

Inside this issue:

President's Letter	2
60th Anniversary	3
Our Programs	4-5
Observing & Imaging	6-9
Featured Article	10
Classified Ads	5
Contacts	11

NGC 891



This image of NGC891 was provided by TAAA member Richard Schulze. NGC891 is an edge-on galaxy located in the constellation Andromeda. Its distance is about 30 million light-years. The galaxy can be seen in small to moderate sized telescopes. (C14 telescope on a CGE Pro mount, SBIG ST10XME camera, with on-camera guider, LRGB 4 minute subimages.)

Take Note!

- ◆ 60th Anniversary Celebration Announced
- ◆ Grand Canyon Star Party 2014 Scheduled - make reservations now!
- ◆ Comet ISON and Comet Lovejoy images and observations

A Tale of Two Snowballs

Contributed by Terri Lappin, [terrilappin\[at\]tucsonastronomy.org](mailto:terrilappin[at]tucsonastronomy.org)

"Comets are like cats: they have tails, and they do precisely what they want." -David Levy

Our skies were graced by two comets recently and they lived up to their reputation—they did exactly what they wanted to do. C/2012 S1 (Comet ISON) was discovered on September 21, 2012 by two Russian astronomers and had been reported to be "The Comet of the Century." That may have been true if it hadn't brushed just a little too close to the sun, less than a solar radii. As Frosty the Snowman could tell us, the sun is not a good thing for a snowball! Actually, it was the sun's gravitational pull that pulled the comet apart. Shortly before it met its demise, it brightened considerably but this wasn't visible to earthlings. Alas, it wasn't the comet we were all hoping for. (At the time of publication, the SOHO [website](#) has videos of the close encounter.)

C/2013 R1 (Comet Lovejoy) was just recently discovered by an Australian amateur astronomer on September 7th of this year. At it's brightest it was magnitude 4.5—naked eye visible from a dark site. Although fading, it continues to put on a show, spending much time in Hercules through mid-January.

Check out images and observations of both comets beginning on page 6 of this newsletter.



From Our President

The comet of the century – ISON – has come and gone – leaving a wisp of space dust or maybe a small fragment to greet us after its close encounter with our closest star ... And where were you on November 28? Like the great optimists we are, we expected great things from this comet – but, alas, it was not to be.

However, we were not disappointed by the Arizona Science and Astronomy Expo (ASAE). It did meet and surpass our expectations. Vendors from all over were there displaying the latest innovations and technological advances. All the major telescope manufacturers were there plus many minor ones with telescopes, mounts, eyepieces, filters and binoculars of all descriptions on display. We even had a Clam Shell Observatory featured by Astro Haven Corp. which captured the attention of many attendees. It does not rotate, but it opens up with the panels sliding down to the base. The Opt Corp. had a large exhibit which first greeted you as you walked onto the convention floor. They displayed many of their products and even raffled off a few refractor telescopes and miscellaneous items over the two-day event.

We had a booth showcasing the TAAA plus two large tables where we conducted hands-on educational outreach activities. I want to give special thanks to Terri Lappin who organized and coordinated our outreach efforts. There was some strong interest in our Commemorative Brick program, and some sales. Currently this fundraising activity is being used to fund the building of the Ramada at our Chiricahua Astronomy Complex. Kudos to Bill Lofquist and Mike Magras for their efforts in raising awareness and stimulating interest in this program. Also, I want to thank all the volunteers who made our participation in ASAE possible: Paul & Kathy Anderson, Ben and Hunter Bailey, Paul Delligatti, Edward Eastburn, Chuck Hendricks, Joe Jakoby, Ralph & Sue Jensen, John & Liz Kalas, Jim Knoll, Karen Liptak, Brian O'Connell, Jim O'Connor, Paul Mary Ross, and Tom Wall.

Coming up in January we have a special event – the ratification of our revised ByLaws. Please plan on attending. Mark the date on your calendar – January 3, 2014.

In February, you will be asked to vote for a 3-person nominating committee. The purpose of this committee is to poll the membership for those interested in serving on the Board of Directors. This is a very important task as it is the first step in our election process that will culminate in our yearly election for the board of directors. At our February general meeting, we will elect this Nominating Committee. So, please plan on attending. Also, if you're interested in serving on this committee, please let me know.

In February we will also be celebrating our 60th anniversary. Watch for important notices from our anniversary committee chairperson, Liz Kalas.

In March, we end the quarter on a strong note. On March 15 and 16 is the Tucson Festival of Books. We have participated in this event for the last few years and will do so again this year. Finally, the Messier Marathon will be happening in March. With two new moons in March we have a choice of dates. However, from what I read, the weekend of March 29 and 30 will offer the best opportunity for those in mid-northern latitudes.

