MONTHLY OBSERVER'S CHALLENGE

Las Vegas Astronomical Society

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&

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February 2012

Theta 1 Orionis – Multiple Star (Trapezium) in Orion

Introduction

The purpose of the observer's challenge is to encourage the pursuit of visual observing. It is open to everyone that is interested, and if you are able to contribute notes, drawings, or photographs, we will be happy to include them in our monthly summary. Observing is not only a pleasure, but an art. With the main focus of amateur astronomy on astrophotography, many times people tend to forget how it was in the days before cameras, clock drives, and GOTO. Astronomy depended on what was seen through the eyepiece. Not only did it satisfy an innate curiosity, but it allowed the first astronomers to discover the beauty and the wonderment of the night sky.

Before photography, all observations depended on what the astronomer saw in the eyepiece, and how they recorded their observations. This was done through notes and drawings and that is the tradition we are stressing in the observers challenge. By combining our visual observations with our drawings, and sometimes, astrophotography (from those with the equipment and talent to do so), we get a unique understanding of what it is like to look through an eyepiece, and to see what is really there. The hope is that you will read through these notes and become inspired to take more time at the eyepiece studying each object, and looking for those subtle details that you might never have noticed before. Each new discovery increases one's appreciation of the skies above us. It is our firm belief that careful observing can improve your visual acuity to a much higher level that just might allow you to add inches to your telescope. Please consider this at your next observing session, as you can learn to make details jump out. It is also a thrill to point out details a new observer wouldn't even know to look for in that very faint galaxy, star cluster, nebula, or planet.

Theta 1 Orionis – Multiple Star (Trapezium) in Orion

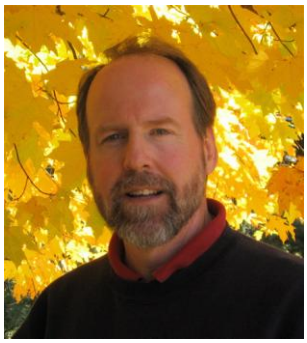
Theta 1 Orionis is a tight open cluster in the heart of the Orion Nebula, M-42. Discovered by Galileo Galilei, he detected only three stars which he sketched in 1617. He'd detected stars A, C and D. B was discovered by several other observers in 1673. By 1888, a total of eight stars were identified within the cluster. Though it may be part of the much larger Orion Nebula open cluster NGC-1976, it's more widely recognized as an asterism and isolated from the cluster as a separate component. Several of the stars have been identified as eclipsing binaries.

The Trapezium is a challenge for all apertures, from binoculars to the largest backyard telescopes. The four major components, A,B, C and D are relatively easy with as small as 60mm (2.4-inch) optics. However, the E and F stars present more of a challenge. Though they have apparent mags. of 10.3 and 10.2 respectively, those numbers are deceptive. Due to the brightness of the background nebula and the proximity to the much brighter stars, they can be quite difficult to see, especially the F star. For an even more extreme challenge, there are the G and H1 stars, with mags. of 14.5 each. Beyond that are H2 and I with mags. 15.5 and 15.0. With the bright background of M-42, spotting these extremely faint specs will take not only the best conditions, but superb optics and very large apertures, not to mention the best observing skills.

Observations/Drawings/Photos

John Goss: Observer from Virginia

We welcome the return of John Goss, vice president of the Astronomical League.



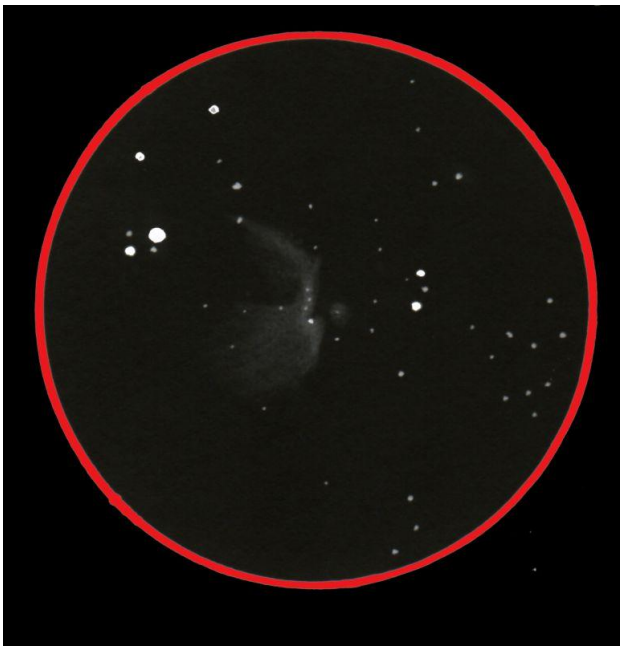
Theta Orionis: February 17, 2012; 8:30 p.m. EST; Fincastle, VA:

I found it really difficult to say everything that can be said about the Theta Orionis region. So, what I've been doing is observing with a more minimalist approach, something I call "250 Eyes." That is, 250 is the number of eyes it would take to roughly equal the light gathering power of a 4.5-inch reflector. This value takes into account the surface areas of the 4.5-inch mirror and the eye's pupil, the reflectivity of the mirrors, and the blocked area due to the diagonal. Throughout my observing career, I've used bigger and bigger instruments, always looking for something — galaxies, in particular — a little bit dimmer or a little bit further away. This can get very expensive, very quickly. Then it occurred to me that the view of a Messier galaxy through a small scope can look very similar to a distant, dim NGC galaxy as seen through a large amateur instrument. That's when I began testing how much I could see with how little aperture I could use.

