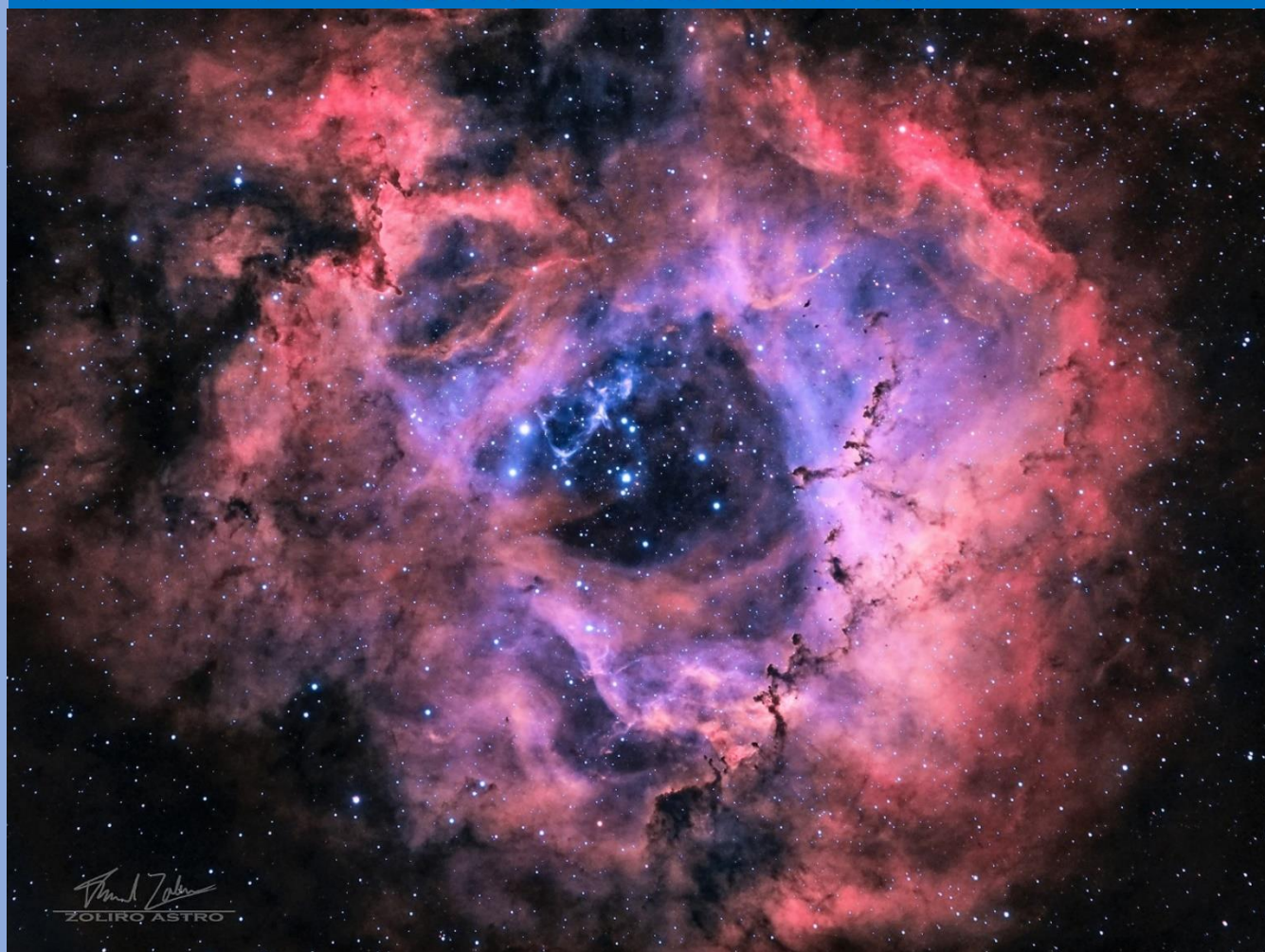




# OBSERVER

FEBRUARY 2021

*Bringing Stars to the eyes of Tulsa*  
since 1937 Editor = John Land



## *NGC 2238 - The Rosette Nebula by Daniel Smith*

The Rosette is an emission nebula in Monoceros. It spans an area about five times the size of the full moon. Dark skies, good sky transparency and a wide-field eyepiece are needed to see it more easily. OIII or UHC filters are helpful in revealing the nebulous areas. The central region contains an open cluster of stars was first discovered by John Flamsteed around 1690.