As always, I encourage you to join us in sharing the wonders of the universe.

With 2014 upon us, I wish everyone a Happy, Healthy and Prosperous New Year!

Remember, through understanding, cooperation, enthusiasm and dedication we can accomplish great things.

Thank you.

Bob Gilroy
TAAA President



The mission of the Tucson Amateur Astronomy Association is to provide opportunities for members and the public to share the joy and excitement of astronomy through observing, education and fun. We fulfill this by providing Astronomy Services to schools, church groups, scout troops, and convention organizers. We support many organizations in the Tucson area that are involved in Science, Technology, Engineering and Mathematics (STEM) programs. Our members enjoy observing the night sky under the dark skies that our observing sites offer. We are an all-volunteer, tax-exempt, non-profit, 501(c)(3) organization.



It's Party Time!

TAAA's 60th Anniversary Celebration!

Mark your calendar and save the date for Sunday, February 16th, 2014! The TAAA will be 60 years old! The fun begins at 2 p.m. at the Michael Drake Building. This is the LPL lab where the OSIRIS-REx mission is headquartered. Enjoy a buffet dinner, roam through one of Arizona's largest meteorite displays, and be treated to talks given by Dolores Hill, Dr. Tom Fleming and co-masters of ceremony David Levy and Tim Hunter.

In her talk, Dolores Hill will update us on the OSIRIS-REx program. She will answer questions about the mission and share her expertise on asteroids and meteorites. Dolores is co-lead of OSIRIS-REx Target Asteroids! She was honored at the White House this past June in the White House Champions of Change program. Dolores is a Senior Research Specialist at the Lunar & Planetary Laboratory (LPL).

Astronomer and Senior Lecturer Dr. Tom Fleming will give a talk on the history of Steward Observatory. Dr. Fleming is responsible for the public outreach program at Steward and has been host of the Steward Observatory Public Evening Lecture Series since 1999.

Long-time TAAA members and past presidents David Levy and Tim Hunter will not only act as our masters of ceremony but will also give us an interesting history of the TAAA. Dr. David Levy has discovered 22 comets, authored 35 (and counting) astronomy books, is a science writer for Astronomy and Sky and Telescope magazines and many other publications. He is most famous for his co-discovery along with Gene and Carolyn Shoemaker of Comet Shoemaker-Levy 9, the comet that crashed into Jupiter in 1994. Dr. Tim Hunter is a Board Certified Diagnostic Radiologist at UAMC. He is one of the co-founders of the International Dark Sky Association. Tim authors a weekly astronomy-related article titled "Sky Spy" in the Arizona Daily Star.

TAAA 60th Anniversary Celebration

Sunday, February 16th, 2014 2 - 6 P.M.

Michael Drake Building
1415 N 6th Ave

\$20 per person

Young People ages 13 to 17 \$10

Children under 12 free

Reservations can be made at the January 3rd and the February 7th meeting, or by mailing them to Liz Kalas, 3470 W. Red Bird Ct., Tucson, AZ 85745. All reservations must be in Liz's possession by end of the February 7th meeting. Payment is required upon reservation. Make checks payable to TAAA. Be sure to note how many are coming (adults and youth) and if there are children under the age of 12. All children must be accompanied by a parent or guardian. Please direct questions to Liz Kalas, [lizkalas\[at\]cox.net](mailto:lizkalas[at]cox.net), or 520 620-6502.

A History Lesson

The TAAA operated a Moonwatch Station from 1957 to 1963. Recently, one of the sighting scopes showed up at Starizona. Although it's privately owned, Terri Lappin was glad to come across it and get a photo of this piece of TAAA history.



The Tucson Moonwatch station was located near Steward Observatory on the U of A campus near the current location of the Psychology Building.



★ Programs

24th Annual Grand Canyon Star Party Set for the Week of 21-28 June 2014

Jim O'Connor, Grand Canyon Star Party South Rim Coordinator, [gcsp\[at\]tucsonastronomy.org](mailto:gcsp[at]tucsonastronomy.org)

First held in 1991, the Grand Canyon Star Party marks its 24th anniversary next year. It's time to lock down your plans to attend this memorable event. As in previous years, GCSP '14 will be a collaboration between the National Park Service (NPS) and astronomers from around North America to bring astronomy outreach to Park visitors. The event is held concurrently on both the North Rim, coordinated by the Saguaro Astronomy Club, and the South Rim, coordinated by TAAA. The level of public interest and involvement, and the opportunity for TAAA to make major contributions to public education and awareness, is profound.