For appreciating M-42, I used the 250 equivalent eyes of a 4.5-inch tabletop telescope. Small? Yes. Inexpensive? Yes. Easy to use? Yes, almost too easy. Easy to aim? Hey, no finder is required. Good views? Definitely. For quick and easy observing, this is the way to go.

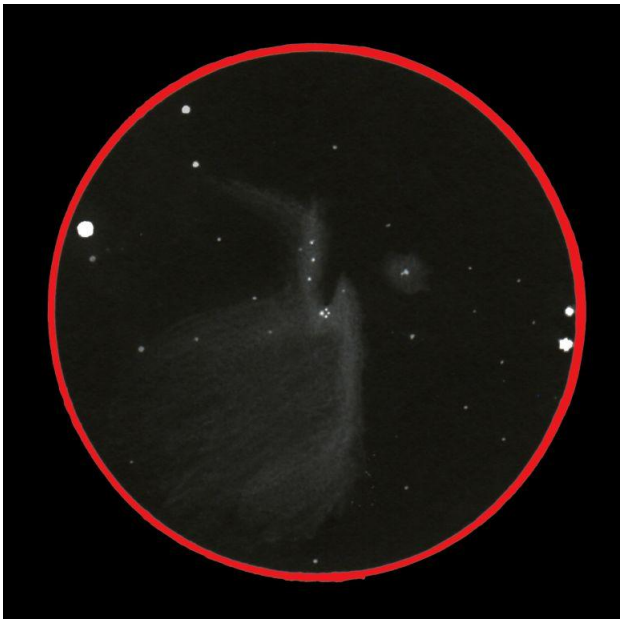
The night of February 17 provided enticing skies. So, at 8:30 p.m., I set the 250 Eyes on the table on my deck and took a peek at what was up. Orion was high above the sky glow from Roanoke, offering M-42 as a tempting target.

The low power drawing was done at 24mm on a zoom eyepiece, giving a magnification of 20X and a field of view just over 2º. Theta's position at the Fish's Mouth is clear. Its' "Trapezium" nature is not.



The higher power drawing was done at 8mm on a zoomar (a joke term my friends and I used when I was in high school in 1970. We always referred to zoom 35mm camera lenses as "zoomars."), giving a magnification of 60X and a field of 1º. The Trapezium, small as it is, stands out plainly. Faint stars in the nebula's bar just pop out, increasing the mysterious feel of the area. The feathery texture in the wispy nether regions appeared after a dozen seconds of staring at the amazing cloud.

Fortunately, this cloud returns year after year, never to disappoint the curious skywatcher.

