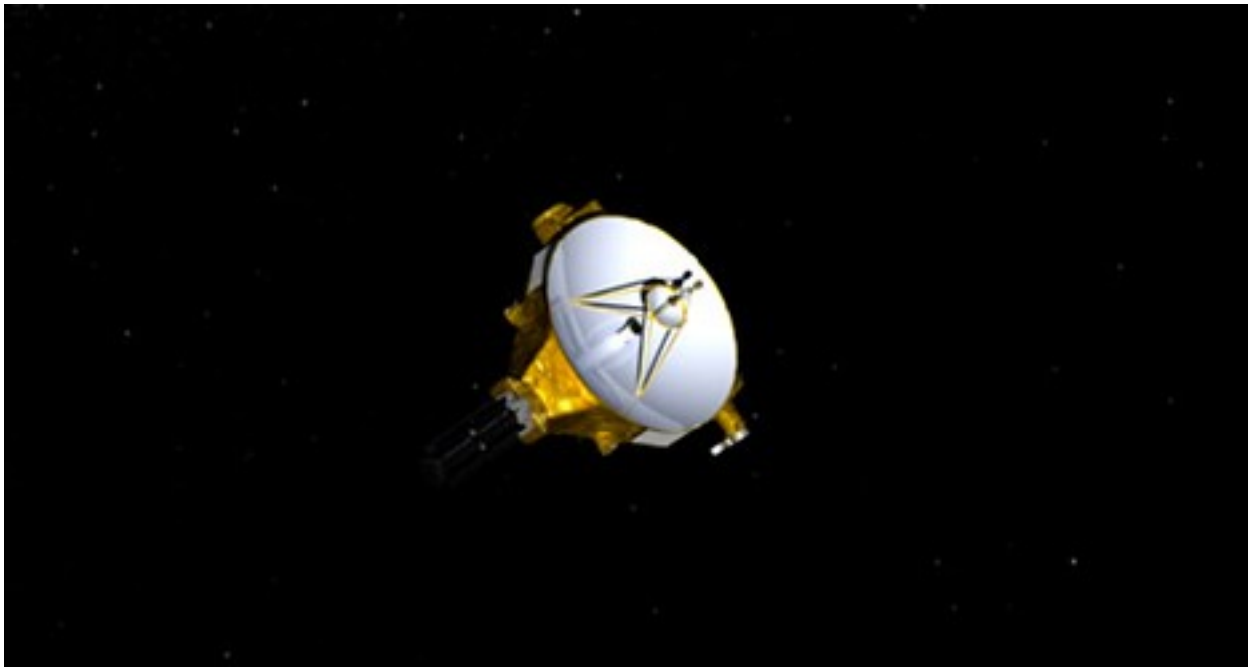
Night Visions

Newsletter of the Baton Rouge Astronomical Society

January, 2015

Next Meeting: January 12th at 7PM at HRPO



Artist concept of New Horizons. For more info on it and its mission to Pluto, click on the image.

What's In This Issue?

President's Message

Welcome to a new year. I can see lots to be excited about this year. First up are the Rockafeller retreat and Hodges Gardens Star Party. Go to our website for details: www.brastro.org

Almost like a Christmas present from heaven, Comet Lovejoy C/2014 Q2 underwent a sudden brightening right before Christmas. Initially it was expected to be about magnitude 8 at its brightest but right after Christmas it became visible to the naked eye. At the time of this writing, it may become as bright as magnitude 4.5 or 4. As January progresses, the comet will move farther north, and higher in the sky for us. Now all we need is for these clouds to move out….

If any of you received (or bought yourself) any astronomical related goodies for Christmas and would like to show them off, bring them to the next meeting. Interesting geeky goodies qualify also, like that new drone or 3D printer.

BRAS members are invited to a star party hosted by a group called the Lake Charles Free Thinkers. It will be January 24, 2015 from 3:00 PM on, at 5335 Hwy. 113, Dry Creek, LA 70634. (This event was rescheduled after their November date was rained out.) That is about 10 miles east of the highway between Lake Charles and DeRidder and between DeRidder and Oberlin. The guest presenter will be Will Messier (Yes, that's right, Messier) of the Astronomical Society of Southeast Texas. The Sowella (community college) astronomy club will also be in attendance. Pot luck in the afternoon. Camping is allowed. Contact Sheryl Johnson, sherylchristine@gmail.com

We still have an Outreach Coordinator (OC) position open. Let me know if you are interested.

Lastly, Richard J. Barlett is still offering his 2015 – 2019 edition of the Astronomical Almanac (Kindle format) for FREE on Amazon. If you don't have a Kindle, there are apps that will read the Kindle format for other devices. Go here for the download: http://www.amazon.com/dp/B00NN6WTWU/ref=cm_sw_r_fa_dp_Eyutub0TFKA26

Clear skies,
Merrill Hess
BRAS President

Wild Weather on WASP-43b

You thought finding planets around stars hundreds of light-years away was spectacular, exceeded only by determining their sizes and orbits.

Well, in the ongoing exoplanet version of the game "can you top this?" comes another phenomenal feat: discerning the weather on a distant exoplanet—including sensing water vapor in its atmosphere.

The planet is WASP-43b, orbiting a deep orange dwarf (at spectral class K7, as orange as a star can be without being a red dwarf) a tenth the size of the Sun, and with a cooler surface temperature (maybe 7,500°F compared to 10,000°F for the Sun, a G2 star). A whopping 260 light-years away in the constellation Sextans, you'd need an 8-inch telescope under dark skies even to pick out the host star (magnitude 12.4).

Like just about every other exoplanet discovered so far, WASP-43b is no vacation spot. The planet is the size of Jupiter but twice as massive. Indeed, the planet is slightly more than a tenth the diameter of the star itself.

Worse, it is in a nearly circular orbit less than a million miles from its star's surface—closer than four times the distance of the Moon from Earth: so close that it orbits the star in a year of just 19.5 *hours*. Its day is also 19.5 hours long because the planet's rotation is tidally locked: one side always faces the star and suffers permanent day while the other side has permanent night.

What does all that mean for its weather?

To find out, a team of astrophysicists—including Jonathan Fortney at the University of California, Santa Cruz (UCSC)—combined two observational techniques for the first time and dove deeply into the data.

Emission and transmission

The team secured several precious days of observing time on the Hubble Space Telescope in November and December 2013 to obtain measurements of the planet over three nearly consecutive orbits with Wide Field Camera 3. They also acquired data from three primary transits (where the planet crossed directly in front of the star) and two secondary eclipses (where it passed behind the star), observing in the thermal (heat) near infrared at wavelengths of 1.1 to 1.7 micrometers (μm) using an instrument called the G141 grism. They supplemented the HST observations with high-precision observations from NASA's Spitzer infrared space telescope at slightly longer wavelengths (3.6 and 4.5 μm).

