or, if you're super rich, fly business or first class. But once you see what you do, you'll realize the trip was worth it.

The inland travel and, in fact, everything about your time in Sydney and inland is organized, timely, and easy. If you don't want to drive on the left (I can barely drive on the right) there is always someone to share a car for the short trip to Coona from the train and into town for supplies.

All the details and information you need to book this is found at www.OzSky.org:

Your Friends on the Yellow Brick Road

Because the guys in Oz may see this, I won't name who the Tin Man, Lion, and Scarecrow are. It's pretty obvious once you meet them. Just like their movie counterparts though, they are there with you all along the way, from the first day at Sydney, through the planned sightseeing (completely optional) and on to the star party. The scopes are well maintained, and the Oz hosts are very adept at herding cats and suffering through Yank complaints, all with a great smile, and a story to share.

I also got a chance to catch up with Chris Wyatt (aka "The Comet Guy") who I met in 2009, and has posted to the ACT board a few times. All the folks I met in 2009 are still in contact, and this year we met several fellows from South Korea. Local Australians, including professionals from the Siding Spring Observatory pop by on occasion. OzSky has also been at the same time as the South Pacific Star Party, allowing even more chances to meet and greet fellow astronomers.

The Takeaway

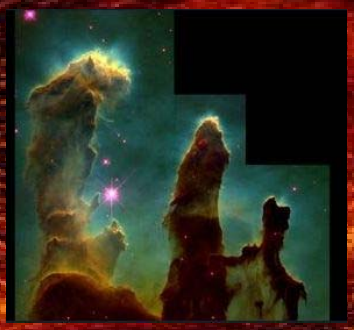
There is another end zone of the field you can't see from your seat at this football game. Instead of waiting for a tornado to carry you there, write your own fairy tale and go to Australia to see the wonders that await you at a safe, well run facility with top-notch equipment and friendly, knowledgeable hosts. If you think I'm gushing, you're right. For me, this was a life altering experience that cannot be adequately described, only experienced. Go to OzSky 2012 in February.

Brad Young

All photos by Lachlan MacDonald, 3RF Australia

HAVE YOU EVER WANTED TO PRINT OUT YOUR OWN POSTERS FROM THE IMAGES SENT BY HUBBLE?

WELL HERE IS HOW YOU DO IT.



SUBMITTED BY: JERRY R. MULLENNIX

Each photo has been adapted specifically for high-quality printing.

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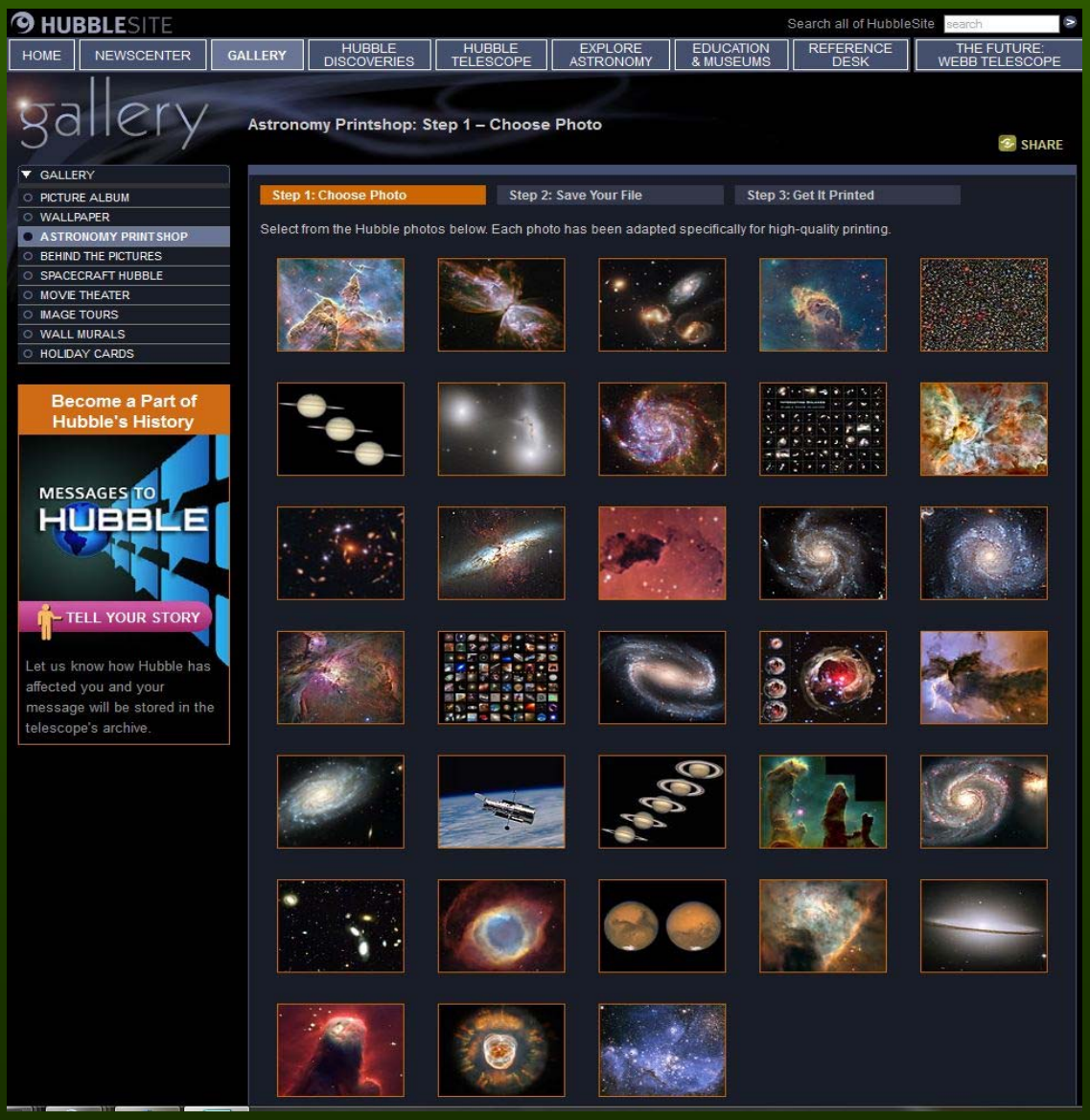
Simply type the above web address into your browser and you will find all of the directions to print your own Hubble pictures.



MUSINGS ON ASTRONOMICAL CATALOGS

BY: RON WOOD

As a beginning amateur I was sometimes confused and mystified by the nomenclature encountered in books and maps. In time I realized that at least some of the confusion was a result of the welter of catalogs that have been produced throughout the history of astronomy. So the following is an attempt to sketch a very brief history of astronomical catalogs and, hopefully, to bring into focus those most often encountered by the beginner.

One of the earliest known catalogs is from the Babylonians late in the second millennium BCE. Written on clay tablets it contains 36 stars. Several Greek catalogs are known from the latter part of the first millennium BCE culminating in the work of Hipparchus (190-129 BCE) who is credited with the first comprehensive star catalog of the western world. He extensively applied mathematics to astronomy and in the process discovered the Earth's precession. In 1988 the first satellite dedicated to astrometry (measurement of star positions) was named Hipparcos in his honor.

Building on the work of Hipparchus, Ptolemy's "Almagest", 300 years later, contained a catalog of 1022 stars. Another catalog of historical significance though little known in the West is "The Book of Fixed Stars" by the Persian astronomer Azophi. Published in 964, it describes more than a thousand stars in detail and provides the first descriptions of the Andromeda Galaxy and the Large Magellanic Cloud.

There are two early catalogs still in use today. The first is Johann Bayer's (1572–1625) "Uranometria" published in 1603 listing bright stars. These are given a Greek letter followed by the genitive case of the constellation in which they are located; examples are Alpha Centauri and Gamma Cygni. A problem arises with constellations having more stars than there are Greek letters. Bayer responded by using lower-case Roman letters ("a" through "z"), and then upper-case letters ("A" through "Q") after the Greek letters were exhausted. Only a few of those designations have survived but a trace of his system is found in the naming of variable stars which start with "R" through "Z", then "RR", "RS", "RT"..."RZ", "SS", "ST"..."ZZ" and beyond.

A second influential early catalog comes from the English astronomer John Flamsteed's (1646–1719) "Historia Coelestis Britannica." It kept the genitive-of-the-constellation rule for the back end of his catalog names, but used numbers instead of the Greek alphabet for the front half. Examples include 61 Cygni and 47 Ursae Majoris.

Until the invention of the telescope astronomical catalogs for the most part contained only stars but in 1888 J.L.E. Dyer published the New General Catalog (NGC) of deep sky objects using observations by William Herschel and his son John. It contained 7,840 entries and was later expanded with two Index Catalogs (IC I in 1896 & IC II in 1905} adding a further 5,388 objects. NGC2000 was published in 1988 by Sinnott correcting the many errors contained in the early version. Entries are sorted by Right Ascension and the NGC is a workhorse for amateurs.

The Henry Draper Catalog (HD) is an important star catalog published between 1918 and 1936 giving spectral classifications for 225,300 stars. By 1949 the catalog was extended to 359,083 stars. It was part of a pioneering effort to classify stellar spectra and its catalog numbers are commonly used as a way of identifying stars.

The catalog most familiar to amateurs was created by the French astronomer Charles Messier and was originally published in 1771, with the last addition, (based on Messier's observations), made

in 1966. Messier was a comet hunter so he created a list of "embarrassing objects" that frustrated his searches. This compilation, made in collaboration with his assistant Pierre Méchain, is known as the Messier Catalog. The first edition included 45 objects, with Messier's final list totaling 103 objects. Other astronomers, using side notes in Messier's logs, eventually completed the catalog with 110 objects.

Very popular with amateurs, The Caldwell Catalog contains 109 bright star clusters, nebulae and galaxies. The list was compiled by Sir Patrick Caldwell-Moore, as a complement to the Messier Catalog which Moore noted did not include many of the sky's brightest deep-sky objects, including the Hyades, the Double Cluster and NGC 253. The Messier Catalog also excluded many bright deep-sky objects visible in the Southern Hemisphere such as Omega Centauri, Centaurus A, the Jewel Box, and 47 Tucanae. He compiled his list and published it in Sky & Telescope in December 1995. The Caldwell Catalog is ordered by declination, with C1 being the most northerly and C109 being the most southerly, although two objects (NGC 4244 and the Hyades) are out of sequence.

The Herschel 400 catalog is a subset of William Herschel's original catalog of 2,500 deep sky objects, selected by several members of the Ancient City Astronomy Club in St. Augustine, Florida around 1980. They decided to generate the list after reading a letter published in Sky & Telescope suggesting that Herschel's catalog would be an excellent basis for deep sky object selection for amateurs desiring a challenge after completing the Messier and Caldwell Catalogs. It is the basis for the Astronomical League's Herschel 400 Club.

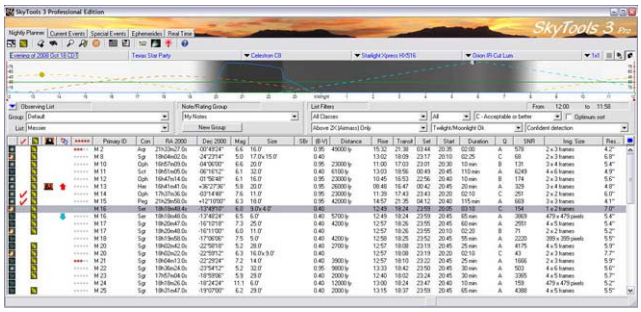
With the advent of automation and satellites capable of observing the whole sky astronomical catalogs have proliferated to the extent that it is even hard to know how many there are at any given time. Wikipedia lists almost 200 astronomical catalogs. Not only are there catalogs for every type of object but there are catalogs for different spectral bands listing positions and magnitudes of sources from the infrared to ultraviolet to gamma rays. There are many exotic catalogs online and they can make for some interesting browsing. Below is a small sample of catalogs that I find interesting for one reason or another.