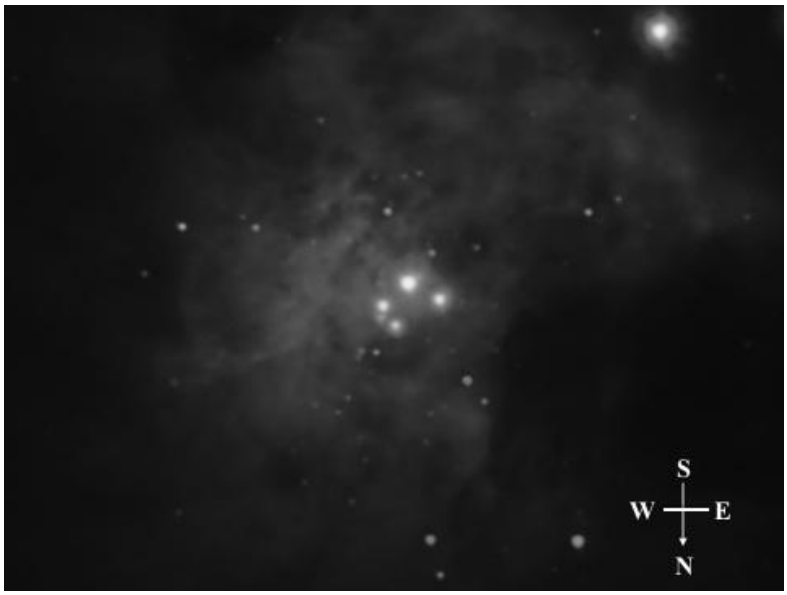


Rob Lambert: Observer from Nevada

As anyone can attest, observing conditions have to be almost ideal in order to visually split the E and F stars of the Trapezium in the Great Orion Nebula. Even in the Desert Southwest near Las Vegas, the conditions don't always allow for observing these two stars. It's even more difficult trying to accomplish the feat with a video camera, even one specifically made for astronomical viewing. Video cameras have the tendency to blow out the area of the Trapezium under normal conditions and must be tweaked way back in sensitivity to capture the four primary stars. It's a rare occasion when conditions will support the capture of the E and F stars. Just as a fluke of chance, the image below was captured outside of Albuquerque, NM in December 2009 on a cold 16º night. The altitude of my observing location in Rio Rancho, NM was approximately 4,800 feet. The night was crystal clear and Sirius was rock-steady, so seeing was close to perfect. Visual observing was accomplished with my 10-inch SCT, an 8-24mm zoom eyepiece, and an f/6.3 focal reducer. The video camera used to capture my supporting images is the equivalent of an 8mm eyepiece, so the resulting image magnification is approximately 200X.

The Trapezium sits just west/southwest off the tip of the dark finger of the Orion Nebula - the dense cloud of gas and dust from which these stars were born. I've provided two similar images of the Trapezium from that night in December 2009 - one labeled and one unlabeled so the view isn't obstructed by the annotation. The E star is definitely noticeable just north of the A star, between the A and B stars, while the F star is just visible southeast of the C star. Neither the G star nor the I star in the center of the Trapezium are detectable. I was just learning how to use my video camera when I attempted this observation and my focus could've been a bit better, although the nebula contributes significantly to the fuzziness of the stars. This was prior to my knowledge of the Bahtinov focusing mask.

My attempt to image the Trapezium while at the LVAS Death Valley Star Party in January of this year proved futile. Although the weather improved on Saturday, there was still a lot of moisture in the air, so transparency was not very good and this time, Sirius was winking at us. I wasn't expecting to see the E and F stars, but I had to give it a shot for the Challenge. I decided to spare everyone the pain of looking at the bloated, fuzzy primary Trapezium stars I captured that night. I'll probably have to wait until next winter to attempt to observe it again on another night like I had back in 2009.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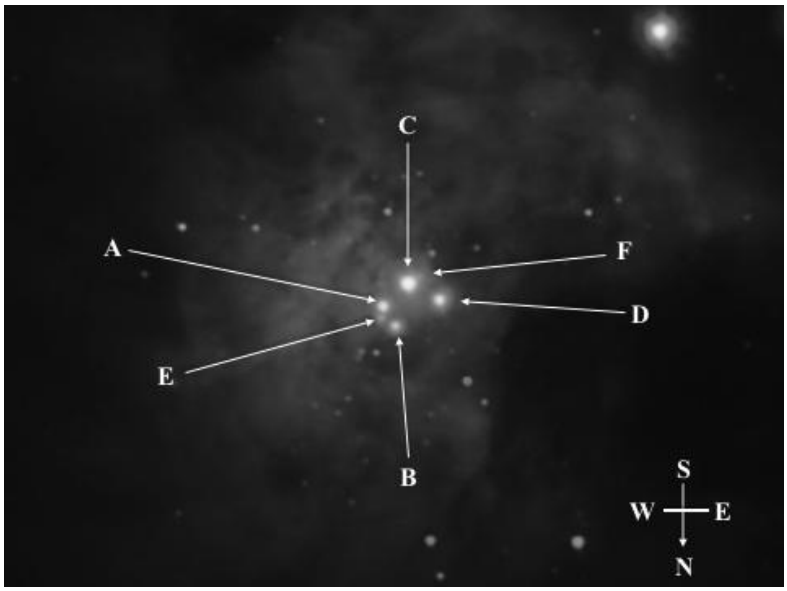
C
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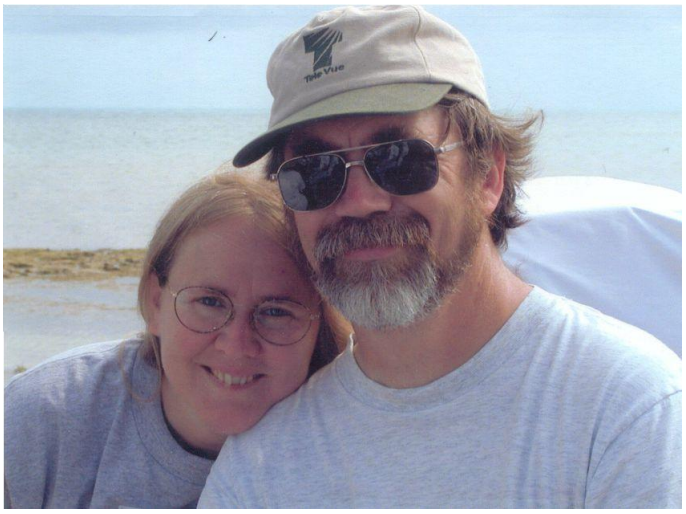
Sue French (see *Sue and Alan French.jpg*): Observer from New York



February 13, 1996, 8:00 PM EST, Winter Star Party, 105/610mm (4.1-inch f/6) APO, 87X: Seeing: fair; Transparency: Good.