During transits, they measured how the host star's light filtered through the planet's atmosphere—a technique called transmission spectroscopy—to determine the abundance of any water vapor in the atmosphere where the day side transitions to the night hemisphere. Also at different points during transits, they used a technique called emission spectroscopy to monitor the heat emitted at night by the planet itself.

Using custom software run on the Hyades supercomputer cluster at UCSC, they used the extracted spectra to provide a comprehensive view into WASP-43b's atmosphere, including how temperatures change with height around the planet. They were also able to map temperatures and water abundances in the atmosphere at different longitudes across the planet's day and night sides—an entirely new technique.

"The emission spectrum shows strong evidence for water absorption," the authors wrote in *The Astrophysical Journal Letters*. The Spitzer data also suggest that carbon monoxide and carbon dioxide exist in the atmosphere. The place seems to be too hot for clouds.

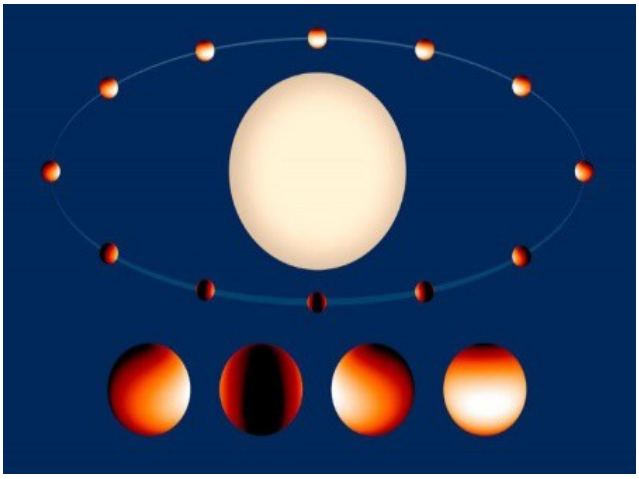
Easier than measuring Jupiter

Studying the exotic inferno WASP-43b 260 light-years away actually may shed light on our own solar

system.
“Even though Jupiter is much closer to Earth, the composition of its atmosphere is actually harder to study than WASP-43b’s.” Fortney explains. “Our own solar system’s giant planet is so cold that most of its important molecules are hidden in clouds far below the visible atmosphere. The high temperatures of ‘hot Jupiters’ such as WASP-43b make studying their atmospheres easier.”
How hot? WASP-43b’s day side is hot enough to melt iron (2,700°F); the night side is much “cooler”—at 900°F it would “only” melt lead. For perspective, that makes the night side as comfortable as Mercury’s day side—maybe worse, because of WASP-43b’s humid atmosphere. Because heat is so poorly distributed through its atmosphere, fierce hot winds roar from the day side to the night side.
The team hopes that their measurements can reveal more about the conditions under which planets form. “These observations with Hubble show us that we can understand the makeup and weather of giant planets around other stars with current telescopes,” Fortney says. “Thus, they are an important step towards characterizing the atmospheres of more Earth-like worlds with future, specialized space telescopes.” *–Trudy E. Bell, M.A.*

Further reading: The findings appeared in two articles: “A precise water abundance measurement for the hot Jupiter WASP 43-b” in the October 1, 2014 issue *ApJ Letters,* and “Thermal structure of an exoplanet atmosphere from phase-resolved emission spectroscopy,” in *Science* on October 9.See also the NASA press release “Hubble reveals most detailed exoplanet weather map ever” at http://www.spacetelescope.org/news/heic1422/ . A time-lapse video of the data as WASP-43b rotates/revolves appears at http://astro.uchicago.edu/~kbs/wasp43b.html .

The University of California High-Performance AstroComputing Center (UC-HIPACC), based at the University of California, Santa Cruz, is a consortium of nine University of California campuses and three affiliated Department of Energy laboratories (Lawrence Berkeley Lab, Lawrence Livermore Lab, and Los Alamos National Lab). UC-HiPACC fosters collaborations among researchers at the various sites by offering travel and other grants, co-sponsoring conferences, and drawing attention to the world-class resources for computational astronomy within the University of California system. More information appears at http://hipacc.ucsc.edu



Artist’s conception (not to scale) shows exoplanet WASP-43B orbiting its orange dwarf host star. The four images below show close-ups of the planet at points in its orbit 90 degrees apart. (Transits and eclipses are not shown.) Credit: NASA, ESA, and Z. Levay (STSci)

Secretary's Summary of December Meeting

- After our annual December potluck dinner, we nominated and voted in by acclamation the club officers for the new year. These are Merrill Hess, president; Ben Toman, vice-president; Trey Anding, treasurer; and Roslyn Readinger, secretary.
- Cathy Gabel and Haley Franklin were recognized and welcomed as new members to BRAS.
- There was a reminder that Trey is currently taking the money for membership renewals for 2015.
- Brad Schaefer will give his annual Star of Bethlehem talk at the HRPO on December 12th at 7:30 pm (he gave a speech on this subject recently in the Netherlands). Chris spoke about the upcoming Geminid meteor shower (there were fireballs already being reported in connection with this). The observatory will be open for this on December 13th from 9:00 pm to 1:00 am. He also mentioned the Christmas dance at Magnolia Mound Plantation and the Vicki Lawrence show at the Independence Park Theatre on December 14th. He talked about the upcoming party at the observatory on December 19th that was going to preview the UN declaration of 2015 as the International Year of Light and Light-Based Technology as well as kick off the observatory's 20/20 Vision Campaign. This campaign has the goal of a light meter reading of 20 by the time of the observatory's 20th anniversary in the year 2017. Chris has been talking with Ingolf Partenheimer of DPW; he is trying to work with us to make sure future lighting changes to the streetlights in his control have the proper cutoffs to improve dark-sky viewing. Concern was expressed about the fact that DPW will now be split into smaller departments due to the vote in the recent election.
- Don Weinell reminded everyone about the upcoming star party at the Rockefeller Wildlife Refuge in Cameron Parish on January 16th and 17th; he will have a signup sheet at the next BRAS meeting. The lodging has been newly renovated. This can turn into mostly a bird watching event, especially if the weather is not that great for astronomy. This is a prime bird refuge with some alligator research going on here as well. Mosquitos should be at a minimum with plenty of other wildlife to see.
- The 9.5x44 binocular that was donated by the late Art Newman was raffled off along with some books, an accessory case, a tee shirt, a bumper sticker ("Mars or Bust"), and Orion pin. Haley Franklin had the winning ticket for the binocular.
- The final announcements included an alert about Sky & Telescope having a sale on globes as well as letting everyone know that membership applications for BRAS were available on the front table.