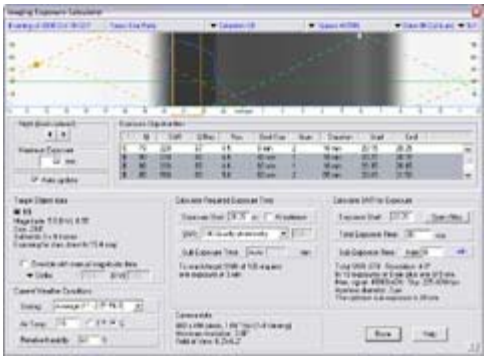
In the 1950s using large Schmidt cameras the Smithsonian Astrophysical Observatory in cooperation with Palomar Observatory photographed the whole sky at both red and blue wavelength. In 1966 these plates along with several earlier catalogs were used to compile the SAO catalog. It contains positions and proper motions for 258,996 stars. With the Hubble telescope came the need for guide stars with accurately known positions. The SAO photographic plates were digitized and positions were accurately determined for stars down to 15th magnitude to produce the Hubble Guide Star Catalog.

Beginning in 1989 with the launch of the Hipparcos satellite, automated space based data collection opened a new era. Hipparcos was a project of the European Space Agency and data was taken to determine position, distance, parallax and proper motion for more than 100,000 stars as dim as 15th magnitude. The name "Hipparcos" is both an acronym (High Precision Parallax Collecting Satellite) and a tribute to the early Greek astronomer Hipparchus; it is especially apt since both man and machine were very much about precise data. A brief comparison may help appreciate just what has been accomplished. Tycho Brahe achieved a precision of about 2 arcminutes in his observations of star positions. The measurements from Hipparcos are accurate to one milliarcsecond which is 1/10,000 the angular size of Mars at its smallest. Parallax and proper motion measurements are equally precise. Compare this precision to the proper motion of Barnard's star which is 10.3 arcseconds per year. This is high precision indeed. The Hipparcos catalog was published in 1997 and in 2000 the Tycho-2 catalog also based on the Hipparcos data was released on cd and contains similar data for 2.5 million stars.

The times they are a changing and it may now be that every decade will be a new era. The Two Micron Sky Survey (2MASS) was completed in 2001. In the 30 years since the last infrared sky survey advances in infrared detectors have made it possible to detect sources 100 million times fainter than before. As a result 2MASS has cataloged more than 300 million point sources and more than 100 million extended sources to a limiting magnitude of about 14. In the process 2MASS detected the first brown dwarfs, extensively surveyed low mass cool stars and mapped distant galaxies previously obscured by the Milky Way. In the words of one of my favorite Guy Clark songs: "Where's it all headed and how'd it get this far?"

SkyTools 3 Club Discount





Discount offer

SkyTools 3 is offering discounts to astronomy clubs that make group orders. SkyTools 3 is observing software that can be used for planning, creating charts and logging observing sessions. It is offered in a Standard and Pro version. Here is the URL to their website:

http://www.skyhound.com/skytools.html

The club discount applys for orders of 2 or more. A 25% discount is offered for the first 2 to 9 with higher discounts for 10-24 etc. See details at:

http://www.skyhound.com/club_discounts.html

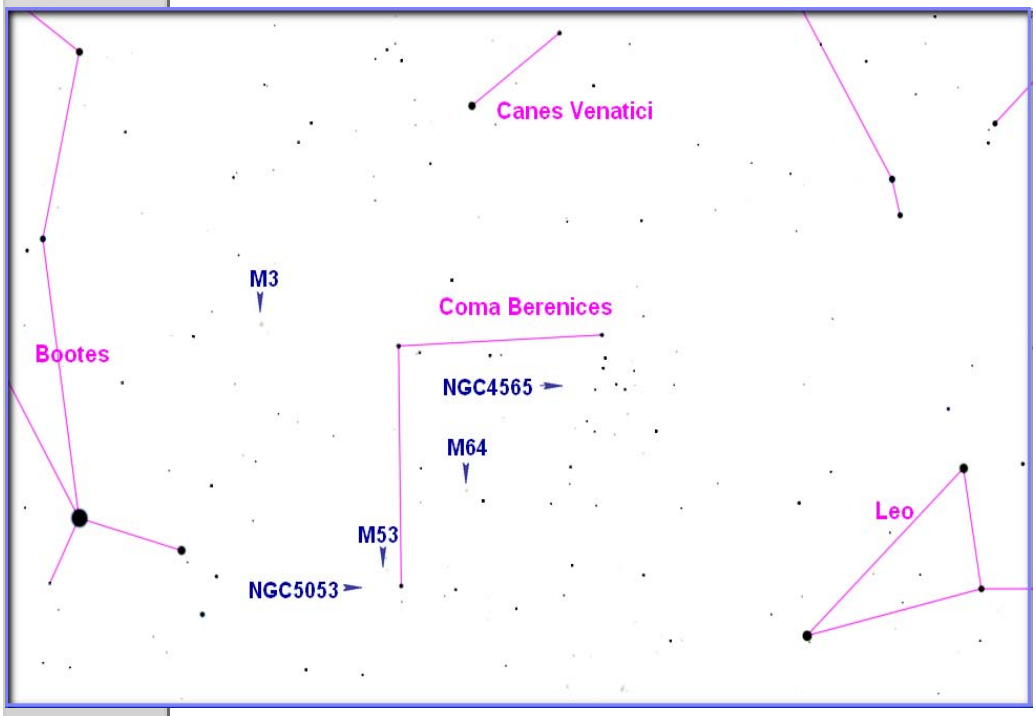
Any Astronomy Club of Tulsa members that are interested in ordering a copy should let me know at act_obs@astrotulsa.com (that's act_obs) I plan to make the order around the end of May.

Ann Bruun

Hopping Around Berenice's Hair

BY: ANN BRUUN

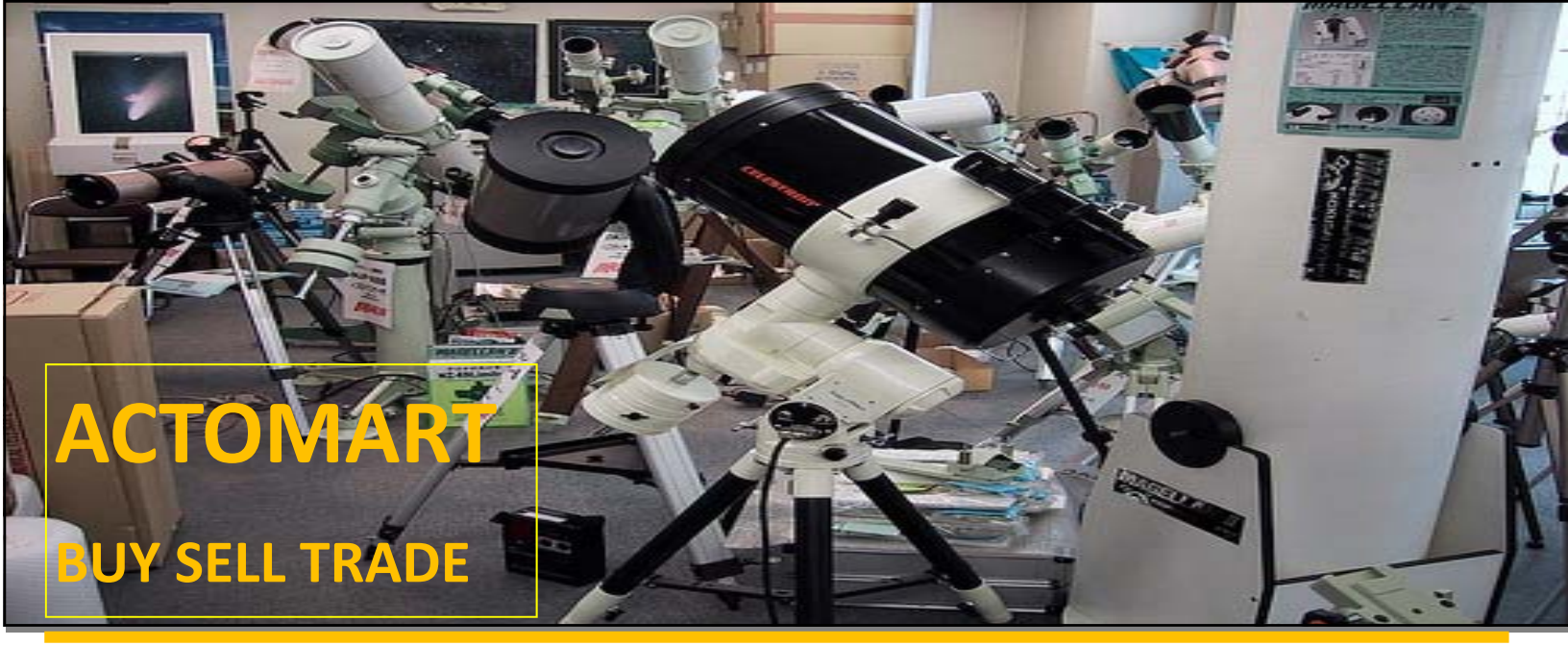
Springtime means lovely green grass, flowering trees, warming nights and most exciting of all, globular clusters. High overhead this spring we can find one of the brightest globs, to kick off this star hop.



M3 is located between two bright stars, Alpha Canes Venatici and Alpha Bootis. It is one of the nicest globular clusters in our skies, large and easily resolvable even with a small scope. The stars gradually brighten to a tight concentrated center. Moving down toward Alpha Comae Berenices we find **M53**. Less than 1° up and to the left from Alpha. M53 is smaller, dimmer and a little more concentrated than M-3 but it is still a nice sight. For a challenge look for **NGC5053** a very different looking globular 1° down and left from M53. NGC5053 is a very low concentration globular. It has no bright core and could easily be mistaken for a rich open cluster. Try using a wide angle or low magnification eyepiece to get both globulars in the same field of view.

Moving inside the Coma Berenices box we find **M64** also known as the Blackeye Galaxy. It is a fairly bright, elongated galaxy with a bright core. The dark smudge near the core that gives the galaxy its name will need an 8 inch or larger scope and high magnification to be seen. Averted vision may also be needed.

Finally, moving on up into Coma Berenices toward Gamma we find **NGC4565** an edge-on galaxy. NGC4565 is a beautiful needle of light with a bright swollen center. Try increasing magnification to make out the prominent dust lane cutting through the core. It is a truly marvelous sight.



ACTOMART is a available to any member of the Astronomy Club of Tulsa free of charge. If you would like to sell your items on ACTOMART please contact John Land or Jerry Mullennix and we will be happy to post your products.

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MOON SUN MOTIONS!

BY: JOHN LAND

Question from Reader named Jack

Hi folks I am wondering if you can direct me to an explanation of why, sometimes, (like today) the full moon does not rise at sunset, but 90 minutes later. April 18, 2011 Sun Rise: Set: Actual Time 6:42 AM MDT 8:31 PM MDT Moon 10:00 PM MDT 6:35 AM MDT Also, how to explain the geometry of the changing azimuth of the moon at moon-rise, which changes widely & dramatically, apart from the seasons.

John's reply

You have been very observant to notice that the moon does indeed radically change its position along the horizon as it rises from day to day. Most people just assume the moon comes up as soon as the sun sets. Even a casual observer will soon learn that the moon is not always up as the sun sets and depending on its phase the moon may not appear in the sky until several hours after sunset. On the other hand those who rise early for work or exercise may often see the moon still well up in the sky as the sun rises. In fact a careful observer may notice the moon in the sky during broad daylight. I prepared two Quicktime videos to illustrate these motions. **See Links at end of article.**

Motions of the Sun and Moon

To understand the motions of the moon and planets we will first start with the motions of the Sun.

The Sun path among the stars called the Ecliptic. The Sun takes a year to travel completely around the sky as it passes through the 12 constellations of the Zodiac.