Astronomers act as interpretive rangers, explaining the day and night skies above the Grand Canyon to the visitors just as the daytime Park Rangers and guides explain the geology of the park. Last year, over 110 astronomers (about two dozen from TAAA) registered with the NPS and showed the wonders of the heavens to as many as 1450 visitors on each of the eight nights. Think 7000 feet with dark skies, where the visitor flow stops around 10:30 p.m., leaving the rest of the night for our own purposes.

Lodging at the Grand Canyon fills fast, so make your plans and reservations as soon as possible. For astronomers intending to stay 6 or more nights, there are a limited number of no-cost campsites available. Requests for a free campsite will be accepted beginning March 1st. Campsites will be assigned in order of request received beginning March 1 until none remain. If you intend to participate for six or more nights and wish consideration for a free site, please send an email to [gcsp\[at\]tucsonastronomy.org](mailto:gcsp[at]tucsonastronomy.org) to get on the list

to the above address to get on the list.

Please let Jim know if you're interested in supporting TAAA in this exciting and extremely rewarding event for one night, eight nights, or anything in between!



South Rim Star Party and Lodging Information

<http://tucsonastronomy.org/gcsp-2>

North Rim Star Party Information

[http://www.saguaroastro.org/
content/2014GrandCanyonStar
PartyNorthRim.htm](http://www.saguaroastro.org/content/2014GrandCanyonStarPartyNorthRim.htm)

If you intend to participate in the 2014 Grand Canyon Star Party, email your intentions to Jim O'Connor at [gcsp\[at\]tucsonastronomy.org](mailto:gcsp[at]tucsonastronomy.org) or phone him at 520-546-2961.



Make your observation!

Report your Observation!

<http://www.globeatnight.org/webapp/>

January 20-29

February 19-28

March 21-30

Learn More: <http://www.globeatnight.org/>

★ Programs

Astronomy Fundamentals Observing Clubs

- ★ Open to all TAAA members
- ★ Guided or work on your own
- ★ Stepping stone into the Astronomical League Observing Clubs
- ★ Join at any time
- ★ Certificate at completion

Lunar Observing Club meets sporadically depending on schedule compatibility and the lunar cycle. The purpose of this club is to identify and log 30 specified lunar features – some of which are easy, while others are more difficult. This is a great club in which to participate, as the moon is ideal for observing from your back yard or patio. Dark skies are not really necessary and some features are even visible through light clouds. If you are interested in participating in the Lunar Observing Club, or if you just want to be added to our email list to keep posted about our activities, email Bob Eby at r.eby[at]comcast.net

Constellation Observing Club meets monthly on our regularly scheduled TIMPA night. The purpose of this club is to identify and log 20 constellations, their brightest stars and deep sky objects. This is a great way to learn your way around the night sky. If you are interested in participating in the Constellation Observing Club, or if you just want to be added to our email list to keep posted about our activities, email Paul and Cathy Anderson at paulanderson[at]tucsonastronomy.org.

Solar System Observing Club meets monthly on our regularly scheduled TIMPA night. The purpose of this club is to observe and log the different features and actions of the planets and their moons and other interesting solar system objects. If you are interested in participating in the Solar System Observing Club, or if you just want to be added to our email list to keep posted about our activities, email Brian O'Connell at boc7[at]inbox.com.

Double Star Observing Club meets monthly on our regularly scheduled TIMPA night. The dark night sky is filled with millions and millions of stars. Some are close by (relatively speaking) but most are far away. Some are single stars (like our sun) but others are multiple star systems. Of these multiple star systems, we can detect and split many double stars with the aid of our observing equipment. The purpose of this club is to observe and log the different types and colors of double stars. If you are interested in participating in the Double Star Observing Club, or if you just want to be added to our email list to keep posted about our activities, email Tom Watson at watson1987[at]cox.net.

TAAA 2014 Wall Calendar

Pick one up at the the apparel table
or email Susan O'Connor at cyzeh[at]jaol.com
Cash and checks only (payable to TAAA).
\$10 each

Classifieds

For Sale: i-Optron 8802 80mm f/5 refractor on an alt-az mount with GPS. Hardly used. Includes SmartStar® CubeTM-G Mount (w/GPS), 25mm & 10mm eyepieces, 3X Barlow, 45° Diagonal. Sky & Telescope "Hot Product" in 2008. New price is \$400, used price \$350. Asking for "Best Offer". Contact Larry at 602-663-3361 or Adele at 602-663-3362.