-Roslyn Readinger
BRAS Secretary

HRPO

FRIDAY NIGHT LECTURE SERIES
all start at 7:30pm
2 January: {no lecture}
9 January: "2014—The Space Year in Review"
16 January: "Astrophotography for Beginners"
23 January: "Wonders of the Winter Sky"
30 January: "Commercial Space Exploration"

SCIENCE ACADEMY
Saturdays from 10am to 12pm
For ages eight to twelve. $5/$6 per child.
3 January: "Calendars and Time Keepers"
10 January: "Expedition 6"
17 January: "Surveying the Earth"
24 January: "Winter Day"
31 January: "Exoplanets!"

CALL FOR VOLUNTEERS
*Friday, 2 January from 6pm to 8pm. *Two volunteers.* **International Year of Light Preview Party.** Various simple tasks; easy.
*Saturday, 3 January from 3pm to 7pm. *Four or five volunteers.* **Learn Your Binocular**. Instructing registrants in the use of their personal binoculars. Previous binocular knowledge required.
*Saturday, 17 January from 6pm to 10pm. *Two volunteers in additional to regular complement.* **Evening Sky Viewing Plus.** Marshmallow roast, demo tables. Easy; training provided.
*Saturday, 24 January from 3pm to 7pm. *Eight or nine volunteers.* **Learn Your Telescope**. Instructing registrants in the use of their personal telescopes. Previous telescope knowledge required.
*Saturday, 31 January from 12pm to 2pm. *One volunteer.* **Solar Viewing**. Three viewing instruments. Moderate; training provided.
***Saturday, 31 January from 3pm to 7pm. *Four or five volunteers.* Learn Your Binocular. Instructing registrants in the use of their personal binoculars. Previous binocular knowledge required.**

The International Year of Light
20/20 Vision Campaign

The Baton Rouge Area Foundation is interested in restoring the Lakes around LSU. Apparently these lakes are, on average, fewer than eighty centimeters in depth. BRAF's $750,000 idea is using as its springboard a U.S. Army Corps of Engineers dredging proposal. The collaborators include EBRP government (the owners of the lakes), LSU and BREC. A final plan is slated for the summer of 2015. On 11 December there was a public function at the Cotillion Ballroom concerning this project. The presenters placed a large map of the lakes and surrounding areas at each of the large round table. Also at each table were markers denotes suggested uses for the lakes and lakeshore that those seated could manipulate on the map while they discuss.

A BRAS member attended and mentioned the BRAS interest of seeing only FCO lighting used in any new development.

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This Month's **GLOBE At Night** runs from 11 January to 20 January. Participants should use the constellation Orion.

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The December SQM measurement was delayed due to inclement weather. The measurement will be taken during the first half of January.

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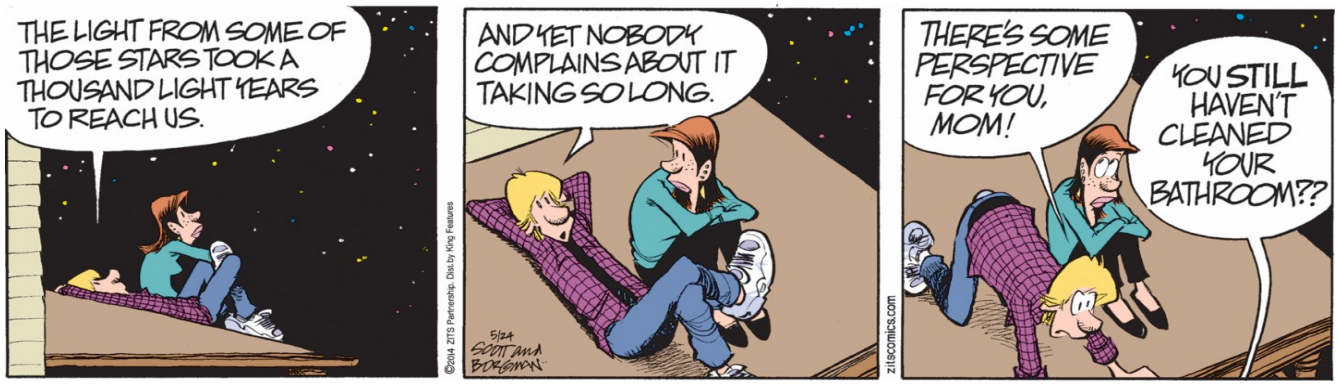
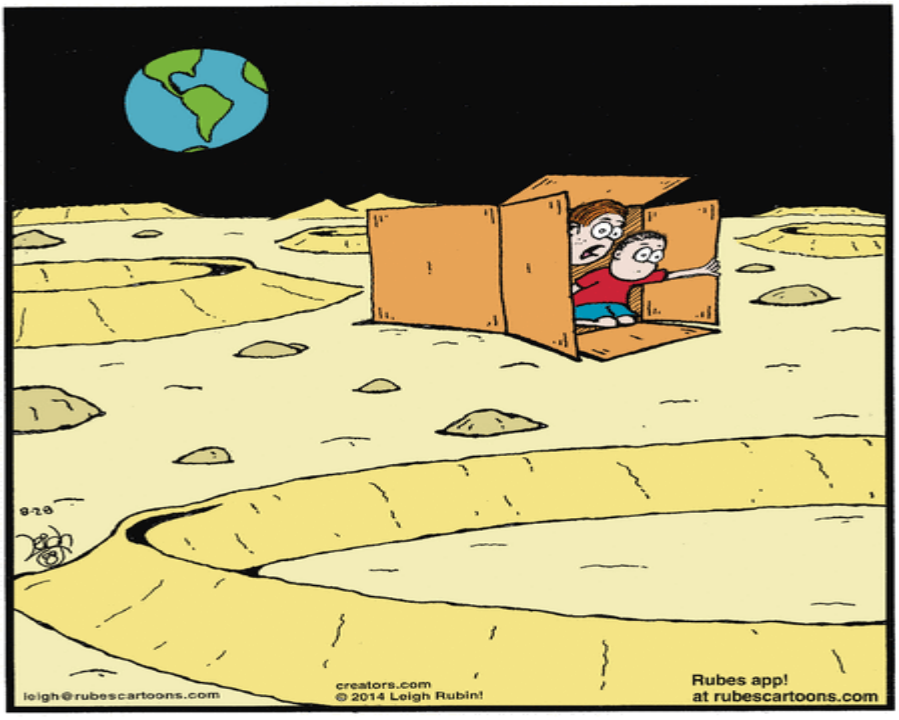
Comet Lovejoy will be brightening in the night sky, possible to a magnitude of 4.1. This event should be utilized to point out the practical benefits of shielding nighttime lighting.



Recent Entries in the Forum

Below are selected recent additions to the BRAS Forum. There are also nine active polls.