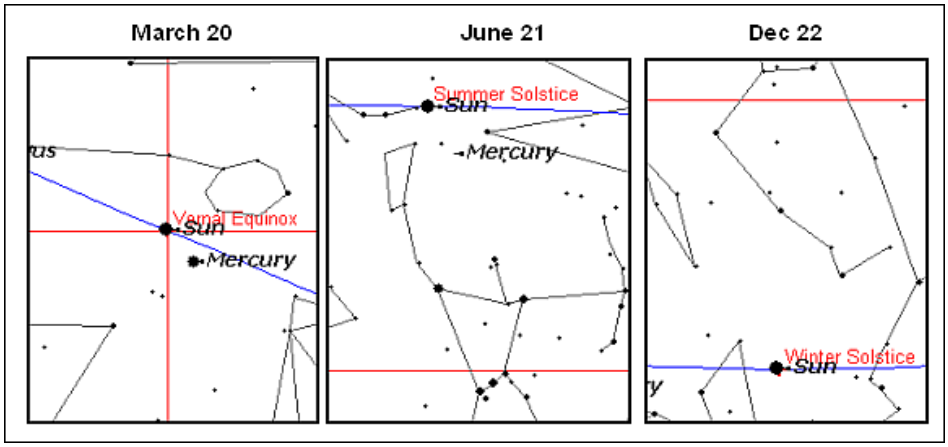
(Actually there are 13 constellations along the Ecliptic but that's a whole other topic)

Of course we know the Earth revolves around the Sun but from our perspective we see the Sun

moving eastward among the stars about 1 degree per day.

The Sun takes a full year to return to the same position along the Ecliptic. On March 20th each year we find the Sun on the Equator at the ***VERNAL EQUINOX*** **– the first day of Spring.**

From March 20 to June 21, *the Summer Solstice*, the Sun moves farther and farther north each day as it rises. Then begins move south until it reaches the Equator again on September 23rd as Autumn begins. From Sept 22 to Dec 22, *the Winter solstice*, it moves south to its lowest point and then returns to begin again to the Equator in March. **The reason for this is that the Earth's Equator its tilted 23.5 degrees to the plane of its orbit around the sun.** Everyone knows the days are longer in Summer than Winter. Here in Tulsa on **June 21st** the Sun is up for **14.5 hours** but on **Dec 22nd** it is only up for **9.5 hours**. The noonday sun on **June 21st is 77.5 degrees** above the horizon but on **Dec 22nd** the sun never gets higher than **30.5 degrees** as seen from Tulsa. These are the primary reasons for our large seasonal temperature changes.



In the images above the **ECLIPTIC** is shown in **BLUE**The Earth's **EQUATOR**

is the horizontal **RED** Line

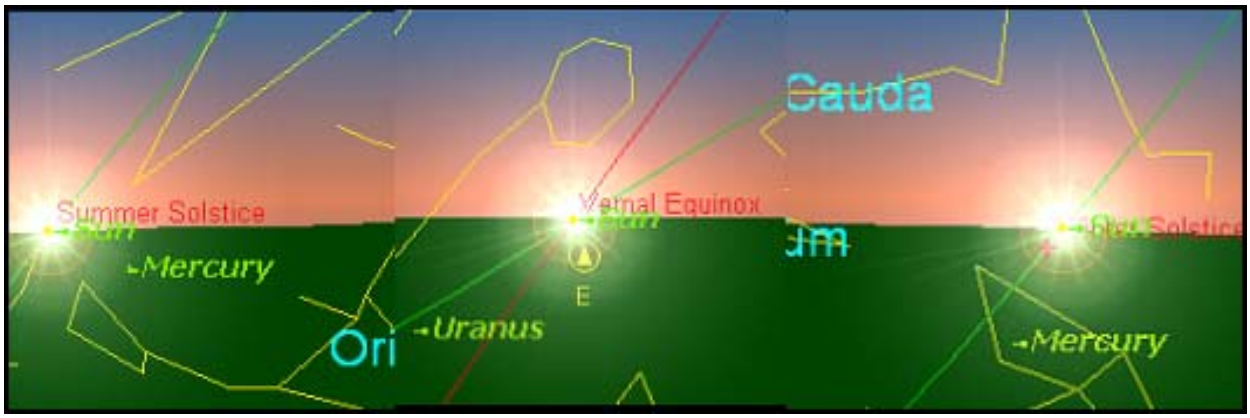
On **March 20th** the Sun is **on the Equator** – on **June 21** it is **23.5 degrees above** the Equator

and on **Dec 22nd** the sun is **23.5 degrees below** the Equator

The direction that an object rises can be measured by its Azimuth. **AZIMUTH is a numerical expression of direction measured in degrees.** Due **NORTH** has an Azimuth of **ZERO** degrees

EAST = **90** degrees, **SOUTH 180** and **WEST 270**.

The set of images below show the position of Sunrise on June 21st, March 20th and Dec 22nd



Note that on March 20th the Sun rises almost due East. The same is true on Sept 23rd at the Autumnal Equinox. If you happened to be driving East or West near sunrise or sunset near the days of an Equinox you may have experienced the Sun shining directly in your eyes.

As seen from Tulsa - on the Summer Solstice June 21st the sun rises at 5:07 AM CST far to the North of East – Azimuth 60 degrees NE. On March 20th the Sun rises due east at 6:27 CST Azimuth 90 East. On Dec 22nd it rises at 7:30 AM CST far to the South - Azimuth 120 SE . The exact times and direction of the sun will change depending on the observers latitude. In far north latitudes the sun never sets for a few days near the Summer solstice and never rises near the Winter solstice. At the Equator the days and nights are equal all year long.

I used Standard Time to make these comparisons. One the primary reasons we use daylight savings time during the summer is that if we stayed on Standard time all year the sun would have already been up for 3 hours before most people went to work. Moving that hour to the evening gives them more time for leisure activities after work.

Motions of the Moon

So now that we have an understanding of the Sun's motion among the stars, let's address the question about the changing positions of the Moon. The Moon and planets also travel near the Ecliptic but not exactly on the ecliptic. **The Moon's orbit is tilted 5.2 degrees to the Ecliptic**. but travels through the same constellations as the sun. Depending on where the moon is along its orbit it may be a little above the Ecliptic or a little below the Ecliptic. **The two points at which the moon crosses the Ecliptic are called NODES.** If the Sun happens to be near one of these nodes as the moon crosses the Ecliptic a solar or lunar eclipse will be seen from some parts of the Earth.

The Moon only takes 27.32 days to make a complete orbit around the sky and return to the same spot. A **Sidereal Month** is the length of time that it takes the moon to return to the **same position relative to the stars**. As it does so it has to travel through the same Zodiac constellations as the Sun but must do so in a very short time. Since It has 360 degrees of sky to cover in only 27.32 days the math reveals (360 / 27.32) that it must travel a little more than 13 degrees each day. Therefore each night the moon will appear about 13 degrees farther to the East among the stars. Since the Earth turns about 1 degree in 4 minutes you can expect the moon to rise about 53 minutes later each evening. Rounding this off – **a general rule to follow is that the Moon rises about 50 minutes later and 13 degrees farther east each night**. **The Moon travels about one moon diameter per hour to the East**. This hourly motion can be easily observed if the moon happens to be near a bright star. However since the Moon's orbit is an ellipse it travels faster at some points in its orbit than others. Also the time of moon rise varies depending on whether it is traveling north or south of the sun's position on the Ecliptic. To complicate the math even further the nodes of the moons orbit slip westward along the ecliptic each year. Thus the exact time and position of moon rise and set requires a series of complicated formulas.

Just as the Sun's position along the horizon changes from day to day so does the moon. However the sun only moves about 1 degree per day. Since the Moon is moving so much faster it is much more noticeable from night to night. One way to better understand these changes is to take regular photos or drawings of the rising (or Setting) positions of the moon over the course of a month. Then compare them to the

rising positions of the Sun over several months.

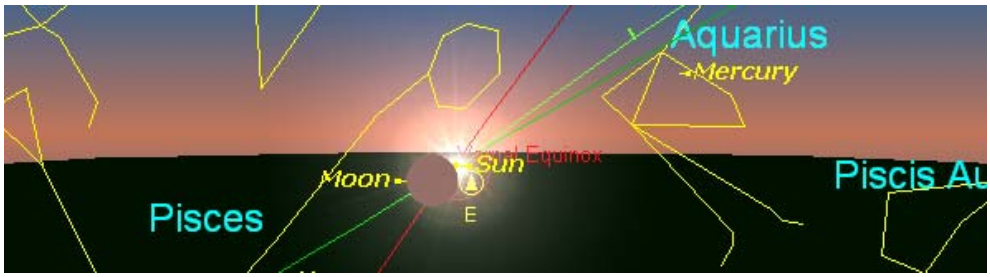
The images below show the rapidly changing positions of the rising moon during one month.

On March 20, 2015 the moon's node is very near the Vernal Equinox. A partial solar eclipse has just occurred a few hours before the moon rises along with the Sun at 6:26 AM CST Azimuth 87 . (All times are in CST) By March 26 the moon can be seen near the Summer Solstice point as it rises at 11:05 Azimuth 67 (Note the moon's orbit is below the ecliptic) On April 2 the moon is back near the equator and rises at 5:18 PM Azimuth 89. By April 9 the moon is above the Winter Solstice point at Azimuth 113 and rises at 11:52 PM. Finally the Moon is back at the Vernal Equinox 27 days later on April 16 having completed one trip among the stars.

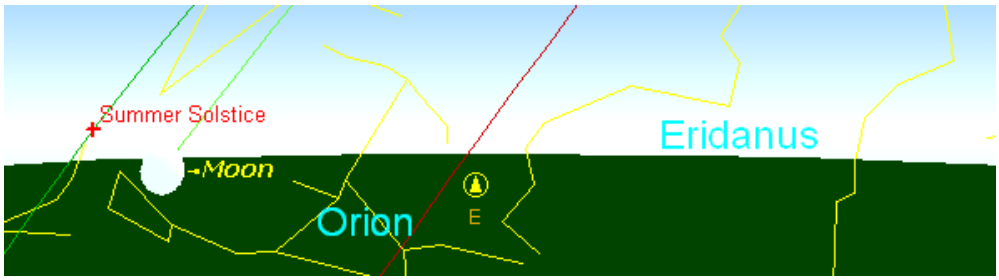
Note however that the Sun is NOT on the Vernal Equinox. Instead of a New moon – the phase is a thin waning crescent. It will take two more days for the new moon to catch up to the sun.

The period of time from one New Moon to the next is called a Synodic Month, which takes 29.53 days. Our calendar months were originally based on the period of time it took the moon to complete its cycle of phases. Julius Caesar standardize the months to 30 or 31 days in 45 BC. Several traditional and religious calendars still use the lunar cycles to determine the times of certain festivals or holy days. The floating date of Easter is one such day. The first Easter occurred during the Passover week on the Jewish Lunar calendar. Now the official rule for Easter is defined as the 1st Sunday after the 1st Full moon after March 20th. Therefore Easter 2011 was celebrated on April 24th but Easter 2008 fell on March 23rd.