Trapezium stars A, B, C, D, orange E, and F were clearly visible.

February 6, 1997, 7:30 PM EST. Winter Star Party, 105/610mm (4.1-inch, f/6) APO: Seeing: good; Transparency: variable.

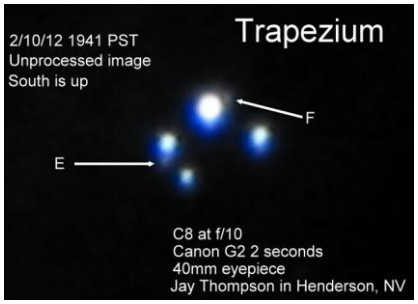
87X: Star E of the Trapezium was easily visible and star F was occasionally visible. 127X: F was much easier.

February 21, 2004, 8:55 PM EST, 15X45 image-stabilized binoculars.

Three Trapezium stars visible.

Jay And Liz Thompson: Observers from Nevada

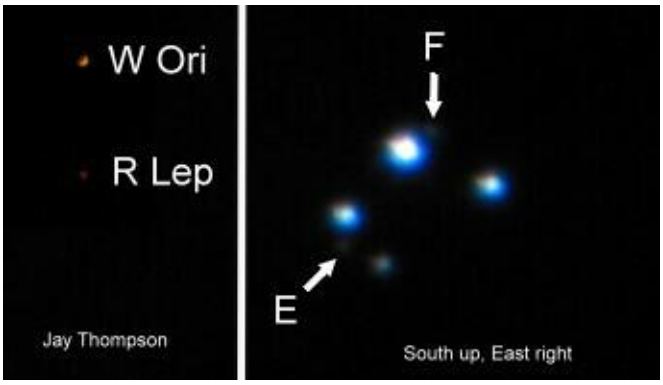
We observed the Trapezium through a variety of telescopes. Six stars (A through F) were apparent using a 17.5-inch f/5 at 247X under excellent skies in Meadview AZ. All subsequent observations and imaging were made from our backyard in Henderson, NV. We saw six stars on February 10, 2012 using an 8-inch SCT. The E star was easier than the F star to see, with the best view at 290X. A 2-second exposure shows the E and F stars just outside the glare from the nearby brighter stars, similar to our visual impression with the 8-inch SCT.



We viewed and imaged the Trapezium with a 14-inch SCT on February 17, 2012. The E and F stars were evident (averted vision NOT necessary) with magnifications from 98X to 434X, with the best view at 279X. A 1.3-second image (right-hand side of the image above) correlates well with the visual impression.

On February 19, 2012 and February 24, 2012, we looked for color in the E star and saw none (i.e., it was whitish with no hue apparent). This was verified by RGB analysis of Trapezium images taken on February 17, 2012. The E star was less blue than A, B, C, D, and F,

and its color fell between those of the components of the visual binary H3945 (K0 and F0 stars). H3945 is shown in the image below.



The E star is a spectroscopic binary, with the components being nearly identical mid-G giants (pre-main sequence) ApJ 132:1763-1767, 2006 November. Curiously, some of the first observations of the E star in the 19th Century described it as very red. For comparison, the images of two red stars are shown on the left-hand side of the first image. The same exposure time, camera, and telescope were used for W Ori, R Lep, and the Trapezium.

Buddy Barbee: Observer from North Carolina

This observation of Theta 1, known as the Trapezium, was made Friday, February 17, 2012 from the back yard of a fellow club members' home in northern Winston-Salem, NC. They have built a seven foot privacy fence as a light block from street and house lights in their neighborhood. I would have to say it works really well. I was using a 2.6-inch APO refractor with a 7mm eyepiece and a 2X Barlow for a magnification of 114X. It was a beautiful clear night with a mild temperature about 40º Fahrenheit. The naked-eye limiting magnitude was only 4.8.