For Sale: Celestron NexStar 8 telescope in good condition. Not used in last four years. Features GoTo mount. Can look up deep sky objects using the key pad and it tells you what you are looking at. Runs on both 12 volts or 110 VAC house current. Two eyepieces: 40mm Celestron Plossl (model 93346) and Vixen 31.7mm (model 3865). Tripod has aluminum legs. Purchased new in 2001 for \$1500; asking price \$400 or Best Offer. Contact John at 520-722-4199 or jesdgs[at]gmail.com.

For Sale: Orion Starblast 6i Telescope, 150mm, f/5. \$225. Less than a year old. Excellent condition. Excellent grab-and-go scope. Includes Sirius 10mm Plossl, GSO 32mm Super Plossl, Red dot finder, and home built octagon-shaped observing table made special for this scope. No shipping; pickup only (Oro Valley). Gary Pugh, 520 825-4143.

For Sale: Astro-Physics 130 EDT f/8 Super ED Triplet Starfire Refractor, 2.7" focuser with upgraded Feather-Touch Micro 9:1. Optics and tube assembly are as-new, having been stored in a dry, dust-free environment. Includes scope with retractable dew shield, extension tube, AP mounting rings, and original vinyl covered wood case, all in outstanding condition. \$5400. **Mach1GTO German Equatorial Mount** on 6" Eagle Adjustable folding pier, with Servo Drive, Go-To Keypad Controller and GTO CP3 Servo Control Box. Price includes mount with Precision-Adjust Rotating Base/Hi-Res Azimuth Adjuster upgrade kit, 6 and 9lb. counterweights, 13.8v 5 amp regulated power supply, AP PASILL4 Alignment Scope with Illuminator, soft-sided carrying case for pier, and Scopeguard case for the mount. \$6500. Prefer to sell as a complete observing package, but will consider serious offers. Components can be seen/tested at my home in Patagonia, AZ. Inquiries welcome. David Kiefner, 520-394-2030, kiefnerdn[at]hotmail.com

For Sale: Stellarvue 102D (4") Refractor, excellent glass, comes with a custom case, retailed originally for over \$900, will sell for \$360 OBO. Contact Allen Klus tel. 520-360-4760.

★ Observing and Imaging

Images of Comet ISON and Comet Lovejoy taken by both amateur and professional equipment, but all by TAAA members.

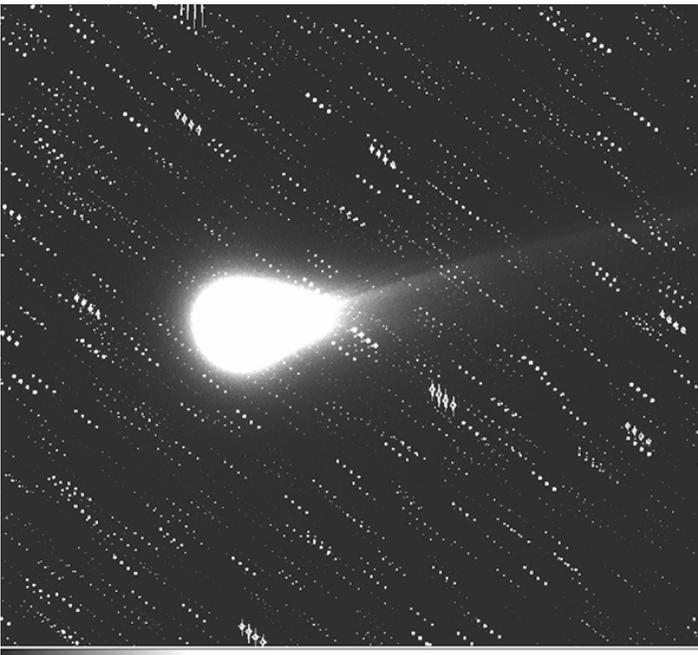


Comet Ison by David Watson and George Hatfield on November 1, 2013 at 4:53am from the Kitt Peak National Observatory Visitor Center using a TAK FSO 106, Canon 60Da, 120 sec, ISO 3200. David and George are guides at Kitt Peak.

Comet ISON



Comet ISON on the morning of November 18, 2013, by Tim Hunter using a C-II HyperStar with Starlight Xpress SXVR-HgC CCD camera – nineteen 30-second exposures median combined. The comet had an altitude of 9 degrees.



Comet Lovejoy on November 10, 2013, taken by Rik Hill using the 28" Schmidt telescope on Mt. Bigelow in the Catalina Mountains. It is four coadded 30sec images.