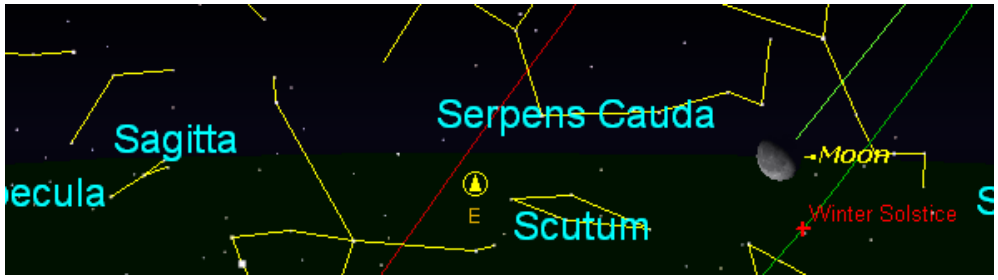
March 20, 2015 New Moon



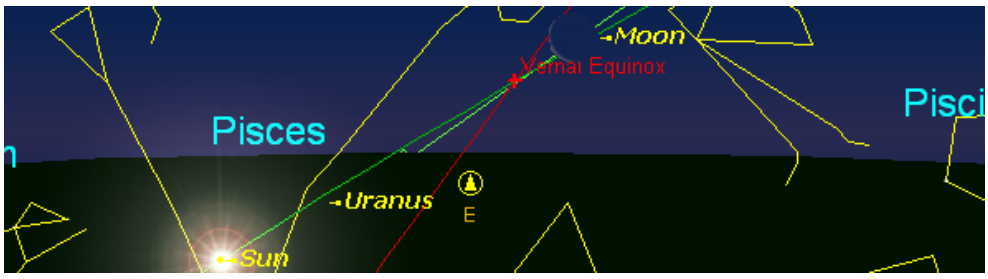
March 26, 2015



April 9, 2015



April 16, 2015 One full orbit - A Sidereal Month 27.32 days

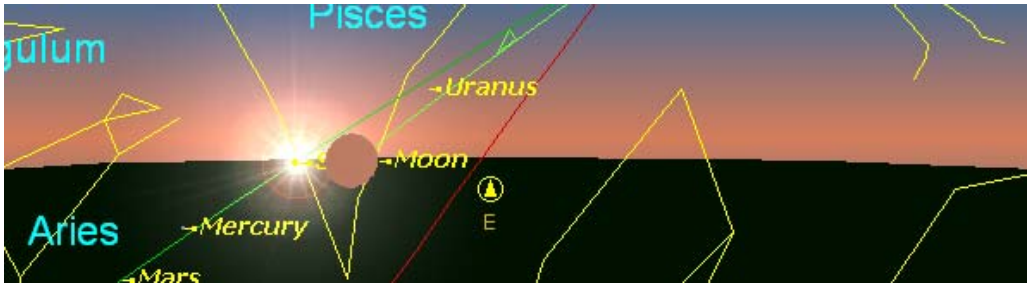


MOON SUN MOTIONS

April 18, 2015 New Moon again – One Synodic Month 29.53 Days

A Sunrise Analemma http://apod.nasa.gov/apod/ap030320.html

Explanation http://www.analemma.com/Pages/framesPage.html



I prepared two Quicktime videos to illustrate these motions.

Both illustrate the motions of the Sun and moon for the year 2015 as seen from the Equator.

I used the Equator to avoid the added changes produced by the observers Latitude.

Images and Video prepared using Starry Night software - www.StarryNight.com

Sunrise from the Equator - http://www.astrotulsa.com/Gallery/JohnL/sunrise.mov

Shows the changing Azimuth of the Sun throughout the year.

Dates are March 20, 2015 to Mar 20, 2016

Moon rise at the Equator - http://www.astrotulsa.com/Gallery/JohnL/moonrise.mov

Shows the moon as it travels through the constellations and its changes in the Azimuth

of its rising point each night. Dates are March 20, 2015 to April 18, 2015

Sidereal and Synodic Months animation http://www.sumanasinc.com/webcontent/animations/content/sidereal.html

By John Land - Astronomy Club of Tulsa May 2011

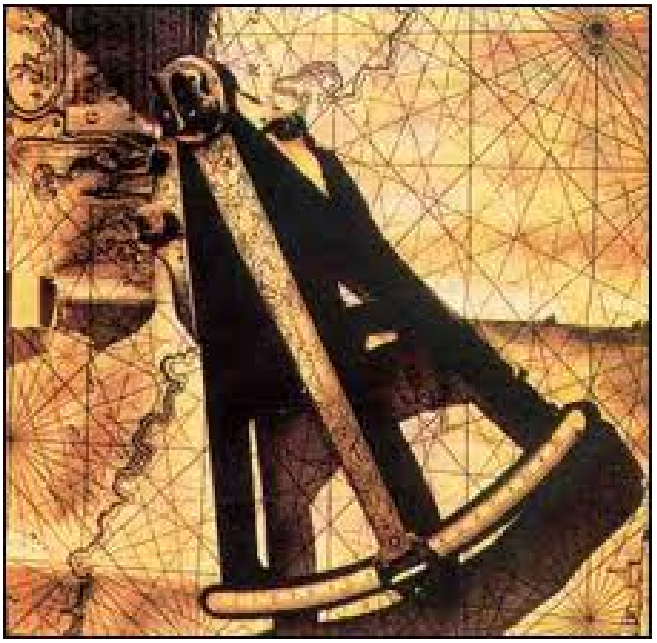
FIGHT, FIGHT— Although they look like they are gathered for round one between Craig Davis and Jim Miller I can vouch for both as we were all eating cookies and drinking coffee when this picture was taken. More than likely someone just got a new eyepiece and the crowd rushed to see.

BEST LAID PLANS!

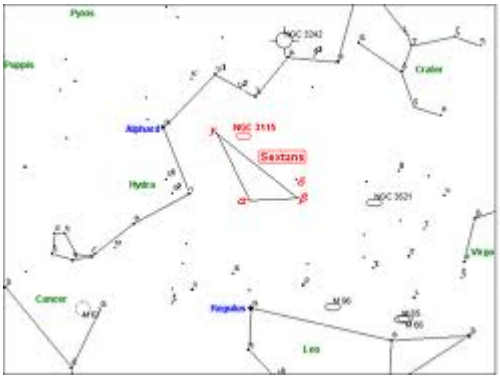
BY: ANN BRUUN

Seven years ago, when I was new to astronomy, I would read my Sky and Telescope from cover to cover taking notes about what to look at during the next club star party. One of my favorite articles then, and now, was Sue French's star hop. I always included all the objects she mentioned in my list of things to look for but though I carefully scanned the sky and followed all her instructions, I was frequently unable to locate the fantastic sights she described prompting the mantra, "Sue French is a liar!" Even then, I knew Sue probably wasn't really a liar. It was my observing skills that were lacking but it made me feel better to say it, so I did – often.

Flash forward seven years, a bigger scope and a lot more observing experience. I decided I would determine once and for all if Sue French was or was not a liar. In the April issue of Sky and Telescope she wrote about Sextans. I decided to follow her star hop using my 6-inch and my 12-inch telescopes and match as closely as possible the views she talked about in her article.



I was ready with all of my equipment at the next available star party. Unfortunately, the only thing missing was a clear sky. Between 10pm and 11pm the sky did finally opened up but unfortunately my resolve to finally clear Sue's name had drained away as I waited in the dark. I only made it as far as the first three galaxies on her list. (Things are not nearly as easy out in the dark as I imagine they will be when I make my plan.) So I missed out on the lovely double stars and the neat asterism and all the other tiny galaxies. Sue will have to wait for another day to be exonerated but I did make a discovery. In trying to match her apertures and magnifications I used eyepiece and Barlow combinations I would not normally have tried. I went deeper and looked for details she mentioned in her article that I probably would not have noticed. I couldn't always make out what she described but by trying to see more I was improving my skills and adding to my arsenal of tricks for observing. Even though my grand plan did not work out my observations gained energy that I noticed carried over into my next observing session.



It is easy to get into the habit of using the same two eyepieces to look at everything but you might be missing out on details within the grasp of your equipment. Try dusting off some of those eyepieces you haven't used in a while, mix things up, throw in a Barlow, use a filter and see what you can see. Depending on how it goes you may even be able to prove Sue French is **not** a liar.

STAR PARTIES WITH THE ASTRONOMY CLUB OF TULSA

SUMMER STAR PARTIES IN TULSA ARE ONE OF A KIND.

MAKE PLANS TO JOIN US THIS YEAR AND BRING THE WHOLE FAMILY.

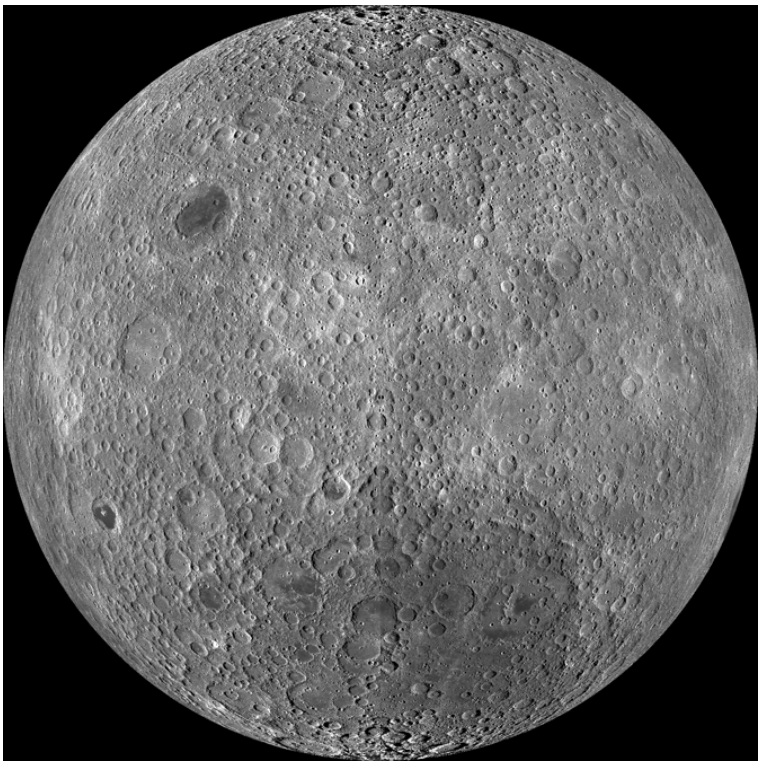
THE FAR SIDE OF THE MOON AND ALL THE WAY AROUND.

SUBMITTED BY: JERRY MULLENNIX CREDIT SCIENCE@NASA.GOV

Because the moon is tidally locked (meaning the same side always faces Earth), it was not until 1959 that the far-side was first imaged by the Soviet Luna 3 spacecraft (hence the Russian names for prominent farside features, such as Mare Moscoviense). And what a surprise -- unlike the widespread maria on the nearside, basaltic volcanism was restricted to a relatively few, smaller regions on the farside, and the battered highlands crust dominated. A different world from what we saw from Earth.

Of course, the cause of the farside/nearside asymmetry is an interesting scientific question. Past studies have shown that the crust on the farside is thicker, likely making it more difficult for magmas to erupt on the surface, limiting the amount of farside mare basalts. Why is the farside crust thicker? That is still up for debate, and in fact several presentations at this week's Lunar and Planetary Science Conference attempt to answer this question.