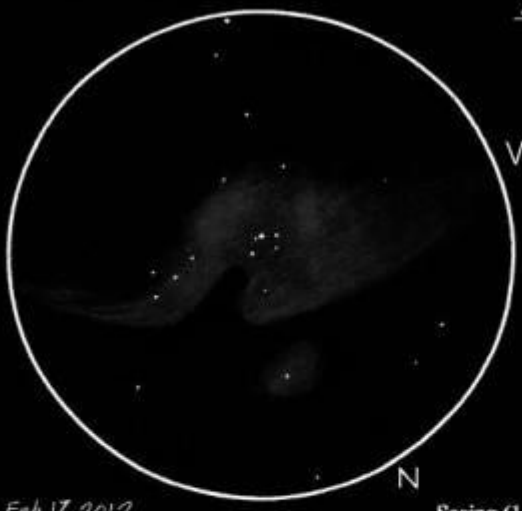
Using a 24mm eyepiece for a magnification of 16.7X with a 4º true field-of-view, I centered the Orion nebula, M-42 and M-43 in my field-of-view before upping the magnification. Putting the 5mm eyepiece in the little telescope, I focused on the bright stars in the center of the nebula. This multiple star system is always a pleasure to see. I've spent so many years looking at the nebula with all of its detail and never paid attention to this multiple star until I worked my way through the Astronomical League's Double Star Club. Now I can't look at the nebula without seeing this multiple star. At first glance, there are only three fairly bright stars visible in the Trapezium, but with closer examination, there's a fourth dim star and a fifth one only seen with averted vision most of the time. No matter what magnification I use, I can't find the sixth component of this system.

So to recap, stars A, C and D were very easy to see. I could also see the B star with direct vision but was much dimmer. I could also see the F star most of the time with averted vision. Only the E star couldn't be seen on this night in the little 2.6-inch refractor. Once again, I could say not too shabby for such a small scope in my light-polluted sky. Small telescopes are so much fun to use.

DEEP SKY OBSERVATION FORM

CONSTELLATION : Orion

OBJECT: Theta 1 Orionis
The Trapezium



Day & Date: Fri. Feb. 17, 2012
Time (local): 8:11 PM EST
Time (UT):
Observer: BLB
Location: Chip's house in Winston-Salem, NC

Seeing (1-5): 4
Transparency (1-7): 4
Limiting Magnitude: 4.8
Temp: 47°F Wind: 0-5mph
Humidity: 45%±

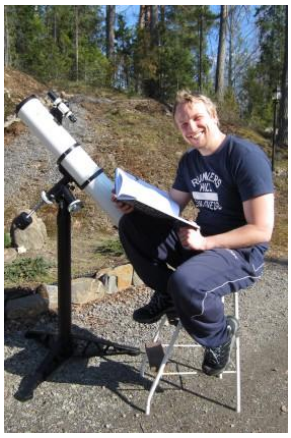
INSTRUMENT
Telescope: AT66
Aperture: 2.6" Refractor
Focal Length/Ratio: 400mm f/6
Eyepiece: 7mm & 2x barlow
Magnification: 114x
Field of view: 00°31'
Filter: None

OBJECT
RA: 05 hr. 35.3 min.
Dec: -05 d. 23.5 min.
Type: Multiple Star
Listed Magnitude: —
Listed Size: —
Altitude of Object: 47°±

Tony Labude: Observer from Oklahoma

It was February 25, 2012, the Moon was at 16% illumination and was just setting. The scope was a 17.5-inch f/4.5 Dobsonian with a 12mm eyepiece for a magnification of 166X, unfiltered. F was a bump on C and E had separation from A. I should've known better than to use a scope I didn't make a good checkout of beforehand. My 10-inch Dobsonian, for some reason, wouldn't stand up to any power above about 30X and the original focuser didn't help matters. The sky was dark and the weather pleasant and to the rescue came a call offering the use of that 17.5-inch, so off I went the 4 miles to the creek cabins. With my 12mm eyepiece, I could make out the E & F without too much eyestrain. I'm gonna have to get a better focuser and rework the primary mirror mount if I'm going to use that 10-inch scope anymore.

Jaakko Solaranta: Observer from Finland



NOTE: These are Jaakko's notes from January on the Trapezium, added here to show the difficulty he had observing our challenge for this month.