Comet Lovejoy



Comet Lovejoy on the morning of December 2, 2013, by Tim Hunter using a C-II HyperStar with Starlight Xpress SXVR-HgC CCD camera – four 30-second exposures median combined.

More Comet Lovejoy on the next page.

★ Observing and Imaging

Comet Lovejoy Observing Report

Contributed by Wayne (aka Mr. Galaxy) Johnson, TAAA member

The weather was a sultry 29°F here in Mescal, AZ. The seeing and transparency were pretty good; no breeze; a thin layer of ice had already covered the cars when I began my observing session; and when I retired for the night I noticed an eighth-inch layer of ice had formed on the water in a bucket I used for gathering some of the day's rain/sleet. I went out at about 4 a.m. and came back in at about 5 a.m. (local AZ times, Thurs/Fri, 5/6 Dec 2013).

Comet Lovejoy was readily seen with my naked eye as a small fuzzy spot between two stars of similar brightness (about magnitude 4.5), forming a small arc about 5 degrees northish of the constellation of Corona Borealis. The comet was easily seen in my 10x50 binoculars and I was able to detect a short tail. In my 25-inch scope, at about

200x, Lovejoy was incredible! The outer coma nearly filled the 15 arcminute field of view of my eyepiece and the tail could easily be traced for several fields in a westerly direction. In my notes I described it as, "extremely Large, pretty Bright, Roundish outer coma with a Roundish, pretty Small, much brighter inner coma. The broad, straight tail has about the same width as the outer coma and is about 1-1/2 degrees in length." I thought I could detect some clumpy structure in the tail.

Even though Comet Lovejoy is not of the "comet of the century" caliber, not that it ever pretended to be, it is definitely worth your effort to take a look at this comet (particularly in a telescope) and it is most definitely worthy of someone taking a series of images of it.

IC1396



IC1396 imaged by Howard H Bower from his home in Chandler, AZ. Howard used a TAK FSQ106ED on an Astro-Physics Mach 1 GTO mount, Finger Lakes Instrumentation MicroLine 16803 camera, Astrodon 5nm filters (Ha, OIII, SII), Lodestar guide camera, and a converted Takahashi 50mm finder scope as an external guide scope. This image consists of twenty-four 20-minute exposures in Ha, thirty 10-minute exposures in SII, binned 2x2, and thirty 10-minute exposures in OIII, binned 2x2.

IC1396 is also known as the Elephant Trunk Nebula. It's probably an area of star formation about 2400 light years away towards the constellation Cepheus.

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★ Observing and Imaging

Planetary nebulae of the quarter – Winter 2013

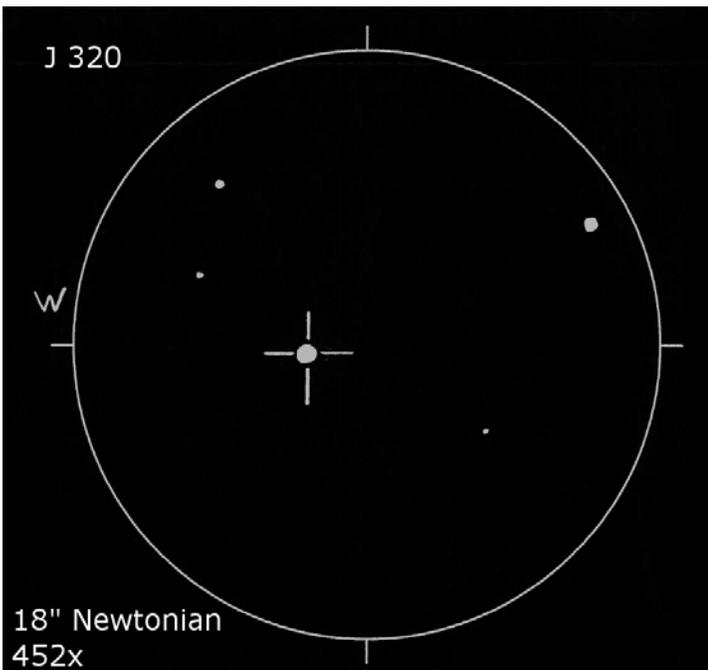
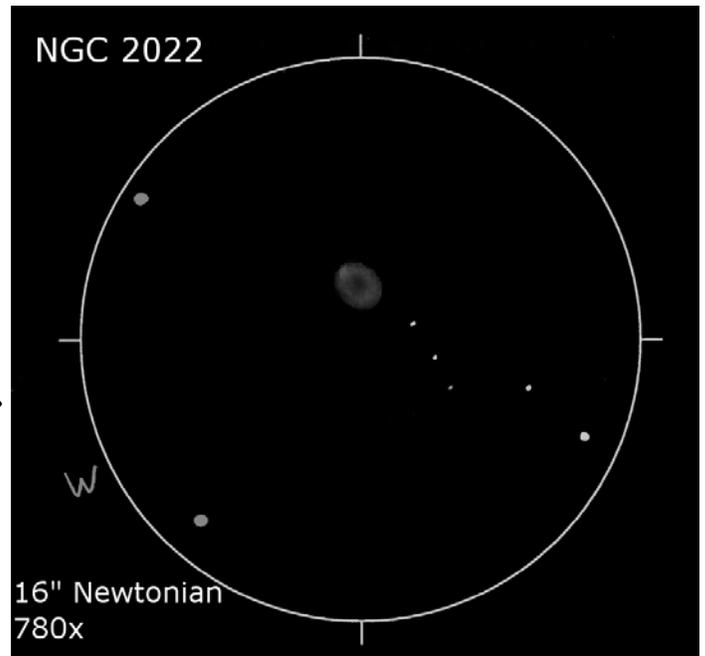
By Christian Weis, [weis\[at\]astroweis.de](mailto:weis[at]astroweis.de)