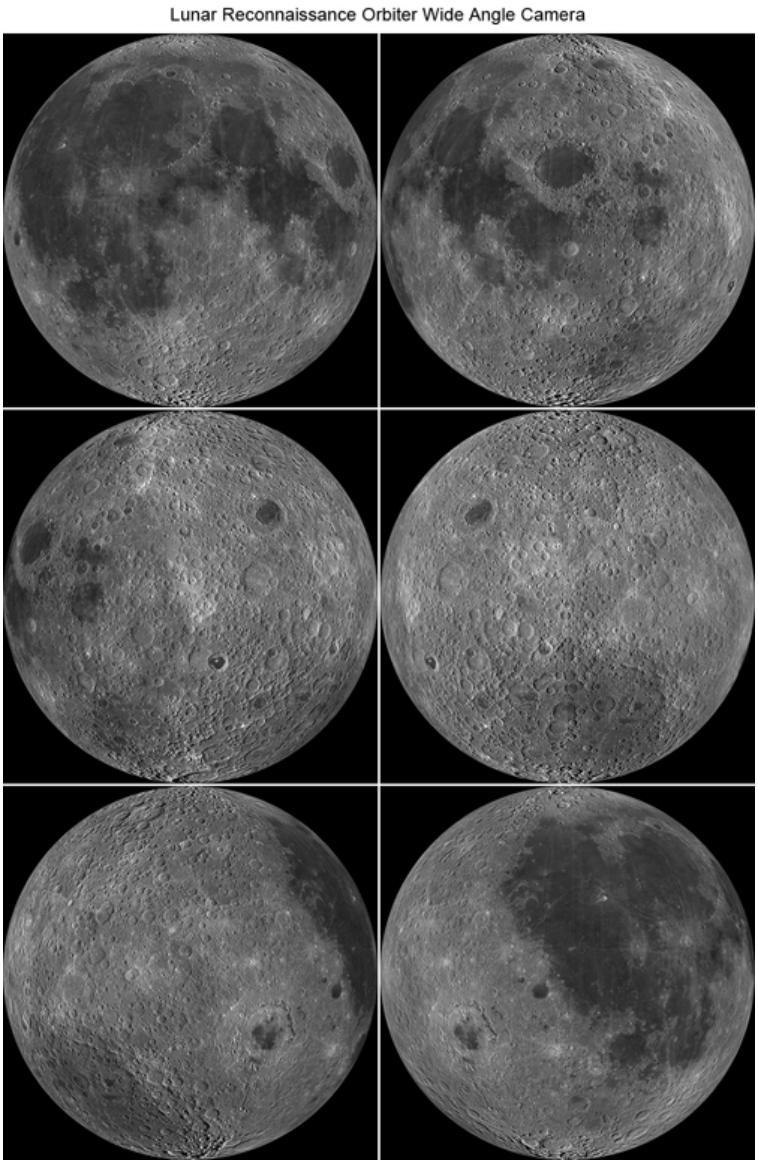
The Clementine mission obtained beautiful mosaics with the sun high in the sky (low phase angles), but did not have the opportunity to observe the farside at sun angles favorable for seeing surface topography. This WAC mosaic provides the most complete look at the morphology of the farside to date, and will provide a valuable resource for the scientific community. And it's simply a spectacular sight!



The lunar farside as never seen before! LROC WAC orthographic projection centered at 180° longitude, 0° latitude. Credit: NASA/ Goddard/Arizona State University.

The Lunar Reconnaissance Orbiter Camera (LROC) Wide Angle Camera (WAC) is a push-frame camera that captures seven color bands (321, 360, 415, 566, 604, 643, and 689 nm) with a 57-km swath (105-km swath in monochrome mode) from a 50 km orbit. One of the primary objectives of LROC is to provide a global 100 m/pixel monochrome (643 nm) base map with incidence angles between 55°-70° at the equator, lighting that is favorable for morphological interpretations. Each month, the WAC provides nearly complete coverage of the Moon under unique lighting. As an added bonus, the orbit-to-orbit image overlap provides stereo coverage. Reducing all these stereo images into a global topographic map is a big job, and is being led by LROC Team Members from the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR). Several preliminary WAC topographic products have appeared in LROC featured images over the past year (Orientale basin, Sinus Iridum). For a sneak preview of the WAC global DEM with the WAC global mosaic, view a rotating composite moon (70 MB video from ASU's LROC website). The WAC topographic dataset will be completed and released later this year.

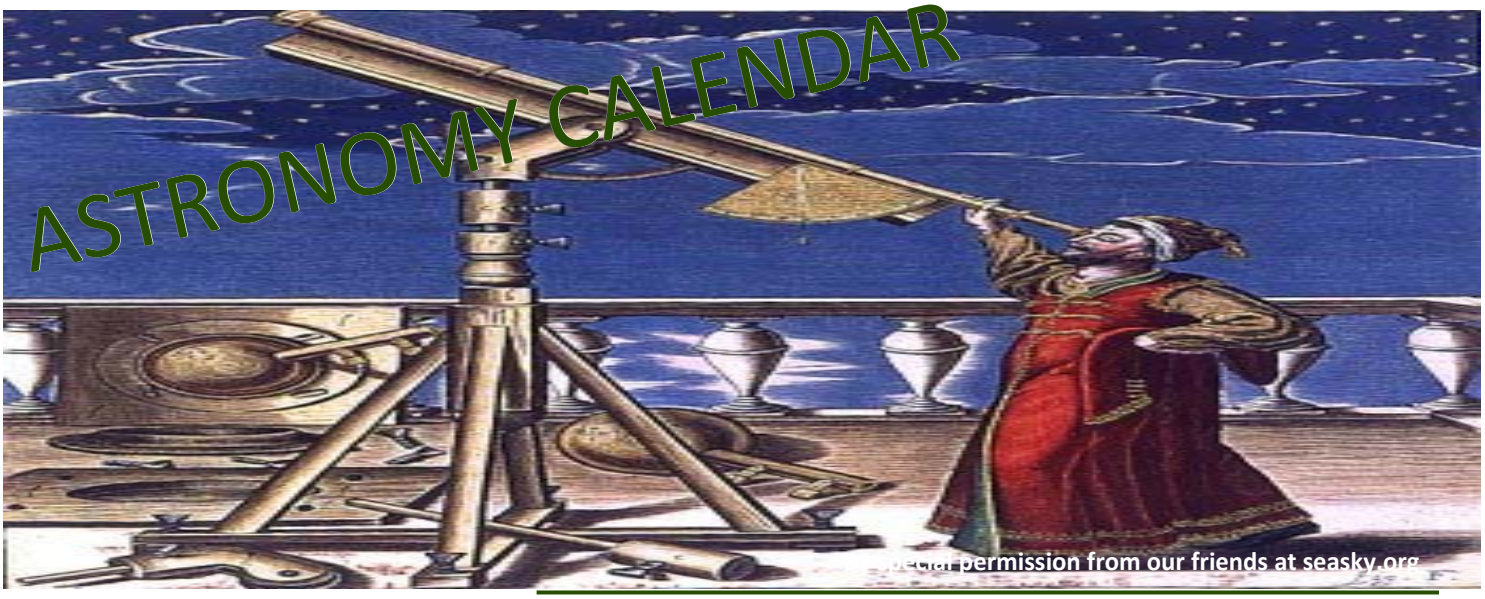
The global mosaic released today is comprised of over 15,000 WAC images acquired between November 2009 and

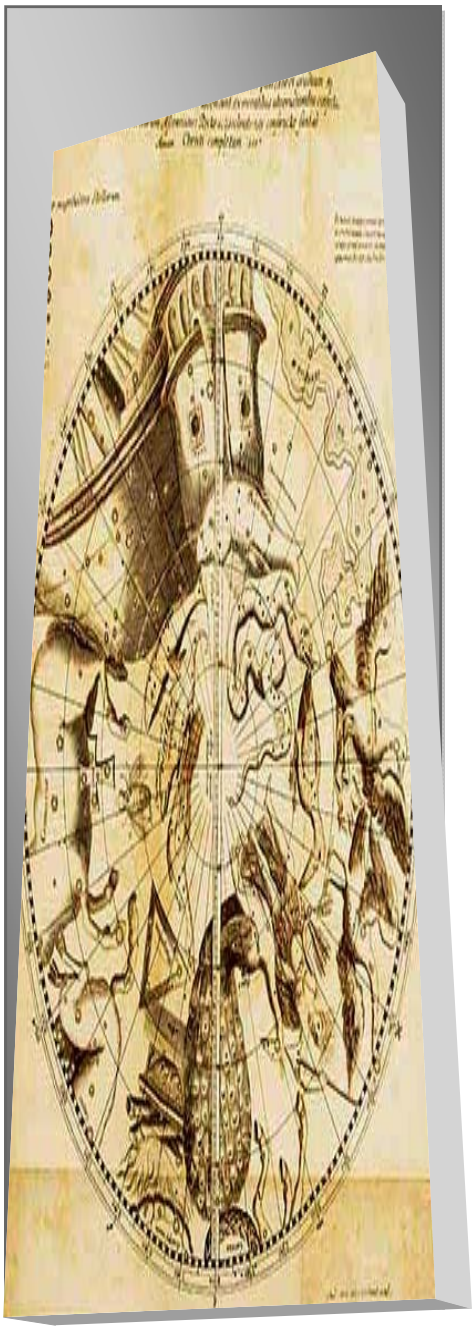


Six orthographic views of the Moon created from the new WAC global mosaic. From upper left to lower right the central longitude is 0°, 60°, 120°, 180°, 240°, 300°. Credit: NASA/Goddard/ Arizona State University

February 2011. The non-polar images were map projected onto the GLD100 shape model (WAC derived 100 m/pixel DTM), while polar images were map projected on the LOLA shape model. In addition, the LOLA derived crossover corrected ephemeris, and an improved camera pointing, provide accurate positioning (better than 100 m) of each WAC image.

As part of the March 2011 PDS release, the LROC team posted the global map in ten regional tiles. Eight of the tiles are equirectangular projections that encompass 60° latitude by 90° longitude. In addition, two polar stereographic projections are available for each pole from ±60° to the pole. These reduced data records (RDR) products will be available for download on March 15, 2011. As the mission progresses, and our knowledge of the lunar photometric function increases, improved and new mosaics will be released! Work your way around the moon with these six orthographic projections constructed from WAC mosaics. The nearside view linked below is different from that released on 21 February.





- **May 3 - New Moon.** The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 06:51 UTC.

- **May 5, 6 - Eta Aquarids Meteor Shower.** The Eta Aquarids are a light shower, usually producing about 10 meteors per hour at their peak. The shower's peak usually occurs on May 5 & 6, however viewing should be good on any morning from May 4 - 7. A thin, crescent moon will set early in the evening leaving dark skies for what could be an good show. The radiant point for this shower will be in the constellation Aquarius. Best viewing is usually to the east after midnight, far from city lights.

- **May 7 - Astronomy Day Part 1**. Astronomy Day is an annual event intended to provide a means of interaction between the general public and various astronomy enthusiasts, groups and professionals. The theme of Astronomy Day is "Bringing Astronomy to the People," and on this day astronomy and stargazing clubs and other organizations around the world will plan special events. You can find out about special local events by contacting your local astronomy club or planetarium. You can also find more about Astronomy Day by checking the Web site for the Astronomical League.

- **May 11** - Conjunction of Mercury, Venus, and Jupiter. The three planets will form a 2-degree long vertical line in the early morning sky. The planet Mars will also be visible nearby. Look to the east near sunrise.

- **May 17 - Full Moon.** The Moon will be directly opposite the Earth from the Sun and will be fully illuminated as seen from Earth. This phase occurs at 11:09 UTC. This full moon was known by early Native American tribes as the Full Flower Moon because this was the time of year when spring flowers appeared in abundance. This moon has also been known as the Full Corn Planting Moon and the Milk Moon.

- **June 1 - New Moon.** The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 21:03 UTC.

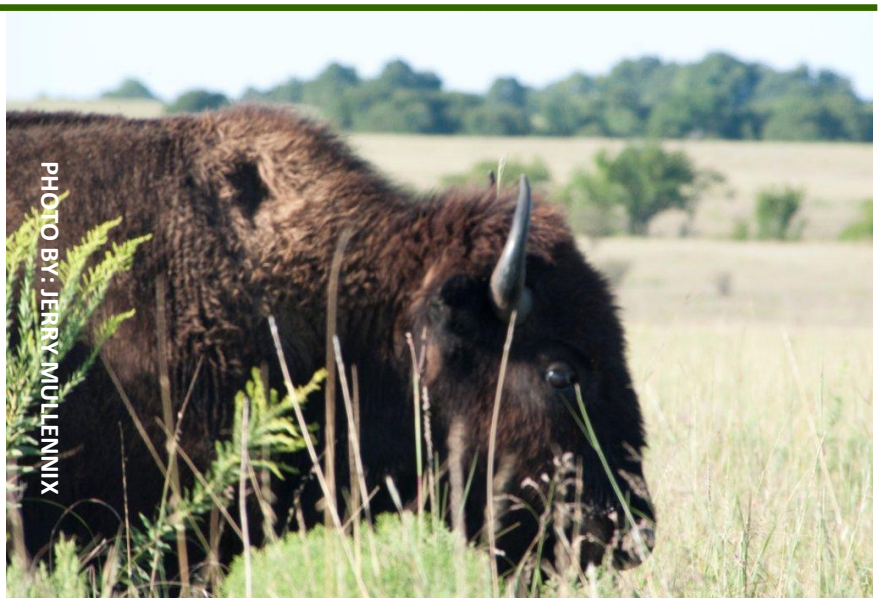
- **June 1 - Partial Solar Eclipse.** The partial eclipse will be visible in most parts eastern Asia, Alaska, northern Canada, and Greenland.