Daniel used a Astro-Tech 115mm triplet refractor on an EQ6-R Pro equatorial mount using both H-alpha and OIII Baader filters with a ZWO ASI 1600mm Pro astronomy camera. The total integrated exposure time was 4.2 hours. Eighty-three exposures at 180 seconds each were stacked with Pixinsight and the post processing was completed with Pixinsight and Photoshop. The color palette used was an HOO combination.

Contents:

- 1 Rosette Nebula by Daniel Smith
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***Astronomy Club Events***

Check our website [AstroTulsa.com](http://AstroTulsa.com) events section for updates

Observatory ONLY OPEN for SCHEDULED EVENTS. [Click for Observatory Map](#)

CAUTION: **DO NOT** use GPS it will likely send you on some nearly impassible back roads

**Members ONLY Events continue with Social Distancing Guidelines in Effect**

We are limiting our Observatory nights to our MEMBERS ONLY. Please observe Social Distancing and we strongly recommend wearing a mask when around other people. PLEASE WEAR a MASK when in the heated CLASSROOM. Please keep minor family members within your observing area.

No guests – other than immediate family – no large family groups. Be sure to review the map directions carefully. When you arrive be aware of people on the field and telescopes set up. Check website for changes due to weather.

Due to the higher numbers of Covid cases, the ACT board has decided to conduct **Our Members ONLY Observing Nights on SATURDAYS ONLY until the DST begins.**

**Saturday, Feb 6, 5:30 PM**

**Saturday, Feb 13, 5:30 PM**

**NOTE: If weather conditions predict hazardous driving conditions events may be postponed or cancelled. Please check our website before heading out.**

**Saturday, Mar 6, 6:00 PM**

**Saturday, Mar 13, 6:00 PM**

**Tuesday February 16 at 7:00 PM - “You can almost touch the stars”**

Our Presenter, Tom Field, will explain how astronomers can discover the composition of stars from examining the spectral patterns of starlight. He will also demonstrate a program he has developed that lets amateur astronomers capture those spectrum and analysis their structure.



**Thurs Feb 18 - Mars 2020 Perseverance Landing**

**[LIVE on NASA TV](#) beginning 1:00 PM CST**

See NASA website and Page 12 for more details



A YouTube of our [January 19 Zoom meeting](#) is now available online

Featured short talks

Stacking Digital Photos, Books for Novice astronomers, Meteorites samples.

Main program - [NASA's Search for Meteorites in Antarctica](#)

# PRESIDENT'S MESSAGE

BY TAMARA GREEN



Hey Y'all !!

I want to thank those of you who have been participating in our General Meetings via Zoom. This has proven to be a nice alternative way for us to still be in communication with each other as a Club until this pandemic is either over or significantly under control. Hopefully, with the new vaccines that have rolled out, the number of new COVID cases will drop significantly and we will begin to get back to something approaching normalcy.

In the meantime, due to the alarming number of new COVID cases recently, we have changed the schedule for members' nights at the observatory. Beginning in February and going until Daylight Savings Time begins, which will be on Sunday, March 14, the members' nights will be on Saturdays only. They will be as follows:

**Saturday, February 6 at 5:30 PM**  
**Saturday, February 13 at 5:30 PM**  
**Saturday, March 6 at 6:00 PM**  
**Saturday, March 13 at 6:00 PM**

We will continue to monitor the progress of the pandemic and make decisions on event scheduling accordingly. Please be patient with us. We will have to see how things play out. Our goal is to have all of or as many of our Club members and their families safe and free of disease.

I have spoken with Ron Wood, and he does not plan to have us out at TUVA this Spring for the Messier Marathon.

*For our new members, the Messier Marathon is a night we try to find as many possible of the 110 M objects in Charles Messier's catalogue of star clusters, nebulae, and galaxies. These are popular viewing objects that can be seen our telescopes.*

Instead, Ron would like for us to do a star party and potluck with them later in the year. Both Ron and Maura are older people, and therefore at a more severe risk for the disease. Hopefully, by later in the year, the vaccines will prove effective, and the curve will flatten at last! However, that does not mean that we can't use one of the March dates for doing Messier searches at the observatory! There just would not be a potluck due to the risk involved with communal food, and people would have to bring their own snacks and drinks. What do y'all think?

I apologize for not being at the members' nights lately. In November and part of December, Owen had to work many hours of overtime and I had to drive him to and from work. Plus, due to post-COVID complications that I have suffered from, I am no longer able to handle cold very well. I am always either too hot or too cold now. This virus has very strange effects on each and every person who gets infected and sick from it. I hope that this will eventually resolve itself and I will be able to do more cold-weather astronomy once more! Owen and I both got our senses of taste and smell back (for the most part), so there is hope! :D

I look forward to seeing you all soon.