Planetary nebulae (PN) are fascinating objects which come in numerous forms or appearances. Besides the well-known grand four Messiers (M27, M57, M76 and M97), there are hundreds more to explore. This article suggests two PN's, a pretty bright and easy-to-observe one, and a harder one for the more ambitious observer who is equipped with a bigger scope.

When thinking of Orion, a lot of nebulae come to mind. The Great Orion Nebula and M78 are visually thrilling. The Horsehead Nebula and also Barnard's Loop can be found on lots of images of this most famous winter constellation. However, one doesn't usually associate Orion with planetary nebulae. What a pity! NGC 2022 proves that there is more to discover than just M42. NGC2022 was discovered in 1785 by William Herschel. Although a brightness of 11.9 magnitude does not sound very appealing, you should give it a try, even if you have a smaller aperture. NGC 2022 is rather small but has a high surface brightness, so you can use a high-power eyepiece.

I observed this beautiful planetary in September 2010 from Geology Vista north of Tucson with a 16" Dobsonian and noted, "Very bright, uniform in brightness in general, but at 780x and using an [OIII]-filter a ring can be seen with averted vision, no central star, approximately 1:1.2 elongated, brighter spot in the southern part of the nebula; fst 6.3 magnitude (And), 780x."

NGC 2022
 RA: 5h 42.1min
 Dec: 9° 05'
 Constellation: Orion
 Brightness: 11m9
 Central star: 15m8
 Size: 28 arcsec
 Distance: 6800 ly



Also in Orion, there is another interesting planetary nebula that quite often is overlooked. Jonckheere 320 (J 320) is a pretty bright but very small object. A 5" refractor should be able to show J 320 – but it will remain stellar, so you will need a filter to identify the correct "star" as the PN. Kent Wallace notes in his book "Planetary Pages" that Jonckheere himself first catalogued this planetary nebula as a double star but later realized that he had seen a small elongated nebula when he again observed J 320 with a 28" refractor. This object shows a strong response to a UHC or [OIII]-filter, so it can be used as a standard object to visualize the effect of "blinking". Bigger telescopes

J 320 (PK 190-17.1)
 RA: 5h 5.6min
 Dec: 10° 42'
 Constellation: Orion
 Brightness: 11m9
 Central star: 14m4
 Size: 7 arcsec
 Distance: 13000 ly

and a higher magnification will show a tiny disk. In March 2011 I observed J 320 in the Austrian Alps under a very dark sky with an 18" Dobsonian. I noted, "Bright, very small but clearly non-stellar at high power, no central star seen, no structures, identified using filter blink technique, strong response to UHC; fst 6m7 (UMa), 452x."

Observing and Imaging

Constellation of the Season: Columba - The Dove

By Chris Lancaster

This obscure little constellation largely escapes notice by many stargazers because of two circumstances. First, it is in a part of the sky which contains many other bright constellations which present luring deep sky objects to steal attention away from it. Secondly, its southern location means that it is in its most favorable spot above the horizon for a comparatively short period of time before sinking back into the murky atmosphere. Columba made its first appearance in star charts published around 1679, having been split off into its own constellation from stars which were originally considered to be part of Canis Major. It is considered to be the dove which, in the book of Genesis, Noah released from the Ark after the rains had subsided. The dove returned to the Ark with an olive branch, signifying not only that flood waters had receded to uncover pieces of land but also the fact that God had made his peace again with his children on Earth.