- **June 15 - Total Lunar Eclipse**. The eclipse will be visible throughout most of South America, Europe, Africa, Asia, and Australia.

- **June 21 - June Solstice.** The June solstice occurs at 17:16 UTC. The North Pole of the earth will be tilted toward the Sun, which will have reached its northernmost position in the sky and will be directly over the Tropic of Cancer at 23.44 degrees north latitude. This is the first day of summer (summer solstice) in the northern hemisphere and the first day of winter (winter solstice) in the southern hemisphere.

- **July 15 - Full Moon.** The Moon will be directly opposite the Earth from the Sun and will be fully illuminated as seen from Earth. This phase occurs at 06:40 UTC. This full moon was known by early Native American tribes as the Full Buck Moon because the male buck deer would begin to grow their new antlers at this time of year. This moon has also been known as the Full moon will be hanging around for the show, but it shouldn't cause too many problems. Best viewing is usually to the east after midnight from a dark location.

OKLAHOMA BUFFALO ROAMING THE TALLGRASS PRARIE — A SURE SIGN SUMMER ASTRON0MY IS LURKING.



THE TOY BOX

Here are a few new items that look very interesting. I have not spoken with anyone who has tried any of these but would welcome any review on new astronomy gear. This is not an endorsement of any of these items and the information provided is from the respective companies website.

JMI Telescopes
8550 West 14th Ave,Lakewood, CO 80215
800-247-0304; jmitelescopes.com

JMI Telescopes continues its long tradition of developing useful accessories with the introduction of its new Moto-focus ($169) for the Sky-Watcher Pro Series 80ED Refractor. The motor slips over the fine-focus knob of the Sky-Watcherís dual-speed focuser, and a mounting bracket attaches to its base with existing screws, enabling you to adjust your telescopeís focus at the push of a button. Each order comes complete with motor, mounting bracket, replacement hardware, and a hand-paddle controller.

Finger Lakes Instrumentation
7298 W. Main St., P.O. Box 19A; Lima, N.Y. 14485
585-624-3760; flicamera.com

Finger Lakes Instrumentation releases its new CenterLine CL1-10 Filter Wheel ($2,495) for large-format CCD cameras. The CL1-10 incorporates two overlapping 5-position filter wheels that hold up to ten 50-millimeter-square filters. The unit's symmetrical design and centrally located aperture evenly distributes mass and eliminates the offset weight problems associated with most filter wheels. Measuring 13½ by 11 inches, the filter wheel's symmetrical design is ideal for shooting at prime focus on large astrographs. It's powered by two internal stepper motors and TruMotion synchronous belts. The internal wheels are supported by ball bearings that provide smooth, quiet, and repeatable operation. The CL1-10 attaches to your CCD camera via a zero-tilt adapter custom machined to fit your particular camera, and is controlled via a USB-2 connection.

Lunt Solar Systems
2520 N. Coyote Drive Suite 111 Tucson AZ
85745
520-344-7348 ; luntsolarsystems.com

Andy Lunt, son of the late David Lunt who founded Coronado Technology Group, is carrying on a family tradition with the launch of Lunt Solar Systems, a company dedicated to producing affordable solar telescopes and filters. The LS35THα ($499) is a hydrogen-alpha telescope that breaks new ground for a compact system that can show the Sun's prominences and delicate surface detail. Featuring a full-aperture, 35-mm etalon, the system has a bandpass narrower than 0.75 angstrom, and it comes with a mounting bracket and diagonal — just add a tripod and eyepiece and you're ready to enjoy our nearest star.

iOptron
6-X Gill Street, Woburn, MA 01801
781-569-0200; ioptron.com

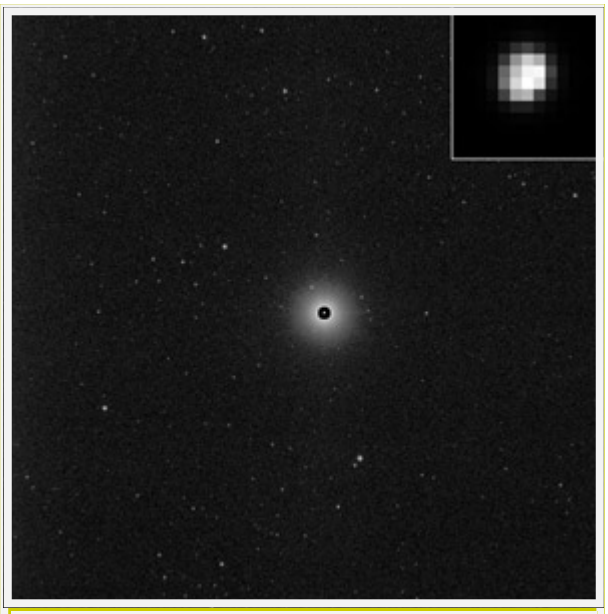
iOptron has responded to consumer requests for a heavy-duty version of its groundbreaking Cube alt-azimuth mount (a Hot Product pick for 2008). The Mini-Tower ($799) wraps a 25-pound capacity and very accurate Go To performance into a compact mount that's exceptionally easy to set up and use. It's sold as a package noteworthy for its completeness, since it includes a tripod, multiple power options, adapters for mounting scopes on both sides of the altitude axis, counterweight, and hard-sided carrying case.

Put the Solar System on your ceiling.

From: John Land

Wal-Mart is carrying night light that projects an image of the Solar system on your ceiling or wall. It also has a soft blue glowing orb to light up the floor. Depending on far it projects the image can be as much a feet or more across. So being a soft hearted Grandpa I just had to get some for my grandsons. They also come in Tropical Fish or Princess Castles. For $ 8 it's a fun way to bring the sky indoors. The product is licensed by a Jasco Products Company, LLC in Oklahoma City.

(PS I found them over in the section where they sell light bulbs and such)



A processed version of the image taken by Dawn shows Vesta as a bright object (center) surrounded by glare, and set against a starry background. The position of the stars will help scientists steer Dawn toward Vesta.

VESTA/DAWN UPDATE

If you read last months Observer than your interest in Vesta should be peaking about now. Well not to disappoint we will follow Dawn as it flies toward the mysterious astoriod for its encounter this summer.

f you were riding with NASA's Dawn spacecraft, now cruising the asteroid belt between Mars and Jupiter, you would see a brightening new point of light against the starry background. This is Vesta, your immediate destination.

Dawn's first image of Vesta, the second-largest object in the asteroid belt, still has fewer pixels than those of it taken by the Hubble Space Telescope in 2007. But this view and others enable engineers at the Jet Propulsion Laboratory in California to steer the craft into precisely the right direction for its meet -up with Vesta this summer.

Our own Ann Bruun prepares for a night of viewing as she answers questions about her 12" Lightbridge from Meade.

STAR PARTY SHOTS

Criss Proctor and Tim Davis looking west on the star field. "Hey Tim, is it true that a watched sun will never set?"

Submitted by: Jerry Mullennix

By special permission from our friends at seasky.org

Question: What was the first thing every astronomer says when they looked at the sky the first time?

Answer: Always starts with "I wonder"

There are as many questions about what is going on in our universe as there are sheets of paper to answer them on. Even then we could never get them all.

While cursing the web I went to a site I had not visited in a long time and found this FAQ section and thought what would be the harm in asking if we could reprint these in the Observer? Well the folks at seasky.org went and checked a copy of our newsletter to see how it might be used and responded with a very positive email about our newsletter and permission to reprint these.

I caution all of you beginners as you read these answers, these are the cliff notes and you could make a career learning all that is known about any one of these questions. This is meant to give you the quick answer and you should be left wanting more.

Thanks Jerry

What is the difference between astronomy and astrology?

Believe it or not, this is the most asked question that astronomers encounter. Many people do not understand the difference. In ancient times, they were considered one and the same. But the two disciplines were separated during the Age of Reason in the 17th century. Astrology is a practice of using the locations of the planets to look into a person's personality or predict the future. It is not a science and is considered a form of divination. By contrast, astronomy is the scientific study of the universe. Astronomers observe the objects in the night sky to try to determine their composition and learn more about the origin and structure of the universe.

Do I need an expensive telescope to enjoy astronomy?

Many people hesitate to get involved with astronomy because they believe it requires expensive equipment. The only thing you really need to enjoy the night sky is your eyes, a dark viewing location, and some patience. To get a better look at things, a pair of binoculars can provide a really good view. Many people will be surprised how many more stars and objects they can see with a decent pair of 10X binoculars. They collect much more light than the human eye and will bring much dimmer objects into view. You can even see Jupiter's moons with binoculars. A simple camera tripod to steady the binoculars is also a good idea, since your arms can get tired very quickly.

How does a telescope work?

The primary purposes of a telescope are to gather light and magnify an image. The aperture (opening) of a telescope is larger than that of the human eye and therefore, can gather much more light. This enables us to see dim objects that are too faint to see with the naked eye. The larger the aperture of the telescope, the more light it can gather. Telescopes also use a series of lenses or mirrors to magnify the image, enabling us to see more detail.

Why can't I see very many stars at night?

If you live near a big city, you may not be able to see a lot of stars. The reason for this is light pollution. Dust and water vapor in the atmosphere reflects the bright city lights back down towards the ground. This "light pollution" tends to be brighter than some of the dim stars and other deep sky objects, essentially hiding them from view. To truly appreciate the night sky, you must get as far away from city lights as possible. There is no more beautiful sight then the band of the Milky Way stretching across a dark sky. We can all help to combat light pollution by convincing our local authorities to use more efficient light fixtures that shine the light on the ground and block it from going up into the sky.

Where does space begin?

Space is defined as the area above the Earth's atmosphere. But there is no specific boundary since the atmosphere gradually thins out as you move farther away from the Earth. However, NASA awards astronaut status to anyone who flies above 50 miles (80 km).

Why is the sky blue?

This is another question that gets asked a lot. The blue color of the sky during the day is caused by scattered sunlight. The white light from the Sun is composed of all the colors of the rainbow. During the day, the molecules in the air scatter the blue light from the Sun more that the red light making the sky appear blue. In the evening, however, we see

the red and orange colors because the blue light has been scattered away from our line of sight.

Why is the sky dark at night?

Believe it or not, there is no easy answer to this question. Scientists have observed that if the universe was infinitely large, and contained an infinite number of stars, then the night sky should actually be as bright and as hot as the surface of the Sun. But this obviously is not the case. This little brain teaser has come to be known as Olber's paradox, named after the German astronomer who tried to solve the problem in 1823. The most likely explanation is that the universe is simply not old enough and the observable part of the universe contains too few stars to fill the sky with light. Thus, the night sky is dark.

What is the speed of light?

Light travels at a constant speed of 186,262 miles per second (299,792,458 meters per second). Since the speed of light is constant, it can also be used to measure vast distances. Distances between objects in space are measured in light years. One light year is equal to the distance light travels in a year, which is just under 6 trillion miles (10 trillion kilometers). The speed of light is considered to be the ultimate speed limit in the universe. Scientists believe that it is impossible to travel faster than light because any object traveling at the speed of light would have to achieve infinite mass.

Did galileo invent the telescope?

Many people believe that Galileo invented the telescope, but they are wrong. It was actually a man named Hans Lippershe from Holland who assembled the first telescope. Several years later, Galileo became the first person to use a telescope for astronomical observation. With his early telescope, Galileo observed the craters on the moon, the rings of Saturn, and the moons of Jupiter.

The Moon

Also See John Lands article on page 15 of this issue for a more detailed explanation of the Moon and the Suns rotation.

How far is the Moon from Earth?

The distance between the Moon and the Earth averages 238,857 miles (384,403 kilometers). Since the Moon's orbit is not a perfect circle, its distance varies. At its farthest point, known as apogee, it is 252,080 miles (405,686 km) away. At its closest point, known as perigee, it is 225,621 miles (363,104 km) away.