*Stay Safe and Clear Skies, Tamara Green*

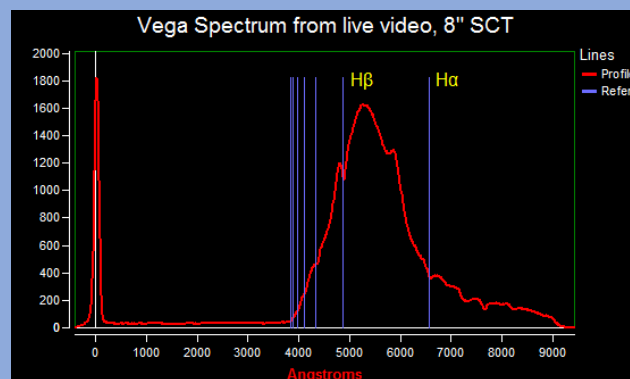
## Zoom meeting Tuesday Feb 16 at 7:00 PM “You can almost touch the stars”

Our presenter will be Tom Field. He has been a Contributing Editor at Sky & Telescope Magazine for the past 7 years. He is the author of the RSpec software ([www.rspec-astro.com](http://www.rspec-astro.com)) which received the S&T “Hot Product” award in 2011. Tom is a popular speaker who has spoken to hundreds of clubs via the web and in-person at many conferences



Even if you wanted to touch a star, they’re all impossibly distant. Despite these great distances, astronomers have learned an enormous amount about stars. How? The most common method to study the stars is called spectroscopy, which is the science of analyzing the colorful rainbow spectrum produced by a prism-like device.

Until recently, spectroscopy was too expensive and too complicated for all but a handful of amateurs. Today, though, new tools make spectroscopy accessible to almost all of us. You no longer need a PhD, dark skies, long exposures, enormous aperture ... or a big budget! With your current telescope and FITS camera (or a simple web cam or even a DSLR without a telescope) you can now easily study the stars yourself. Wouldn’t you like to detect the atmosphere on Neptune or the red shift of a quasar right from your own backyard?!



This talk, with lots of interesting examples, will show you what it’s all about and help you understand how spectroscopy is used in research. Even if you are an armchair astronomer, understanding this field will enhance your understanding of the things you read and the night sky. We’ll do a live Q&A after Tom’s 45-minute presentation.



New additions on our [website observing page](#) Click each image to see what's new.

**February Skies.** - The winter sky contains 8 of the skies 20 brightest stars. The winter circle of constellations includes Orion, Taurus, Auriga, Gemini Canis Minor and Canis Major. Many nebula and star clusters await eyes eager to peel back the curtain and peer into the depths of the sky. [Try this site](#) to learn more about these jewels in the night.

Alas the bright planets we enjoyed all winter are gone from the evening sky. Only Mars and dim Uranus linger for evening viewers. Jupiter, Saturn, and Venus are all too close to the sun for viewing. Jupiter & Saturn will greet early risers this spring beginning in early late this month. Venus will be tucked behind the sun until it emerges as our evening star in April.

Craving something sweet for that special astronomer in your life? Perhaps you would like a [Chocolate Telescope](#) from recent Facebook post.

**Planetarium shows are a good way to enjoy astronomy without the hassle of clouds and cold.** [Tulsa Air & Space museum](#) planetarium is now open Thursday thru Saturday during February. In addition to their regular selection of shows Two Special New Shows are scheduled in February.



**Searching for Skylab: America's Forgotten Triumph** A documentary of America's first space station featuring actual footage from the Skylab missions. Oklahoma astronaut William Poque was pilot of the Skylab 3 crew.



**The World's Greatest Domes - Feb 12-13 & 26-27** Travel the world during this unique event and experience the art and architecture of the world's most awe-inspiring domes as they are projected above your head.



The [Jenks High School planetarium](#) is bringing a special show Feb 20 & 22 - **Undiscovered World, the Search Beyond Our Sun** from the Hayden Planetarium in New York.

Also check out their many regular selections of weeknight and Saturday shows. Tickets must be purchased in advance and seating is limited to allow social distancing.