Medical Thermometer Comes from NASA Spinoff Technology
Dates Set for Hodges Gardens Star Party
Second BRAS Good Lighting Award goes to Woman's Hospital
2015 is International Year of Light
Next Light Pollution Committee Meeting is 12 January
BRAS Receives Representation at Baton Rouge Lakes Project Meeting
2015 Dates Announced for GLOBE at Night
Tenth Anniversary of Huygens Probe Release
IAU and MESSENGER Team Hold Contest to Name Craters on Mercury Orion Exploration Flight Test 1 a Success
Thirtieth Anniversary of Claxton Meteorite Fall
Geminid Meteor Shower Peak Very Active
Fifth Anniversary of WISE Launch
2014 UR116 *Not* an Impact Risk
Rosetta's Philae Lander Makes it to Comet Churyumov-Gerasimenko
Comet Lovejoy to Brighten in January Sky



"Aw, jeez, now what are we supposed to do? I only had enough imagination to get us here."

Taurus – The Bull

Position RA 04 04 41.7 Dec. +22 04 55

Named Stars:

Aldebaron (Alpha Tau),"al-dabaron", "The Follower", "The Bull's Eye", mag. 0.87, 04 35 55.20 +16 30 35.1, is an orange giant star and is the 13th brightest star in the sky. Aldebaron has a red dwarf companion at 13th magnitude and a separation of 31.4". Although Aldebaron appears to be the brightest star in the Hyades cluster, it is not part of it.

Elnath (Beta Tau),"an-nath", "The Butting (horns)", mag. 1.65, 05 26 17.50 +28 36 28.3, is a white giant star that is sharing the border with the neighboring constellation of Auriga – The Charioteer, resulting in having a second designation of Gamma Aurigae also.

Hyadum 1 (Gamma Tau),"First Hyad", mag. 3.65, 04 19 47.53 +15 37 39.7, is a giant star in the Hyades Cluster.

Eudora (Delta-1 Tau),"Hyadum II", "The Second Hyad", mag. 3.77, 04 22 56.03 +17 32 33.3, is a triple star system, with the primary being an orange giant star with a 12th magnitude companion at 107" of separation. Delta-2 Tau is a main sequence dwarf star at mag. 4.80 and a separation of 0.23° away from Delta-1 Tau.

Kleeia (Delta-3 Tau), mag. 4.30, is triple star system, lying 0.72° from Delta-1 Tau. The primary star (Delta-3 Tau) is a white sub-giant star with two companions, at 8thand 11th magnitudes.

Ain (Epsilon Tau),"Oculus Borealis", "The Eye", mag. 3.53, 04 28 36.93 +19 10 49.9, is an orange giant star with an 11th magnitude companion at 182" separation.**Epsilon Tau** has one planet orbiting the star every 1.6 years, and the planet is the first discovered in an open cluster (Hyades), and is still the only known planet in the Hyades Cluster.

Alcyone (Eta Tau), mag. 2.85, 03 47 29.06 +24 06 18.9, is an eclipsing binary system separated by 0.031". **Alcyone A** is a blue-white giant star and a rapid rotator. The binary star has three companions **Alcyone B, C, and D. Alcyone B,** mag. 8.30, 03 47 19.20 +24 08 22.0, is a white dwarf star along with **Alcyone C. Alcyone D** is a yellow-white dwarf star at mag. 8.3. **Alcyone** is one of the Pleiades Sisters.

Pectus (Lambda Tau),"The Bull's Chest", mag. 3.41, 04 00 40.82 +12 29 25.4, is a triple star system. The main component is a pair of inner stars, designated as Lambda Tauri AB, which orbit each other every 3.95 days and form an eclipsing binary star. The star is a rapid rotator, and the secondary star is a sub-giant star and a rapid rotator also. The third component orbits the inner pair with a period of 33.025 days.

Ushakaron (Xi Tau), mag. 3.73, 03 27 10.72 +09 43 58.0, is a triple star system consisting of three blue-white main sequence dwarf stars. It is a spectroscopic and eclipsing binary system. Two of the three stars are in a close orbit, revolving around each other every 7.15 days, while orbiting the third star every 145 days.

Atlas (27 Tau), mag. 3.62, 03 49 09.73 +24 03 12.7, is a triple star system named after the Titan Atlas, the father of The Pleiades. The primary**, Atlas A,** is a blue-white giant star and a spectroscopic binary with component5s having visual magnitudes of 4.1 and 5.6. The binary star has an orbital period of 1250 days. The primary has a dim companion, **Atlas B**, at mag. 6.8, and is at 0.4" separation.

Electra (17 Tau), mag. 3.72, 03 44 52.52 +24 06 48.4, is a blue-white giant star. **Electra** is one of the Pleiades Sisters, and is also a rapid rotator. This star emits an excess level of radiation in the infrared.

Maia (20 Tau), mag. 3.87, 03 45 49.59 +24 22 04.3, is a blue giant star named after the eldest of the

Pleiades Sisters. It is one of the stars in the Maia Nebula (NGC 1432), a relatively bright emission or reflection nebula. **Maia** is a mercury-manganese star.
Merope (23 Tau), mag. 4.14, 03 46 19.56 +23 56 54.5, is a blue-white sub-giant star surrounded by the Merope Nebula (NGC 1435, IC 349, Caldwell 5), and is a Pleiades Sister.
Taygeta (19 Tau), mag. 4.30, 03 45 12.48 24 28 02.6, is a triple star system named after one of the Pleiades Sisters. The primary is a binary star, **Taygeta A**, and is a blue-white sub-giant star. Its two components, mag. 4.6 and 6.1, are separated by 0.012 arc seconds, and orbit each other every 1,313 days. **Taygeta B** is an 8th magnitude companion, separated from **Taygeta A** by 69 arc seconds.
Pleione (28 Tau, BU Tau), mag.5.05, 03 49 11.20 24 08 12.6, is a binary star named after the daughter of Tethys and Oceanus, and is the mother of the Hyas, Hyades, and The Pleiades. **Pleione** is an extremely fast rotator and rotates close to its breakup velocity.
Celaeno (16 Tau), mag. 5.45, 03 44 48.20 +24 17 22.5, is a blue-white sub-giant star and is sometimes called "The Lost Pleiad" because it is the most difficult one of the seven Pleiades Sisters to find, and can only be seen with optical aid. **Celaeno** is another rapid rotator in the Pleiades Cluster.
Asterope (21 Tau and 22 Tau), is a binary system. **Asterope 1** (21 Tau), at mag. 5.76, 03 45 54.46 +24 33 16.6, is a main sequence dwarf star. **Asterope 2** (22 Tau), mag. 6.43, 03 46 02.89 +24 31 40.8, is also a main sequence dwarf star. Separation between these stars is 0.04°. **Asterope** is named after one of The Pleiades Sisters.