Is the Moon moving away from the Earth?
Yes, the Moon is gradually moving away from the Earth at the rate of about 1.5 inches (3.8 centimeters) per year. We know this because we can track the Moon's distance using lasers. The Apollo moon missions left reflective mirrors on the Moon's surface. By measuring the time it takes a laser beam to travel to the Moon and back, we can calculate the distance using the speed of light. When the Moon first formed, it was much closer to the Earth. Astronomers believe it was about 12 times closer than it is now, which means it would have been much larger in the night sky.

How was the Moon formed?

Astronomers believe that the Moon was formed billions of years ago when a small planet the size of Mars collided with the Earth. The foreign planet hit with a glancing blow and ejected a large part of the Earth's molten mantle into space. Over time, this material coalesced and cooled to form the Moon.

Why does the Moon shine?

The Moon shines because the light from the Sun shines and reflects from the Moon's surface. What we think of as Moon shine is actually just reflected sunlight.

Why is the Moon larger when it is close to the horizon?

Although the Moon looks much larger when it is low in the sky near the horizon, this is actually just an optical illusion. It is actually the same size as when it is directly over head. This illusion has been known since ancient times and also happens with the Sun and the constellations. This same illusion works on mountains and tall buildings as well. They appear larger at long distances than they do at closer distances. The reasons for this are complex, but they have something to do with how our brains interpret the sizes of large objects on the horizon. If you don't believe this is only an illusion, you can compare the size of the Moon near the horizon to the size directly over head by holding your finger out at arm's length and comparing the sizes of the Moon with your finger.

What causes the phases of the Moon?

The Moon goes through phases because it is traveling around the Earth. One half of the Moon is always illuminated by the Sun. As the Moon circles the Earth, different amounts of the illuminated part of the Moon are facing us. These phases range from Full Moon (when the Moon is on the opposite side of the Earth then the Sun) to a New Moon (when the Moon is between the Sun and the Earth. It takes about 29 and a half days for a complete cycle, which equals one complete orbit of the Moon around the Earth.

Can you see the flag on the Moon with a telescope?

This is a question that astronomers get asked a lot. Unfortunately, the equipment left behind by the Apollo missions is tiny in comparison to the size of the Moon. Ground-based telescopes, especially those owned by amateur observers, are not capable of resolving objects this small at such extreme distances. Extremely large telescopes could theoretically catch a bright spot of sunlight reflecting from some of the moon landing equipment, although they would not be able to observe the equipment directly.

What is a blue moon?

The answer to this question is a bit complicated. The most recent and most popular definition says that a blue moon is the second of two full moons occurring in the same month. Since the lunar cycle is 29 days and most months have 30-31 days, we eventually find a situation where a full moon occurs at the beginning and the ending of the same month. There is also a second, older definition of a blue moon. This one defines a blue moon as the third full moon in a season with four full moons. Normally there is one full moon each month, so a season such as summer would usually have three full moons. The reason for this is complex, and has to do with the ancient Christian ecclesiastical calendar. This calendar was used to determine important dates such as Easter. Each of the usual 12 full moons of the year had a name associated with the time of year in which they usually occurred. In a year with 13 full moons, the extra full moon was referred to as a blue moon so the calendar could stay on track.

The Sun

How far away is the Sun?

The average distance from the Sun to the Earth is 93 million miles (149 million kilometers). Because the Earth's orbit around the Sun is not a perfect circle, it varies. At its closest point to the Sun, known as perihelion, the distance is 91 million miles (152 million km). At is farthest point, known as aphelion, the distance is 94.5 million miles (152 million km).

How big is the Sun?

The Sun is an average-sized star that is 865,000 miles (1,392,000 kilometers) in diameter. It is so large that you could fit the planet Earth inside it well over a million times. The Sun actually makes up about 99% of the entire mass of the Solar System. The remaining objects, including all of the planets, moons, comets, and asteroids compose the other 1% of the Solar System.

How hot is the Sun?

The core of the Sun is extremely hot at about 27 million degrees Fahrenheit (15 million degrees Celsius). The surface of the Sun is much cooler than the core, at about 9,900 degrees F (5,500 degrees C). For some strange reason, not yet completely understood by scientists, the Sun's outer atmosphere is hotter than its surface. Known as the corona, its temperature reaches 5 million degrees F (2.7 million degrees C).

How long does it take the light from the Sun to reach Earth?

The light from the Sun travels at the speed of light, 186,282 miles per second. Since the Sun is about 93 million miles from Earth, it takes the light about 8.4 minutes to reach us. This means that when you look up at the Sun, you are actually seeing it the way it looked 8.4 minutes ago. To give you an idea just how close we are to the Sun, the light from the next nearest star, Proxima Centauri, takes 4.3 years to reach the Earth.

What are sunspots and why do they appear dark?

Sunspots are temporary areas on the surface of the Sun that are cooler than the surrounding areas. They are caused by intense magnetic activity that inhibits convection and reduces the surface temperature. Sunspots appear dark on images of the Sun taken with filters because the filter significantly reduces the brightness of the Sun overall. If you could observe a sunspot by itself, away from the rest of the Sun, it would actually be blindingly bright.

What is the solar wind?

The Sun is an average-sized star that is 865,000 miles (1,392,000 kilometers) in diameter. It is so large that you could fit the planet Earth inside it well over a million times. The Sun actually makes up about 99% of the entire mass of the Solar System. The remaining objects, including all of the planets, moons, comets, and asteroids compose the other 1% of the Solar System.

The Solar System

How many planets are there in the Solar System?

This used to be an easy question. Many of us grew up learning about the nine planets, starting with Mercury and ending with Pluto. But recent discoveries of other Pluto-type objects in the outer Solar System began to call Pluto's planet status into question. Finally, in 2006, the International Astronomical Union (IAU) decided to change the official definition of a planet. Pluto was reclassifies as a dwarf planet, leaving the total number of planets in our Solar System at eight.

What is the largest planet in the Solar System?

Of the eight planets in our Solar System, the largest is Jupiter. This giant planet is over a thousand times larger than the Earth, and is composed mostly of hydrogen gas. The famous giant red

spot on Jupiter is a giant storm system that has been raging for several hundred years and is actually twice the size of the Earth.

What is the smallest planet in the Solar System?

The smallest planet in the Solar System used to be Pluto, with a diameter of 1,441 miles (2,320 kilometers). But in 2006, Pluto was demoted and reclassified as a dwarf planet in. Now Mercury is the smallest planet in the Solar System with a diameter of 3,032 miles. (4,879 kilometers).

How old is the Solar System?

Astronomers believe that the Solar System is about 4.6 billion years old. They have determined this age in part by studying meteorites. It is believed that meteors formed at the same time as the rest of the Solar System from a could of dust and gas. When meteors fall to earth as meteorites, a technique called radioactive dating can be used to calculate how old they are. Astronomers also believe the Sun is about middle aged, which means it should continue to shine for about another 5 billion years.

What exactly is a meteor shower?

A meteor shower is an event where a large number of meteors appear to radiate from a common point in the night sky. The meteors are cause by streams of debris left over by comets. This debris is usually no larger than a grain of sand. As the debris enters the Earth's atmosphere at a high rate of speed, the friction causes the gases to glow. This glowing trail of ionized gas is known as an ionization trail. Meteor showers occur at the same time every year as the Earth passes through the debris field. Meteor showers can be stronger if the comet has recently passed by leaving a fresh stream of debris.

What are asteroids and where do they come from?

An asteroid is a small, rocky or metallic body found in orbit around the Sun. Most of the asteroids in our Solar System are located between the orbits of Mars and Jupiter in an area known as the asteroid belt. They are thought to be the left over remains of a planet that was either destroyed or never fully formed. Asteroids can range in size from a few feet to several miles in diameter. Occasionally, gravity can cause an asteroid to change its orbit and send it on a path towards the inner Solar System. If the asteroid crosses the orbit of Earth, it is known as a near-Earth asteroid, or NEA. NEAs have a small chance of eventually colliding with the Earth. Meteor crater in Arizona is an impact crater nearly a mile across that was caused by an asteroid about the size of a city bus. It is believed that an asteroid about 5 miles in diameter may have been responsible for the extinction of the dinosaurs.

What are comets and where do they come from?

Comets are relatively small Solar System bodies composed of ice and dust. Due to this unusual composition, many astronomers refer to them as "dirty snowballs". It is believed that most comets originate in an area at the outer edge of the Solar System known as the Oort cloud. Occasionally, gravity will disturb a comet's orbit and send it on a new course toward the inner Solar System. Comets with highly elliptical orbits like this are known as periodic comets, and they return to the inner Solar System at a regular period. The most famous periodic comet is comet Halley, with a period of 76 tears.

Why do comets have tails?

Comets are probably best known for their long, luminous tails. These tails are actually plumes of dust and gas that are ejected from the comet as it nears the Sun. Comets are composed of frozen ice and dust. If a comet's orbit takes it close to the Sun, the solar radiation will cause the volatile materials in the comet to vaporize, carrying some of the dust along with them. As the Sun shines on this vaporized material, known as the coma, it begins to glow. The solar wind pushes the material out away from the comet. Because of this, a comet's tail always points away from the Sun. Comets will usually have two tails, one formed from ionized gas, and the other formed from dust reflecting the sunlight.

Stars

What is a star?

A star is a gigantic, luminous ball of heated gas, or plasma, held together by gravity. They are formed mainly of hydrogen and helium. Stars burn helium in a process called nuclear fusion, where helium atoms are fused together under enormous pressure and temperature to form helium. This process gives off an incredible amount of energy. Stars are very large. The Sun, which is the closest star to the Earth, is so large that you could fit a million Earths inside it.

How far away is the closest star?

This is actually a trick question. The closest star to the Earth would be the Sun, at a distance of about 93 million miles (149 million kilometers). The closest star outside our solar system would be Proxima Centauri. It is located about 4 light years from Earth. That is over 23 trillion miles (38 trillion kilometers).

Why do stars seem to twinkle?

The twinkling of stars is caused by instability of our atmosphere. As the starlight passes through the atmosphere, the movement of the air bends the light

slightly and makes the stars twinkle. If you could view the stars from outside the atmosphere, like the space station or the Moon, they would not twinkle.

How many stars are visible in the night sky?

The number of stars visible in the night sky depends on many factors, such as the clarity of the atmosphere, the time of the year, and the amount of light pollution. But on a good night, far away from city lights, you should be able to see about 2,000 stars with the naked eye. Astronomers have calculated that about 6,000 stars should be seen from the darkest locations.

How many stars are there in the universe?

The universe is unbelievably huge. There are billions of galaxies and each galaxy contains billions of stars. The latest estimates from astronomers say that there are a staggering 300 sextillion stars in the known universe. That is a 3 followed by 23 zeros, or 3 trillion times 100 billion. That represents several stars for every grain of sand on Earth.

What is the brightest star in the sky?

The brightest star visible in the night sky is Sirius, located in the constellation Canis Major. With an apparent magnitude of -1.46, it is nearly twice as bright as Canopus, the second brightest star. Apparent magnitude is a measure of a star's brightness as seen from Earth. The lower the number, the brighter the star. Some of the planets appear like stars and can be brighter than Sirius when they are close to the Earth. Jupiter can have an apparent magnitude of -2.6 when it is close.

How long do stars live?

The life cycles of stars differ greatly and depend mostly on the star's size. Large stars burn their fuel faster while smaller stars burn it more slowly. The largest stars burn their fuel so fast that they only last for a few million years. Average sized stars like the Sun live for about 10 billion years. Smaller stars, such as red dwarfs, burn their fuel so slowly that they can live for trillions of years. Our Sun is believed to be about 4.5 billion years old. It should shine for about another 5 billion years.

How do stars die?