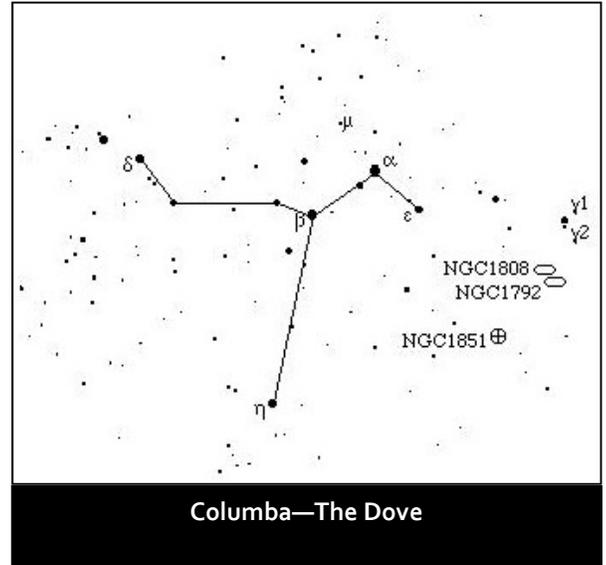
To find Columba, look directly below the well known constellation of Orion. Your eyes will pass through the dim stars of Lepus, and when you get about 2/3 of the distance between Orion's feet and the horizon, you will see an irregular zig-zag of 3rd and 4th magnitude stars. Columba is only slightly smaller in area compared with neighboring Canis Major and Lepus. In the middle of January, Columba is rising at 5pm, is at its highest by 9:30pm (15 to 25 degrees above the horizon), and is well on its way to beginning its descent below the western horizon by midnight.

An interesting, but visually mundane, star is in the northern half of Columba. This is Mu Columbae. It is one of three stars (the others being AE Aurigae and 53 Arietis) which are termed "runaway stars" because of their high velocity through space. The three are moving

in opposite directions from each other but are thought to have originated in the same nebulous regions of Orion. Mu is moving through space at close to 75 miles per second, which means it was launched on its present course between 2 and 3 million years ago. Perhaps Mu and its counterparts were members of close binary pairs, and their companions exploded as supernovae to release the stars from their grip, changing the orbital velocity to a straight line velocity. By simply looking at Mu Columbae, it is difficult to imagine the incredible speed at which it is traveling.

The best deep sky objects are all located in the southwest section of the constellation. NGC1808 is a bright magnitude 10.8 spiral galaxy at RA 5h 7m 42.7s Dec -37d 30' 51", or 1.9 degrees south southeast of Gamma 2 Columbae. Its bright center spans about 4'x 1' but including its faint outer arms increases its full expanse to about 6.5'x 3.9'. This barred spiral galaxy is near 40 million light years from Earth and about 35,000 light years across. There are a couple of unique features of this galaxy. Its disk is fairly warped and it has such a tremendous rate of star formation near its center that it can be put in the category of "star burst" galaxies. It is possible that its structure and behavior can be linked to its proximity to nearby galaxy NGC1792.

NGC1792 is a similar spiral galaxy, presenting a



magnitude of 10.7 and an expanse of 5.2' x 2.6'. It is only 40' to the southwest of NGC1808 or RA 5h 5m 15.1s Dec -37d 58' 47". It can be spotted in scopes as small as 3" and shows mottling in large scopes of 12" or larger.

Move 2.6 degrees southeast of NGC1792 (RA 5h 14m 6s Dec -40d 3' 00") to find a very good globular cluster. This is a rich, bright cluster, about 54,000 light years distant, and well worth the time to hunt down. Its thousands of stars are packed into a dense cluster with a bright center. The overall magnitude is 7.3 and a size of 11'.

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Under Dark Skies - A Guide to the Constellations

By Chris Lancaster

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or directly from Chris for \$10
ctlancaster[at]msn.com
(while supplies last)



Featured Article

Intelligent Life in the Universe

Contributed by Paul E. Sobel, Industrial Engineer, TAAA Member, [pablo23\[at\]earthlink.net](mailto:pablo23[at]earthlink.net)

We can judge the probability that the Universe is infinite by looking at our planet which could not have developed in a finite Universe.