Other Stars:
Kappa Tau, mag. 4.21, 04 25 22.10 +22 17 38.3, is the primary star of a binary system and the brighter of the pair. **Kappa 2 Tau**, mag. 5.27, 04 25 24.94 +22 12 0.4, is a dwarf star, with a separation of 5.3 arc seconds from **Kappa 1 Tau.** There is another binary system consisting of two 9th mag. stars lying between **Kappa 1 and 2 Tau**, and a separation of 183 arc seconds from **Kappa 1 Tau**. The **Kappa Tau** system has two more components, both at 12th magnitude.
119 Tau, mag. 4.32, 05 32 12.75 +18 35 39.3, is one of the largest stars known, a red super-giant star, and one of the reddest stars known.
T Tau, mag. 9.60, 04 21 59.43 +19 32 06.4, is a variable star serving as the prototype for the T Tauri Variables. These variables are pre-main sequence stars with less than 2 solar masses, have a high overabundance of Lithium, and are usually located near molecular clouds. The T Tauri system consists of at least 3 stars of which only one can be seen at optical wavelengths, the other two are visible in the infrared. One of the stars is a source of radio waves. The T Tauri system is located near the reflection nebula NGC 1555 (Hind's Variable Nebula) and illuminates it.
HD 24496, mag. 6.81, 03 54 28.03 +16 36 57.8, is a binary star with one planet in orbit around it.
HD 24040, mag. 7.52, 03 50 22.97 +17 28 34.9, has one planet.
HD 37124, mag. 7.58, 05 37 02.49 +20 43 50.8, has three planets.
HD 28678, mag. 8.54, 04 31 25 +04 34 31, has one planet.
Gliese 176, mag. 9.97, 04 42 55.78 +18 57 29.4, has one planet.
HD 285507, mag. 10.5, 04 07 01.0 +15 20 06, has one planet.
Crab Pulsar (PSR Bo531+21), mag. 16.5, 05 34 31.95 +22 00 52.1, is a pulsar in the Crab Nebula (M 1, NGC 1952).
2M J044144, 04 41 44.90 +23 01 51.4, has one planet.

DEEP SKY:

M 1 (NGC 1952),"The Crab Nebula", 3C144, mag. 8.4, 05 34.5 +22 01, 6' x 4'in size, is a supernova remnant from 1054 AD, and is located 67' northwest of Zeta Taurii (mag. 2.97, 05 37 38.68 +21 08 33.3), the star that marks the southern tip of the Bull's Horn. This supernova was bright enough to be observed during the day, and is mentioned in Chinese historical texts. There is a neutron star at the center of the nebula, known as the "Crab Pulsar", emitting pulses of radiation ranging from gamma rays to radio waves that rotate 30.2 times a second. Orange filaments are the tattered remains of the star, and consist mostly of hydrogen. The blue light comes from electrons whirling at nearly the speed of light around magnetic field lines from the neutron star. The nebula is about 11 light years (ly) in diameter and is expanding at the rate of 1,500 km/sec. M 1 is a strong source of X-rays, the first identification (Taurus X-1) of an X-ray source with an optically visible object outside the Solar System. A pulsating radio source was detected in the central region, and in 1968 it was suspected that this source derived from one of the two faint stars which appear near the center of the nebula. In 1969, the south preceding component – a blue, 16^{th} magnitude star – was pulsating in optical wavelengths also, and at the same frequency (0.033 sec.) as the radio pulsar, now designated as NP 0532 (psr 0531+21).

M 45, "The Pleiades", mag. 1.2, 03 47.0 +24 07, 1.8° in size, is an open cluster containing as many as one thousand stars, with the brightest seven stars going under the name of "**The Seven Sisters".** Going from brightest to dimmer, **The Seven Sisters** are: Alcyone (Eta Taurii), Electra, Maia, Merope, Taygeta, Celaeno, and Asterope. Added to the lot are also Pleione (28 Taurii, BU Taurii), just east of Alcoyone, and Atlas (27 Taurii), who are actually Mum and Dad for **The Seven Sisters**. **The Seven Sisters** are generally taken to be all half-sisters to the Hyades. The entire star-swarm is enveloped in a faint diffuse nebulosity of vast extent, and is visually elusive.

The Hyades (Caldwell 41, Cr 50, Mel 25), mag. 0.5, 04 27.0 +15 50, 5.5°in size, is an open cluster with at least 400 member stars; detached, weak central concentration of stars; large range in brightness; brightest star is mag. 3.4. **The Hyades,** the daughters of Atlas and Aethra, are mentioned in the works of Homer, Virgil, and other early writers Prominate members of **The Hyades** form an asterism of stars in a "V" or "A" shape, forming the profile of the Bull's face (Gamma, Delta, Epsilon, and Theta Taurii – all of them are red giant stars). Although Aldebaron (Alpha Tau) is the "Eye "of the Bull, it is not part of **The Hyades.** There were originally seven of **The Hyades** named, but one name has been lost, and another is debated – astronomers avoided problems by not naming any of the stars in **The Hyades.** The five names we know of are as follows: Eudora; Koronis; Phaeo; Kleea; and Phaesua. They had one brother, Hyas.

NGC 1746, mag. 6.1 (photo), 05 03.6 +23 49, 41'in size, is an open cluster of 20 stars; detached, no concentration of stars; small range in brightness; large; brightest star is mag. 8 (photo).

NGC 1647, mag. 6.4, 04 46.0 +19 04, 44'in size, is an open cluster of 200 stars; detached, weak concentration of stars; moderate range in brightness; mag. of brightest star is 8.6.

NGC 1807, mag. 7.0, 05 10.7 +16 32, 16' in size, is an open cluster of 20 stars; detached, weak concentration of stars; moderate range in brightness; brightest star is mag. 8.6, located about 0.5° west-southwest of open cluster NGC 1817.

NGC 1817, mag. 7.7, 05 12.1 +16 42, 15' in size, is an open cluster of 60 stars; detached, no concentration of stars; small range in brightness; large; brightest star is mag. 11.2, located about 0.5° east-northeast of open cluster NGC 1807.

NGC 1514, "The Crystal Ball Nebula", PK 165-15, mag. 10.9, 04 09.2 +30 47, 2.2' in size, is a planetary nebula that is irregular, has a smooth disk involved in a large faint nebulosity. It appears more like a nebulas star than a planetary nebula because the 9.4 mag. central luminary dominates the view.