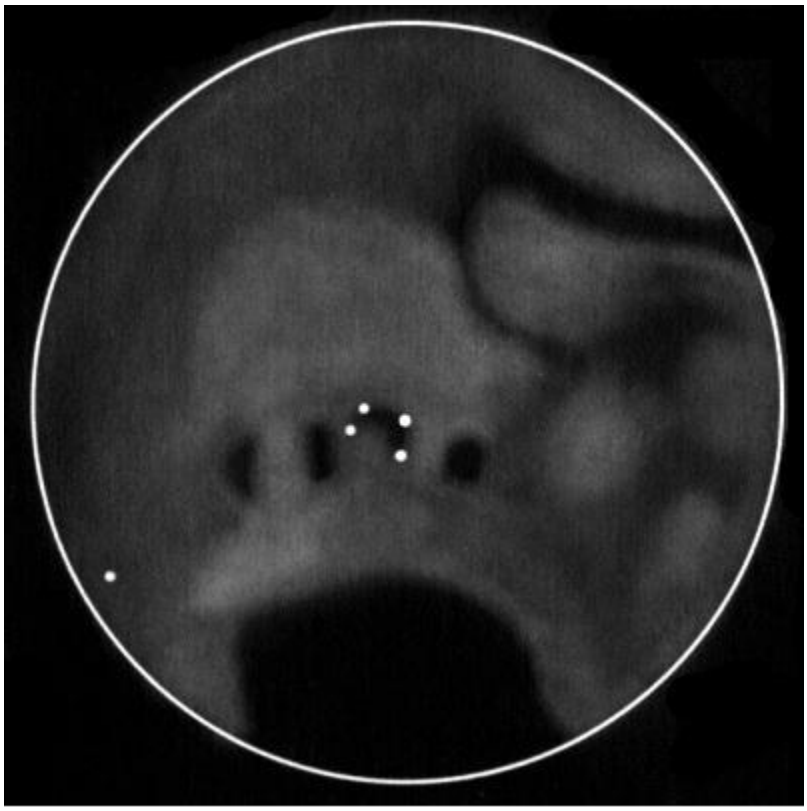
The weather's been pretty bad here as could be expected of a regular Finnish winter. The NELM from my backyard has dropped below 5 due to thick snow cover amplifying all light pollution, and temperatures have come down to below 0ºF. On the 28th, I did get a clear night but the weather was simply too horrible for anything but the next month's challenge: the Trapezium. I didn't get much done as I could only see 4 stars from the Trapezium no matter the magnification. This was of course not uncommon since M-42 was pretty low (~25º) when viewed from Finland and this almost always means turbulent weather in the Orion-region and 40º Celsius difference between inside and outside makes the telescope cool-down quite long. Actually, when I first brought the telescope outside, the focuser almost instantly got frozen solid, so I had to use it by pulling and pushing it with force. Therefore, I did make a quick, though not very accurate sketch of the Huygens region and rotated it to match the old HST picture of the same region. I'll use this sketch in the next "Observers Challenge" unless I get to re-observe it next month.

February 2012 - Theta 1 Orionis:

Unfortunately, as I mentioned in my previous notes, the Great Orion Nebula, with all of its gems, rises only 24° above the horizon from Southern Finland, which makes good views of it quite often troublesome. Add in generally turbulent seeing conditions during the winter, light polluted environment, months of clouds and thick snow cover and the observer most certainly isn't in for a treat.

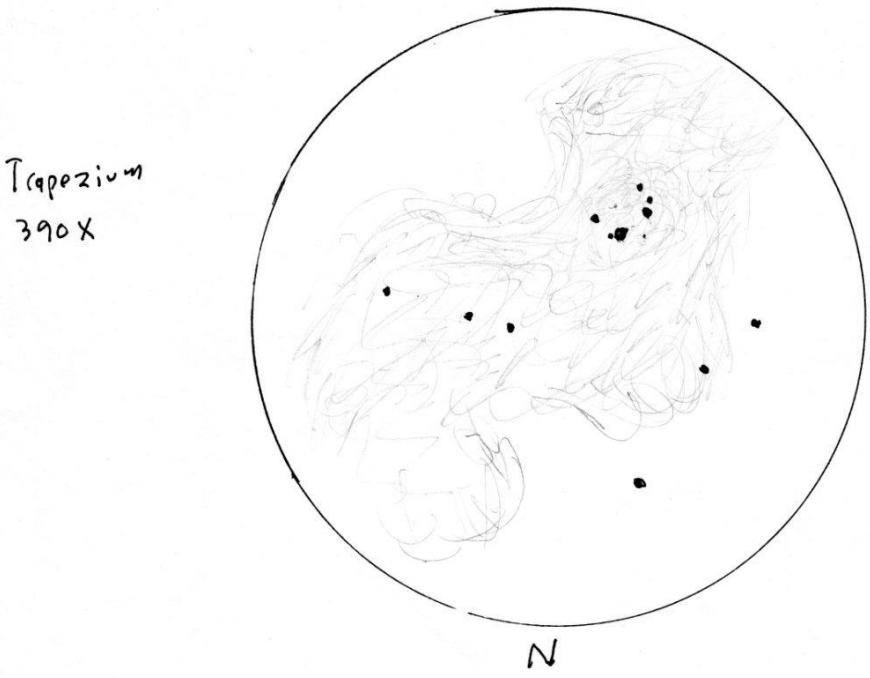
Under such terrible conditions (NELM 4.5 / SQM-L 17.45), I observed the Trapezium cluster on the night of January 28, 2012. 28% moon was setting in the west as I started looking at Orion near its culmination point. Temperature was 1° F (-17°C) and it wasn't long until the focuser got frozen stuck and I had to use some force just to focus the brightest stars. It also quickly became apparent that no matter what I did at the eyepiece, I couldn't spot more than the typical 4 components (A, B, C and D respectively) from the group. This seems always somewhat puzzling since I vividly remember being able to see 5 stars with a simple 3-inch refractor from more southern locations! Anyway, the view using my 8-inch Dobsonian @ 400X (6mm EP) was far too turbulent and detail-wise I couldn't make out much more with it compared

to the lower magnification of 200X (12mm EP). Despite the poor conditions, I got the general impression of a ghost or the more commonly known shape "Fishmouth" in the Sinus Magnus/Huygens Region as well as several dark spots and lanes in the area. The quick sketch made that night of the Trapezium region was done by using high magnification and a UHC filter. The Trapezium showed without nebulosity in the background – this being a common illusion known to observers. I cannot wait for next month's NGC-2362 as it rises only a few degrees above the horizon!