Just as the lives of stars depends on their size, so does their death. Stars exist in a state of equilibrium because the gravity pulling in on them equals the pressure pushing out. When a star begins to run out of fuel, the outward pressure decreases, and gravity wins. The effect of gravity on the star depends on its size. Smaller stars will eventually lose their outer layers and shrink their cores to form white dwarfs. Larger, more massive stars will experience much more violent deaths. Gravity crushes these stars so fast that a shock wave is created, resulting in a massive explosion known as a supernova. What remains behind depends on the mass of the star. Large stars will form extremely dense objects known as neutron stars. The largest and most massive stars will experience such a tremendous crush of gravity that they will literally be crushed out of existence into what are known as black holes.

What exactly are constellations?

Constellations are arbitrary groupings of stars that seen to form pictures. Ages ago, ancient people looked up at the night sky and thought they could see patterns. Since different constellations are visible at different times of the year, people used these patterns to tell what time of the year it was. Today, we use the constellations to map the night sky and help classify the locations of objects.

How many constellations are there in the night sky?

Throughout the ages, different cultures saw different patterns and images in the stars. Thus, the constellations have changed over time. Today, we divide the sky into 88 different constellations. Astronomers use them to classify objects in the sky. Every star or other object in the night sky falls into one of these 88 constellations.

Are all of the stars in a constellation the same distance from us?

No. Most of the stars in a constellation have no connection with one another. They are simply chance alignments of the stars. The stars are all different distances from us, but because they are so far they all appear flat as seen from Earth. If you could travel far out into space, the constellations would look completely different from your point of view.

Are the constellations permanent?

All of the stars in the sky are moving in relation to the Earth. Since they are so far away, it takes thousands of years to notice their movement. But eventually the movement of the stars will make today's constellations completely unrecognizable.

The Universe

How old is the universe?

This is a question that has puzzled astronomers for many years. The most recent estimates put the age of the universe at between 13 and 20 billion years. However, as new discoveries are made with the Hubble space telescope and other new technologies, these numbers may continue to be revised.

How big is the universe?

ASTRONOMY FAQ

The latest estimates say it is about 156 billion light years across. Since one light year equals about 6 trillion miles, that is a very big number. But since we can only see so far, we may never know exactly how big the universe is. Some astronomers even believe the universe is infinite in size. And there may be even other universes out there beyond ours.

How did the universe begin?

The most widely accepted scientific theory today suggests that the universe began about 14 billion years ago from an infinitely small, dense, and hot state that expanded rapidly. As it continued to expand and cool, hydrogen gas formed into stars and eventually formed into galaxies. This theory is known as the big bang theory and helps to explain why the universe appears to be expanding today. Astronomers have observed that galaxies are moving away from each other. The farther away a galaxy is, the faster it is moving away. The big bang theory states that it is actually the fabric of space that is expanding. Matter is simply going along for the ride like dust on the surface of a balloon. As the balloon expands, the dust gets farther and farther apart.

How will the universe end?

Scientists used to think that the combined gravity from all of the matter in the universe would eventually slow its expansion and cause it to contract back into an infinitely small, dense state as it existed before the big bang. But now, most agree that there is not enough matter in the universe to slow its expansion. This means that it will continue to expand until all of the stars eventually burn out. Eventually, matter will decompose and all that will be left is a cold, dark void. That may sound depressing, but it will take at least 100 trillion years.

How many galaxies are there in the universe?

This is a question that continually puzzles astronomers and is subject to frequent revision. The reason for this is because we can only see so far with the instruments we have available to us today. The most recent estimates by astronomers suggest that there are about 200 billion galaxies in the known universe. However, as new telescopes and new technologies emerge, this number is almost sure to be increased as we gain a better understanding into the true size of the universe.

LAST MONTH ON THE STAR FIELD

(background) Tom explains to KC which end you look through!

Couple of our new members join the fun— hope to see them frequently this summer and bring those big scopes with you!!!

OBSERVATORY REPORT 4-29-11

The **Snapper Mower is FINALLY repaired** and back at the observatory. **$ 547.71** only about $ 2 more than their estimate. (we will not be taking it there for repairs again unless they hire some more technicians)

I repaired the Big Wheel line trimmer that the club bought several years ago myself. Its air filters were completely clogged - They will need to be checked regularly after use

A mouse had built a nest in the throttle regulator – so it couldn't move. The fuel line was rotten and leaking.

I cleaned it up and got it going again. You may have to reset the hand throttle from time to time as it seems to vibrate toward the choke position.

This thing will take on medium heavy tall grass but it does tend to break line frequently. The line for it is on the pegboard. Cut it off in 14 or 16 inch lengths. I also included a pair of safety glasses. Long pants and good shoes also.

I tied an experiment on the dome rim that seems to be working well.. I used liquid nails to glue in some blocks of wood along the rim. Then cut a strip of soft vinyl flooring I had and screwed it into the blocks.

Ann helped me get it set up. We rotated the dome all the way around and it wasn't dragging.. Really did cut down on the wind that was howling in from the south. The south side has some big tears in the external rubber lining (which needs repair)

There is only about 12 ft of vinyl now – We can see how it stands up to a couple of months use. And if it works We can do the rest of the dome. If it doesn't work it will come down easily. Also bought 3 bags of tick and chigger RX that will need to go down sometime. There was some water on the floor in the NW corner and near the tool rack

I swept it out. And aired out the place. In the summer we can leave the Restroom door open and it won't be so humid in there. I signed the log in register along with the group that came up Friday night

First time it has been signed in 2011

Me – Ann – Steve – Jerry – Michael and Marilyn

I Don't know who closed up. I told Steve about the log book.

Except for the missing camera that Chris mentioned everything seemed in order.

John Land

ASTRONOMY CLUB OF TULSA – MINUTES— GENERAL MEETING FRI FEB 18, 2011.

PRESENT:	NOT PRESENT:
Owen Green, President	Christopher Proctor, Board
Teresa Kincannon, Vice President	Allen Martin, Board
Tamara Green, Secretary	John Land, Treasurer
Tim Davis, Board	
Bill Goswick, Board	There were 15 people in attendance, including guests.

President Owen called the meeting to order at 19:01. 15 people attended.

WELCOME AND INTRODUCTION: Owen welcomed everyone, introduced himself. He then apologized for the lack of a speaker due to the speaker calling on Monday and cancelling. He tried to get others, but none were available this month. He decided to make tonight's meeting an open forum.

PROGRAM: Open forum.

OFFICERS'/STAFF REPORTS:

SECRETARY – Tamara announced that she has minutes from last month's meeting, and said if anyone wants a copy to email her. She then, at the request of the attendees, read the minutes from last month's meeting.

TREASURER – Not present, no report.

VP/GROUPS – Teresa talked about her and Tim going out to the observatory with a group, reported that the dome is a lot quieter and runs a lot easier. Tom McDonough talked about what was done to the dome to make it run smoother.

OBSERVING – Ann had a couple of items to discuss. One was bad news and the other was good news. She gave bad news first, which concerns the Adams Ranch. A lot of changes have taken place at Adams Ranch, so no groups will be admitted there, at least for this year. She is looking into other locations for our Members Weekend. Owen mentioned that there was a Boy Scout ranch near Lake Bluestem. Another member mentioned an observatory near the Ouachita National For-

Continued Next Page

est, and even found a website for it. It is called the Blue Moon Astronomical Observatory. Teresa said that she grew up in that area, and the only problem was that it is very wet in that area and it is about 4 hours away. Good news: Tom said there is a club discount for SkyTools 3 if more than 9 people buy it through the club, we would get a 40% discount. She will get an announcement in the newsletter.

FACILITIES – Not present, no report.

PR/OUTREACH/SIDEWALK – Owen announced the Sidewalk Astronomy at Bass Pro for Saturday, Apr. 16.

ANNOUNCEMENTS: Tom brought a couple of calendars to give away. Owen then discussed upcoming events for the rest of the month and for May. The speaker for May is Austin Holland from OU. He spoke briefly about him. He then announced that for the months of May through August our Sidewalk Astronomy events will be at RiverWalk Crossing in Jenks. They have a limit on who drives around the back, down the bike path to where we set up. Members going to set up scopes must arrive before 7PM, and can't leave until after 10 PM, due to the concerts. Tom suggested to Owen to delete the spam and other unnecessary things on the Yahoo! Groups since Owen is now an admin. Teresa has been unable to talk to anyone about a public event due to other things going on. She said it would be really easy to get an event together at TCC West Campus. She will talk to West Campus.

Owen adjourned the meeting at 19:39.

MESSAGE FROM THE PRESIDENT

From: Owen Green

Our guest speaker for May is Austin Holland from the Geophysical Observatory in Leonard.

Here is a quote from an email from him, "The title of my talk will be "Past and Present Earthquakes in Oklahoma: recent observed increases in the number of earthquakes". I will be talking about new observations of seismicity patterns within the state and discussing the implications of the recently observed increase in the number of earthquakes within Oklahoma."

He is a Seismologist from the University of Oklahoma.

OBSERVER

The Astronomy Club of Tulsa's Newsletter

Published Since 1937 **February 2011**

Lands Tidbits – by *John Land* for May 2011

Membership rates for 2011 will be as follows.

Adults - $ 45 per year includes Astronomical League Membership

Sr. Adult $ 35 per year for those 65 or older includes Astronomical League Membership

Students $ 30 with League membership Students $ 25 without League membership.

Additional Family membership $ 20 with voting rights and League membership. $ 15 without League Membership

The regular membership allows all members in the family to participate in club events but only ONE Voting Membership and one Astronomical League membership.

Magazine Subscriptions: If your magazines are coming up for renewal, try to **save the mailing label** or renewal form you get in the mail. Forms are available on the club website.

Astronomy is $ 34 for 1 year or $ 60 for 2 years. www.astronomy.com

To get the club discount you must go through the club group rate

Sky & Telescope is **$33 / yr** www.skyandtelescope.com

Sky and Telescope also offers a 10% discount on their products.

Note: **You may renew your Sky & Telescope subscription Directly Online** without having to mail in the subscriptions to the club. NEW SUBSCRIPTIONS must still be sent to the club treasurer.

We now have an automated on line registration form on the website for new AND renewal memberships plus magazine subscriptions. You simply type in your information and hit send to submit the information.

http://www.astrotulsa.com/Club/join.asp To Join or Renew Memberships

You can then print a copy of the form and mail in your check.

Astronomy Club of Tulsa - 25209 E 62nd St – Broken Arrow, OK 74014

Address Corrections- Email changes – Questions:

You may forward questions to the club by going to our club website and Fill out an online form or just click on John Land and send an email. Please leave a clear subject line and message with your name, phone number, your question – along with email

CLUB OFFICERS

President	Owen Green	918-851-8171
Vice-President	Teresa Davis	918-637-1477
Treasurer	John Land	918-357-1759
Secretary	Tamara Green	918-581-1213

BOARD MEMBERS AT LARGE

Bill Goswick	
Allen Martin	918-407-9706
Tim Davis	
Chris Proctor	918-810-6210

APPOINTED STAFF

Newsletter Editor	Jerry Mullennix	
Facility Manager	Chris Proctor	918-810-6210
Membership Chair	John Land	918-357-1759
Observing Chair	Ann Bruun	918-834-0757
New Members	Owen Green	918-851-8171
Group Director	Tamara Green	918-581-1213
Webmaster	Jennifer Jones	
Night Sky Network	Teresa Davis	918-637-1477

MEMBERSHIP INFO

Astronomy Club of Tulsa membership ($45/year) includes membership in the Astronomical League and subscription to ACT's "Observer" and AL's "Reflector". "Astronomy" ($34/year) and "Sky and Telescope" ($33/year) are also available through the club. For more information contact John Land at 918-357-1759. Permission is hereby granted to reprint from this publication provided credit is given to the original author and the Astronomy Club of Tulsa "Observer" is identified as the source.

Jim "O'Toole" Millers—Astro Words of Wisdom:

"The crowd cheered when I blazed across the star field with my bright lights on"

ACT welcomes your questions, suggestions, comments and submissions for publication. Please send all inquiries to jerrym@pantherenergy.us