NGC 1554, 1555, "Hinds Nebula", 04 21.8 +19 32, 0.5' in size, is a very faint, small, roundish reflection nebula associated with the star **T Tau.**
NGC 1435, "Merope Nebula", "Tempel's Nebula", IC 349, Caldwell 5, 03 46.3 +23 56, is a reflection nebula that surrounds the star **Merope** (23 Tau) in **The Pleiades** (M 45), and is a suspected supernova remnant.
NGC 1409, 1410, 03 41 10.4 -01 18 09, is a set of colliding galaxies connected by a pipeline of gas, spanning over 20,000 ly (light years), that is being funneled from **NGC 1409** to **NGC 1410**. Both galaxies are gravitationally bound and will eventually merge into one galaxy.
IC 353, 03 55.0 +25 29, 3.0°x 0.5° in size, is an extremely large, very diffuse nebula; has a very faint filamentary structure; illuminated by a 6.4 mag. star. This is the eastern portion of bright nebula IC 1995, just northeast of **The Pleiades**.
IC 1995, 03 50.3 +25 35, is a very faint, extremely large, filamentary nebula with a 6th magnitude star involved.
IC 2087, 04 40.0 +25 44, 4' in size, is a small, and extremely faint nebula.
Ced 33, 04 27.1 +26 06, 5'x2' in size, is a faint and diffuse nebula illuminated by a 10th magnitude star.
Ced 34, 04 27.2 +22 57, 10'x6' in size, is a bright nebula illuminated by a 5.5 magnitude star.
vdB 26, 04 13.6 +10 13, 6' in size, has a 7.2 magnitude star involved in nebulosity.
vdB 29, 04 48.4 +29 47, 7'x5' in size, has a 6.5 magnitude star involved in the east side of a diffuse nebula.
Simeis 147, Sh2-240, 05 39.1 +28 00, 3.3°x3.0° in size, is a supernova remnant; extremely large and extremely faint; has a very wispy and filamentary structure. It is also a radio source.

There are 5 objects and 35 IC objects beyond 10th magnitude – see me for them.
There are over 130 Double and Multiple stars; over 45 Variable stars; and over 30 Star Clusters, Nebulae, and Galaxies in Taurus.

SKY HAPPENINGS FOR JANUARY

Jan.3rd- Pluto is in conjunction with the Sun at 6:00 PM CST.
Jan. 3rd/4th- Quadrantid Meteor Shower peaks – a near Full Moon makes viewing any of this shower's meteors a challenge.
Jan. 4th- Earth is at perihelion (91.4 million miles from the Sun) at 1:00 AM CST.
Full Moon occurs at 10:53 PM CST.
Jan. 8th- The Moon passes 5° south of Jupiter at 2:00 AM CST.
Jan. 8th-12th- Dusk – low in the southwest sky in early evening you will find Mercury and Venus within 1° of each other.
Jan. 9th-The Moon is at apogee (251,909 miles from Earth) at 12:18 PM CST.
Jan. 11th- Asteroid Vesta is in conjunction with the Sun at 12:00 AM CST.
Jan. 13th- Last Quarter Moon occurs at 3:46 AM CST.
Jan. 14th- Mercury is at greatest eastern elongation (19°) at 2:00 PM CST.
Jan. 16th- The Moon passes 1.9° north of Saturn at 6:00 AM CST.
Jan. 19th- Mars passes 0.2° south of Neptune at 3:00 PM CST.

Jan. 20th- New Moon occurs at 7:14 AM CST.
Mercury is stationary at 10:00 PM CST.

Jan. 21st- The Moon passes 3° north of Mercury at 12:00 PM CST.
The Moon is at perigee (223,473 miles from Earth) at 2:07 PM CST.
Dusk – Look to the west shortly after sunset, where a hairline crescent Moon forms a nearly equilateral triangle with Mercury and Venus. The Moon is to the right of bright Venus.
The Moon passes 6° north of Venus at 11:00 PM CST.

Jan. 22nd- Dusk – The waxing crescent Moon shines about 4° to the right of Mars.
The Moon passes 4° north of Neptune at 7:00 PM CST.
The Moon passes 4° north of Mars at 11:00 PM CST.

Jan. 23rd/24th- A rare triple shadow transit occurs on Jupiter from 5:27 to 5:52 UT on the 24th (12:27 AM to 12:52 AM CST) by the moons Io, Europa, and Callisto.

Jan. 25th- The Moon passes 0.6° north of Uranus at 6:00 AM CST.

Jan. 26th- First Quarter Moon occurs at 10:48 PM CST.

Jan. 29th- The Moon passes 1.2° north of Aldebaron (Alpha Taurii) at 12:00 PM CST.
Asteroid Juno is at opposition at 5:00 PM CST.

Jan. 30th- Mercury is in inferior conjunction at 8:00 AM CST.

Mercury – Low in the southwest at dusk, Mercury and Venus spend the first half of January within the field of view of a 7x50 binoculars. Look for Mercury to the lower right of Venus for the first week or so of the month, then to Venus's right through about the 17th. On January 1st, Mercury lies 3° to Venus's lower right and some 4° above the horizon 30 minutes after sunset, glowing at magnitude -0.8. By January 10th, Mercury's altitude a half hour after stands 5.5°undown has more than doubled to 9°, and will appear conspicuous only 0.6° due west of Venus. From January 8th thru 12th, Venus and Mercury stay within 1° of each other. Their least separation, 39', comes on January 10th around 6:00 PM CST. As Mercury swings away from Venus, it reaches greatest elongation on January 14th, lying 19° east of the Sun, and hanging 10° above the horizon a half hour after sunset, at magnitude -0.7. A few days after greatest elongation, Mercury starts to fade and sink lower, having an inferior conjunction on January 30th. As darkness falls on January 21st, the waxing crescent Moon stands 5.5° above Mercury (at mag. -0.6), and the same distance to Venus's right. On the 1st, Mercury's disk spans 5" and appears nearly full. On the 14th, at greatest elongation, the planet shows a 7" diameter disk that is slightly more than half-lit. At the time of its conjunction with the Moon on the 21st, it appears 9" across and just 1/4th lit.

Venus – Venus shines all month at magnitude -3.9, with its disk growing from 10" to 11", and its phase shrinking from 96% to 92% lit during the month of January. See Mercury above for particulars.

Mars – Mars lies 20° high in the southwest after sunset throughout January at magnitude +1.1 to +1.2, and has a disk of less than 5" wide, as seen through telescopes. Mars races eastward in front of the stars of Capricornus and Aquarius, with its motion carrying it just 0.2° south of Neptune on January 19th.