Fred Rayworth: Observer from Nevada

I've observed the challenge many times over the years but never really paid attention to it as more than just part of the Orion Nebula until about two years ago, when it was pointed out to me that there were more than four stars associated with the asterism. As a personal challenge, I took extra time to try and find the extra stars with varying success. During most of my observations, it was pretty easy to pick out the E and F stars, though the F star was usually more difficult being closer to the C star and lost in the glare. On some nights, I couldn't pick out either of them. The real challenge for my 16-inch aperture were the G and H stars, which though they should be well within reach at mags. 14.5 respectively, are lost in the glare of the nebula. I've spotted them both on one occasion last year when conditions were superb. The pinpoints flitted in and out of view between blurs and I could only detect them with averted vision. There is an H2 at mag. 15.5 and an I at mag. 15.0 but I never got even a hint that they were there. My aperture and the glare of the nebula make catching them highly unlikely. The drawing is a composite of sightings from past and present at 390X. I wasn't going to add in the nebulosity due to my lousy artistic skills, but did anyway and it didn't turn out bad enough to redraw, so there it is.



Roger Ivester: Observer from North Carolina

I presented a list of individual observations of Theta 1, the Trapezium over several decades:

March 1977: 4 1/4-inch f/10 EQ reflector, 80X: Beautiful view of all four primary stars, but I could never see the E star with this scope.

December 22, 1995: 80mm (3-inch) f/15 refractor, 75X: All four stars appeared as a beautiful white.

December 23, 1995: 10-inch f/4.5 reflector, 120X: Conditions and seeing not good. Could see only the primary four stars.

December 26, 1995: 4-inch apochromatic f/7 refractor, 190X: Must look carefully to see the "E" star, which appeared very red.

December 26, 1995: 10-inch f/4.5 reflector, 142X: Conditions, fair to good. All six stars visible tonight. The "E" and "F" stars were fairly easy, "E" being a vivid red.

December 29, 1995: 10-inch f/4.5 reflector, 190X: All six stars visible, but only during moments of steady seeing. The "E" star was noted as a red speck.

March 1997: 3.5-inch Maksutov, 135X: Seeing good. The primary stars were so crisp, however, the E star was fleeting and difficult, and could not be for certain.

December 26, 1999: 4-inch achromatic f/9.8 refractor, 224X: Seeing fair to good. The E star was fleeting and difficult, and could not hold constantly.

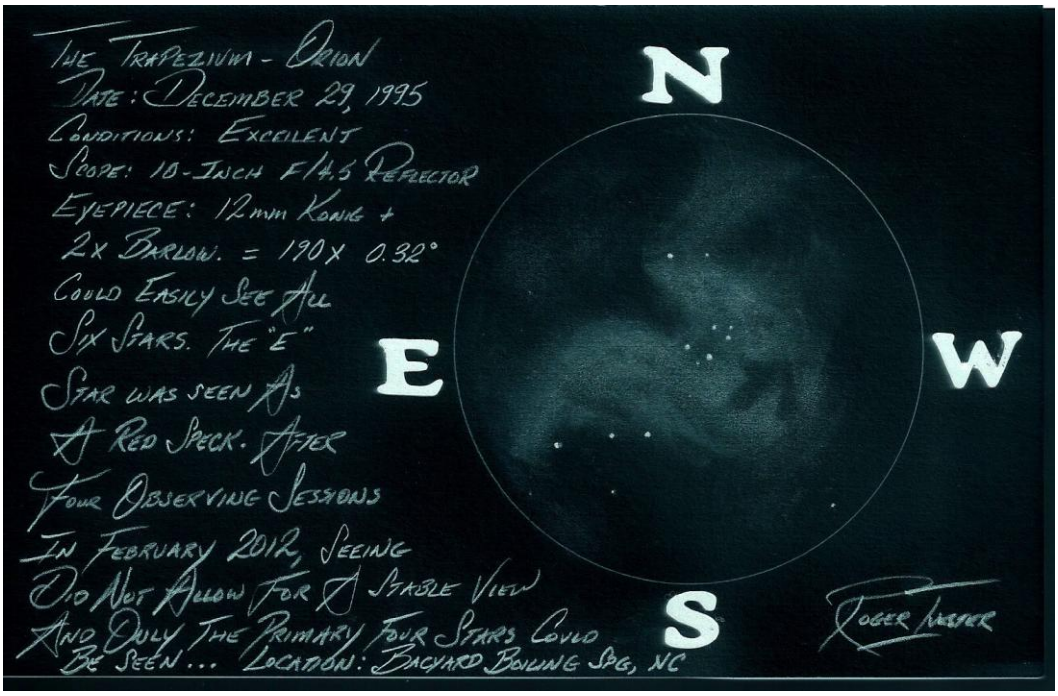
December 26, 1999: 4-inch apochromatic f/7 refractor, 190X: Seeing fair to good. The E star was difficult, but the red color was fairly easy to see.