Astronomers look to the sky, but it is really very unlikely they will find any planet that would sustain life, much less intelligent life, in the foreseeable future. They search great distances that are many light-years away and there is no way to analyze the composition of an earth-like mass. A light-year is 5.9 trillion miles (10 trillion km) and the only things we can ascertain are the distance of a planet from a sun, its size and the orbit. The mathematical probability of an earth-like planet developing decreases rapidly as the outer galaxies expand outward. The time frame for planet development also is decreasing. If life had been developed it would have been developed years ago, because first-generation stars create heavier elements through supernovas much more now than in the future. To even know if an earth-like planet existed becomes even more remote, when you realize the time that a planet exists depends on the life of the sun that supports it. The average life expectancy of suns that could support life is 10 billion years. The sustaining ability is much less; it will overrun or overheat a planet.

It is reasonable to look at the development of our planet Earth to see if it is possible that another earth-like planet could have intelligent life. You can reasonably assume the existence of life somewhere in the Universe, but life with intelligence, consciousness* and diversity would be very unlikely. There are hundreds of factors that have made it possible for our planet to sustain the intelligence and the diversity we find here on earth. By chance and through evolution is how we developed, along with the necessary sequence of events.

The sun formed about 4.57 billion years ago from the collapsed molecules of a cloud that consisted mostly of hydrogen and helium. It is also well to note that our Earth is within the inhabitable zone from our Sun 92-93 million miles away. The Earth's only known satellite,

the Moon, began orbiting about 4 billion years ago providing ocean tides and a stable axis, and gradually slowing the Earth's rotation.

Our earth provides the only example of an environment that has given rise to the evolution of life. Highly energetic chemistry is believed to have produced a self-replicating molecule around 4 billion years ago and a half billion years later the last common ancestor of all life formed.

Photosynthesis allowed the sun's energy to be harvested directly by life forms and the resulting oxygen accumulation in the upper atmosphere formed ozone. The incorporation of small cells resulted in the development of complex cells called eukaryotes. ¹True multicellular organisms formed as cells within colonies and became increasingly specialized. Aided by the absorption of harmful ultraviolet radiation by the ozone layer, life colonized the surface of the earth. ²By 3.5 billion years ago, the earth's magnetic field was established, which helped prevent the atmosphere from being stripped away by the solar winds. ³Earth's biosphere has significantly altered its atmosphere. Oxygenic photosynthesis formed the primarily nitrogen-oxygen atmosphere of today. The change enabled proliferation of aerobic organisms as well as the formation of the ozone layer which blocks the ultraviolet solar radiation permitting life on land. Other atmospheric functions important to life on earth include transporting water vapor, providing useful gases, causing small meteors to burn up before they strike the surface, and moderating temperature⁴. The earth's axis of rotation is tilted 23.4 degrees away from perpendicular of its orbital plane, producing seasonal variation on the planet's surface.

Between 3.8 billion and 4.1 billion years ago, numerous asteroids impacts during the Late Heavy Bombardment Era caused significant changes to the greater surface environment. The ability of hydrogen to escape from the earth's atmosphere may have influenced the

nature of life developing on our planet. Evolution has produced a complex planet. It is estimated that there are 8 million species of animals, plants, birds and mammals, fish and insects. So far only 1.9 million species have been found. The development of the human brain from one cell is amazing in its complexity.

Our Earth will harbor life for 500 million to 900 million years until our Sun will gradually warm, then become a Red Giant in 5 billion years and a White Dwarf in 8 billion years, when this planet will be destroyed by our Sun. I question that there will ever be another planet in the Universe with intelligence, diversity and consciousness*. Humankind's life on this planet depends on how we respect the laws of nature. Now in an over-populated world we have much work to be done. Twenty million people are dying of starvation per year; half the world is living in poverty, the potable water is being depleted and polluted and the oxygen-producing capacity of the forests of the world is diminishing, along with non-renewable resources. We must address global warming. Nuclear and biological weapons are a threat that we must control. The minds of humans must be used to save the world from self-destruction and help nature regain the balance that there was many years ago. We must develop a "Space Ship Earth" or go the way of the dinosaurs.

*Consciousness – The awareness of being, knowing one's existence, awareness of oneself and the world in a subjective sense.

¹ Standish, E. Myles and William, James C. International Astronomical Union Commission "Orbital Ephemerides of the, Moon & Planets." <http://iau-comm4.jpl.nasa.gov/XSChap8.pdf>. (See table 8.10.2, pg 27, calculation based upon 1 AU=149, 597,870,930 meters)

² "Useful Constants." <http://hpiers.obspm.fr/eop-pc/models/constants.html>.

³ Williams, Davis R. "Earth Fact Sheet." <http://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html>

⁴ Cox, Arthur N. *Allen's Astrophysical Quantities*. Springer, 4th Edition, 2000.

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