Jupiter – Jupiter, in Leo, comes up around 8:00 PM local time as January begins, and about 2 hours earlier by month's end. Jupiter brightens from -2.4 to -2.6 magnitude during January, with its disk swelling from 43.5" to 45.3" wide. Jupiter will reach opposition on Feb. 6th. For the first time in five

years, Jupiter's satellite's orbital plane now tilts nearly edge-on to the Sun and Earth. This ushers in a series of "mutual events" where one moon may pass in front of another (an occultation), or enter another's shadow (an eclipse). Dozens of such events occur this month. Such satellite events reach a crescendo the night of January 23rd/24th when three moons and their shadows cross the planet's disk, and Callisto eclipses Io. The action begins at 9:11 PM CST when Callisto's shadow first touches Jupiter. Io's shadow follows at 10:35 PM, and Europa's shadow at 12:27 AM CST. For the next 25 minutes, all the shadows appear as black dots on the planet's cloud tops. Do not miss this rare triple shadow transit – there will not be another until 2032! Io's shadow leaves the disk at 12:52 AM, Callisto's at 2:00 AM, and Europa's at 3:22 AM CST. The moons themselves appear silhouetted against Jupiter's disk from 10:54 PM until 1:12 AM for Io, from 12:19 AM until 5:02 AM for Callisto, and 1:08 AM to 4:02 AM CST for Europa. That leaves a brief four minute interval, from 1:08 AM to 1:12 AM, when the three moons are simultaneously in transit, though Io and Europa are on the planet's limb. The night's other impressive event comes when Io passes into Callisto's shadow. The eclipse begins at 11:41 PM and concludes 18 minutes later at 11:59 PM CST. Observers should notice Io dimming, particularly near the event's middle.

Saturn – Saturn rises in Libra after 4:00 AM local time on January 1st, and about two hours earlier by January 31st. A slender crescent Moon makes a lovely pair with Saturn when it passes 2° north of the planet on January 16th. One day later, Saturn crosses the border from Libra into Scorpio. Saturn shines at magnitude +0.6, and appears slightly yellowish, with a disk diameter of about 16", and the rings extend to 36" with a tilt of nearly 24°. By the end of the month, Saturn comes within a little more than 1° north of the double star Beta Scorpii (Graffias).

Uranus – Uranus rides high in the southwest after darkness falls in January. On January 15th, Uranus appears halfway to the zenith at 7:00 PM local time, and sets after 11:00 PM. Uranus glows at magnitude 5.8, with a 3.5" diameter disk, and has a blue-green color. Uranus lies in the company of three similarly bright stars 3.2° due south of Delta Piscium (mag. 4.4).

Neptune – Neptune, shining at magnitude 7.9 and having a blue-grey hue, is in western Capricornus. On January 19th, Mars will be just 0.2° south of Neptune. Neptune has a second encounter in January, though it will be harder to view. On January 31st, Venus approaches within 1.2° of Neptune. The pair will stand only 10° high an hour after sunset, and it will be difficult to see Neptune against the twilight.

Pluto – Pluto is in conjunction with the Sun on January 3rd, and therefore it is not viewable this month.

Earth – Earth reaches perihelion, the closest point to the Sun in space, on January 4th at 12:37 AM CST. Earth will then be 0.983277 au (astronomical unit – the average distance between the Earth and the Sun) from the Sun, only 1 part in 30 closer than aphelion in July.

Moon – Late on the night of January 1st/2nd, as the waxing gibbous Moon crosses the Hyades, the Moon's invisible dark limb will cover Delta 1 and/or Delta 2 Taurii (mag. 3.8 and 4.8). The Moon is just past full when it rises to the right of Jupiter on the evening of January 7th, and to the lower right of Regulus below Jupiter the next night. The Last Quarter Moon is close above Spica at dawn on January 13th. The waning lunar crescent hangs very near Saturn and Beta Scorpii at dawn on January 16th. At dusk on January 21st, the thin waxing lunar crescent is about 6° to the right of Venus and only about 4° above the dimming Mercury. A thicker Moon hangs a few degrees to the right of Mars on January 22nd.

The waxing gibbous Moon is to the left of Aldebaron (Alpha Taurii) on the evening of the 29th, and

much closer to Gamma Gemini on the 31st.

Asteroids – Asteroid 3Juno reaches opposition and peak visibility on January 29th, but will remain an 8th magnitude object all month. The asteroid rises in early evening following the bright stars of winter. Sirius appears on the right, Jupiter
on the left, and the head of Hydra is in between. 3Juno resides within a few degrees of the head Throughout January. On January 16th, 3Juno will be about 1 1/2° south of Eta Hyd, and on the 21st it will be less than 1° south of Sigma Hyd.
On January 26th, 3Juno will be about 1° east of Sigma Hyd.

Comets – Comet Lovejoy (C/2014 Q2) bolts out from under Lepus the Hare in early January, and arrives near the foot of Andromeda the Princess by month's end. The comet is expected to glow at around magnitude 8, and the comet will cover 3° across the sky per day at its peak. On January 1st, comet Lovejoy will be about 10° south-southeast of Rigel, and about 10° to 12° east of Rigel on the 6th. On the 14th, comet Lovejoy will be about 15° east of Aldebaron, while on the 18th/19th it will be about 10° due east of the Pleiades (M 45).

Meteor Showers – On the night of January 3rd/4th, the Quadranids peak – one of the year's most prolific meteor showers with a peak that can produce 120 meteors an hour. The radiant is in Bootes, but an almost full Moon will make it hard to see most of the meteors. The best bet to observe the shower is in the hour before dawn breaks.

Unique Stellar Eclipse – The visual binary stars Alpha Coma Berenices (mag. 4.3 and a separation of 0.7 arc seconds), is remarkable for its orbit being inclined almost exactly 90° to the plane of the sky. We see the orbit so close to edge on that one of the stars may be about to eclipse the other star. Judging from recent high precision astrometry, an eclipse is "highly likely" in the second half of January. The most likely dates are January 23rd and 24th. The eclipse could last for up to 1 ½ days, depending on how central or grazing it turns out to be. A central eclipse would dim the system by 0.7 or 0.8 magnitude for several hours, quite enough to detect with the naked eye. The American Association of Variable Star Observers (AAVSO) is coordinating a world-wide observing campaign for this event. See more information at the website for the project: aavso.org/observing-campaign-alf-com.

Time to View the Planets

EveningSky	**Midnight**	**Morning Sky**
Mercury (southwest)	Jupiter (southeast)	Jupiter (west)
Venus(southwest)		Saturn(southeast)
Mars (southwest)		
Uranus (south)		
Neptune (southwest)		

Dark Sky Viewing Primary- January 17th, Secondary- January 24th

Taurus – The Bull

The identification of the constellation of Taurus with a bull is very old, certainly dating to the Chalcolithic, and perhaps even to the Upper Paleolithic. Taurus is represented in a cave painting at the Hall of the Bulls in the caves at Lascaux (dated to roughly 15,000 BC), and is accompanied by a depiction of the Pleiades (M 45). The name "The Seven Sisters" has been used for the Pleiades in the languages of many cultures, including indigenous groups in Australia, North America, and Siberia. This suggests that the name may have a common ancient origin.

Taurus marked the point of the vernal equinox (spring) in the Chalcolithic and early Bronze Age, from about 4000 BC to 1700 BC, after which it moved into the neighboring constellation Aries. The Pleiades were closest to the Sun at vernal equinox around the 23rd century BC. In Babylonia (Sumerian) astronomy, the constellation was listed in the "mul.APIN" as GU_4.AN.NA, "The Heavenly Bull". As this constellation marked the vernal equinox, it was also the first constellation in the Babylonian Zodiac, and they described it as "The Bull in Front". The Akkadian name was ALU.