January 2012: 76-mm (2.6-inch) f/4 reflector, 50X: Four stars visible, very crisp view.

January 2012: 100-mm (4-inch) f/4 reflector, 67X: Four stars visible, crisp, but all stars a bit brighter as compared to the 76-mm (2.6-inch).

February 24, 2012: 4-inch f/9.8 refractor, medium to high power: Seeing was fair to poor and the E and F stars couldn't be seen

February 25, 2012: 10-inch f/4.5 reflector, medium to high power: Seeing only fair with tube currents. Only the four primary stars could be seen.


N
E
W
S
The Trapezium - Orion
Date: December 29, 1995
Conditions: Excellent
Scope: 10-Inch F/4.5 Reflector
Eyepiece: 12mm Kong +
2x Barlow. = 190x 0.32°
Could Easily See All
Six Stars. The "E"
Star was seen As
A Red Speck. After
Four Observing Sessions
In February 2012, Seeing
Did Not Allow For A Stable View
And Only The Primary Four Stars Could
Be Seen... Location: Backyard Boiling Spg, NC
Roger Hooper

Gus Johnson: Observer from Maryland. **NOTE:** On April 19, 1979, Gus Johnson, visually discovered Supernova 1979C in spiral galaxy M-100. NASA announced on November 15, 2010, there was evidence of a black hole as a result of this supernova explosion.

February 19, 1967: All six components were seen with my 6-inch f/7.8 reflector at 148X. The fifth star was not difficult.

January 2, 1973: Again, the "E" star was easy using the 6-inch.

February 3, 1976: All six components in my 8-inch at 96X.

April 7, 1978: In a friend's 12.5-inch f/5 reflector and poor seeing, only five stars were seen.

With fresh coatings on the 8-inch at 116X, I noticed a difference of colors with reddish or pinkish seen. The fifth star was rather easy, but the sixth was only suspected.

October 9, 1980: The four main stars are easily seen with my 4.5-inch at 28X.

Although I don't have any notes, I think I've seen all four in my 2.4-inch at 25X, and likely in the 2-inch at 25X.

Dr. James Dire: Observer from Hawaii

The Trapezium, also known as Theta 1 Orionis, is a cluster of four stars ranging from mag. 5 to mag. 8 forming a slightly skewed trapezoid. The stars, shown in Figure 1, have been labeled with their letter designations and their magnitudes. The entire cluster fits within a circle of half an arc minute diameter.

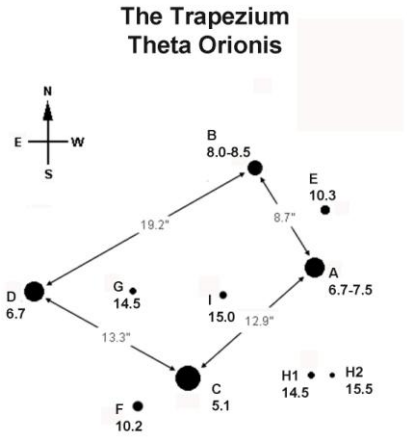


Figure 1

The southernmost star, C, is the brightest followed by D on the east side, A on the west side and finally B on the north side. A and D are variable stars. Most small telescopes can resolve these four stars. The cluster contains six fainter stars from mag. 10 to 15. The two mag. 10 stars can be seen with 10-14-inch telescopes, while the other four are very difficult to spy in amateur telescopes.

It is difficult to photograph the fainter stars in the trapezium without using a large professional telescope. Because of the close proximity of the stars, a very large focal length is needed to spread out the stars and the glow of the Orion nebula. Figure 2 shows an image I

recently took of the Trapezium using a 14-inch SCT with a 3500 mm focal length. The exposure was 1 second (ten 0.1 s exposures stacked).

Figure 2

The four Trapezium stars of Theta 1 are clearly visible. The mag. 10 E and F stars are also visible. The F star is the bump on the east side of the C star, while the E star is right above the A star. I tried a longer exposure, 10 s, to see if I could better see the E & F stars, but the light from the nebula drowned out all of the stars.

The bright star to the southeast of the Trapezium is Theta 2 Orionis, a mag. 5 star. Theta 2 is a binary star with mag. 5.1 and mag. 8.3 components separated by a mere 0.4 arc seconds. They are much too close to be resolved. To the left of Theta 2 lies a mag. 6.2 star and to the left of that is a mag. 8.5 star.