In the Mesopotamian "Epic of Gilgamesh", one of the earliest works of literature, the goddess Ishtar sends Taurus, "The Bull of Heaven", to kill Gilgamesh for spurning her advances. Gilgamesh is depicted as the neighboring constellation of Orion, and in the sky they face each other as if engaged in combat. In early Mesopotamian art, the "Bull of Heaven" was closely associated with Inanna, the Sumerian goddess of sexual love, fertility, and warfare. One of the oldest depictions shows the bull standing before the goddess's standard; since it has 3 stars depicted on its back (the cuneiform sign for "star constellation"); there is good reason to regard this as the constellation later known as Taurus.

The same iconic representation of the Heavenly Bull was depicted in the Dendera Zodiac, an Egyptian bas-relief carving in a ceiling that depicted the celestial hemisphere using a planisphere. In these ancient cultures, the orientation of the horns was portrayed as upwards or backward. This differed from the later Greek depiction where the horns pointed forward. To the Egyptians, the constellation Taurus was a sacred bull that was associated with the renewal of life in spring. When the spring equinox entered Taurus, the constellation would become covered by the Sun in the western sky as spring began. This "sacrifice" led to the renewal of the land. To the early Hebrews, Taurus was the first constellation in their zodiac, and consequently it was represented by the first letter in their alphabet, Aleph.

Taurus is a distinctive constellation, with the head defined by a V-shaped group of stars (asterism) and star tipped horns. Two Greek bull-myths were associated with Taurus. Usually it was said to represent Zeus in the disguise he adopted for another of his extra-marital affairs, this time as the bull that carried away Europa, daughter of King Agenor of Phoenicia. Europa liked to play on the beach with the other girls of Tyre. Zeus instructed his son Hermes to drive the king's cattle from their pastures on the mountain slopes towards the shore where the girls were playing. Adopting the shape of a bull, Zeus surreptitiously mingled with the lowing herd, awaiting his chance to abduct Europa. There was no mistaking who was the most handsome bull. His hide was white as fresh snow, and his horns shone like polished metal. Europa was entranced by this beautiful, yet placid creature. She adorned his horns with flowers and stroked his flanks, admiring the muscles on his neck and the folds of skin on his flanks. The bull kissed her hands, while inwardly Zeus could hardly contain himself in anticipation of the final conquest. The bull lay on the golden sands and Europa ventured to sit on his back. At first, she feared nothing when the bull rose and began to paddle in the surf. But she became alarmed when it began to swim strongly out to sea. Europa looked around in dismay at the receding

shoreline and clung tightly to the bull's horns as waves washed over the bull's back. Craftily, Zeus the bull dipped more deeply into the water to make her hold him more tightly still. By now, Europa had realized that this was no ordinary bull. Eventually, the bull waded ashore at Crete, where Zeus revealed his true identity and seduced Europa. He gave her presents that included a dog that later became the constellation Canis Major. The offspring of Zeus and Europa included Minos, king of Crete, who established the famous palace at Knossos, where bull games were held.

An alternative story says that Taurus may represent Io, another illicit love of Zeus, whom the god turned into a heifer to disguise her from his wife Hera. But Hera was suspicious and set the hundred-eyed watchman Argus to guard the heifer. At the request of Zeus, Hermes killed Argus and freed the heifer. Hera was furious at this and sent a gadfly to chase the heifer, who threw herself into the sea and swam away.

The face of Taurus is marked by the V-shaped group of stars called the Hyades. In mythology, the Hyades were the daughters of Atlas and Aethra, the oceanid. Their eldest brother was Hyas, the bold hunter who one day was killed by a lioness. His sisters wept inconsolably – Hyginus says they died of grief – and for this they were placed in the sky. Hence it seems equally likely that their name comes from their brother Hyas. In another story, the Hyades were nymphs who nursed the infant Dionysus in their cave on Mount Nysa, feeding him on milk and honey. The mythographers were massively confused about the names and even the number of the Hyades. They are variously described as being five or seven in number. Astronomers have avoided the problem by not naming any of the stars of the Hyades.

Even more famous than the Hyades is another star cluster in Taurus: the Pleiades, commonly known as "The Seven Sisters". To the eye, the Pleiades cluster appears as a fuzzy patch like a swarm of flies over the back of the bull. So distinctive are the Pleiades that the ancient Greeks regarded them as a separate mini-constellation, and used them as a calendar marker. In mythology, the Pleiades were the seven daughters of Atlas and the oceanid Pleione, after whom they are named. The name may come from the old Greek word *pleos,* "full", which in the plural meant "many", a suitable reference to the cluster. According to other authorities, the name comes from the Greek word *peleiades*, meaning "flock of doves". Unlike their half-sisters, the Hyades, the names of all seven Pleiades are assigned to stars in the cluster: Alcyone; Asterope (also known as Sterope); Celaeno; Electra; Maia; Merope; and Taygete. Two more stars are named after their parents, Atlas and Peione. Alcyone is the brightest star in the cluster. According to mythology, Alcyone and Celaeno were both seduced by Poseidon. Maia, the eldest and most beautiful of the sisters, was seduced by Zeus and gave birth to Hermes; she later became foster mother to Arcas, son of Zeus and Callisto. Zeus also seduced two other Pleiades: Electra, who gave birth to Dardanus, the founder of Troy; and Taygete, who gave birth to Lacedaemon, founder of Sparta. Asterope was ravished by Ares and became the mother of Oenomaus, King of Pisa. Hence six Pleiades became paramours of the gods. Only Merope married a mortal, Sisyphus, a notorious trickster who was subsequently condemned to roll a stone eternally up a hill.

Although the Pleiades are popularly termed "The Seven Sisters", only six stars are easily visible to the naked eye, and a considerable mythology has grown up to account for the "missing" Pleiad. Eratosthenes says that Merope was the faint Pleiad because she was the only one who married a mortal. Hyginus and Ovid also recount this story giving her shame as the reason for her faintness, but both add another candidate: Electra, who could not bear to see the fall of Troy, which had been founded by her son Dardanus. Hyginus says that, moved by grief, she left the Pleiades altogether, but Ovid says that she merely covered her eyes with her hand. Astronomers, however, have not followed either legend in their naming of the stars, for the faintest named Pleiad is actually Asterope.

A famous myth links the Pleiades with Orion. As Hyginus tells it, Pleione and her daughters were one

day walking through Boeotia when Orion tried to ravish her. Pleione and the girls escaped, but Orion pursued them for seven years. Zeus immortalized the chase by placing the Pleiades in the heavens, where Orion follows them endlessly.