Click the Class Code arrow twice to find the program easily

## The Great Conjunction of Dec 21, 2020 by Stan Davis

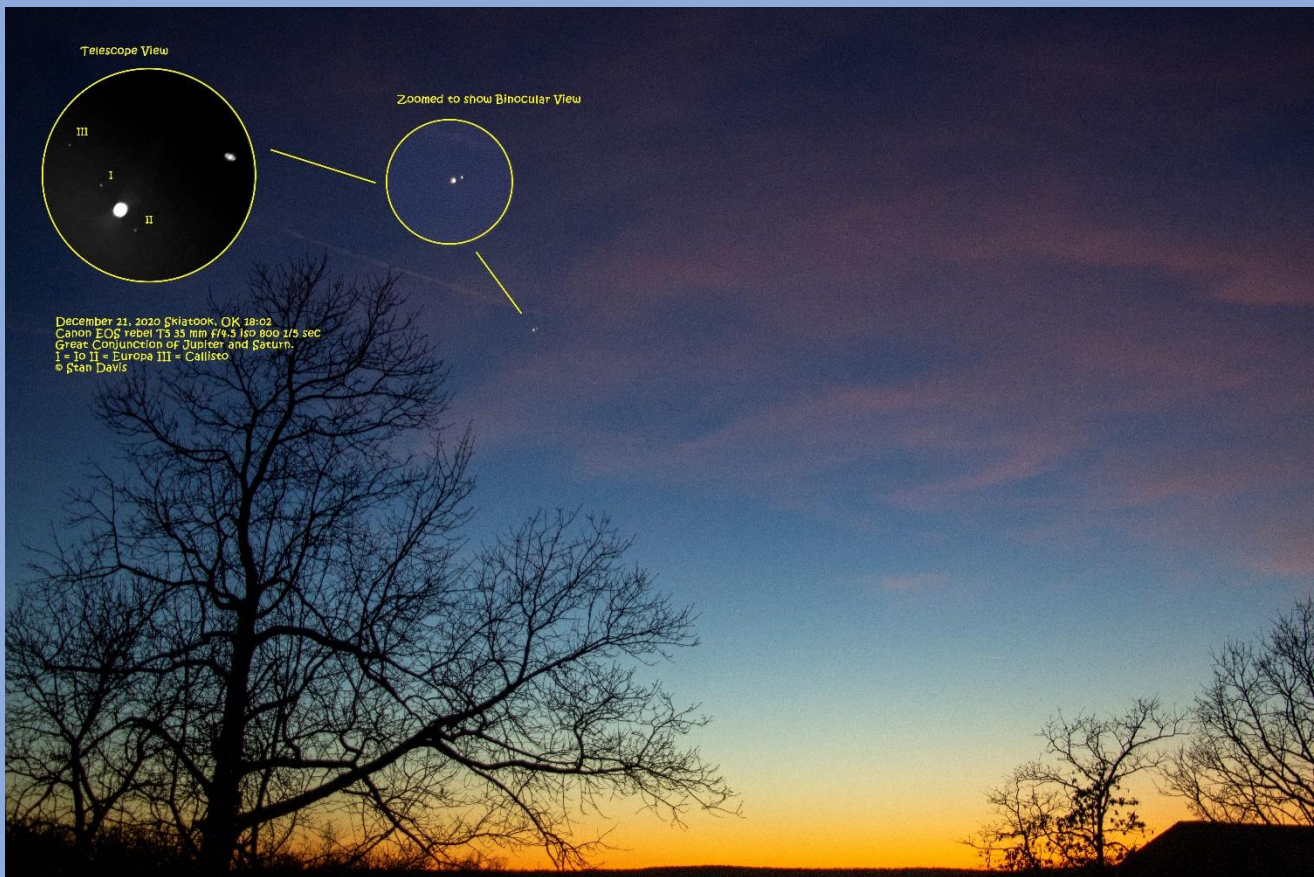
December 21, 2020 was the day of the Great Conjunction of Jupiter and Saturn. The closest they will be in 400 years. Does that sound like once in a life time event or what? Well, actually Jupiter is closer to us (earth) and from our perspective it is moving faster than Saturn as they circle the sun, so actually they meet in a conjunction every 20 years. What actually makes this one special is that from our view point they will appear only 0.1 degree apart. Now that is close. Some people like me that doesn't have the greatest vision anymore, they could appear as one bright star. ( I only could see one bright star, but with small binoculars I could quickly see both planets.)

I decided this would be an astronomical event that I wanted to image and photograph. I knew that they were moving closer together for some time and had been observing them to determine where to setup my telescopes and cameras for the big night. The weather was not the greatest the week of the event, but I did get a couple nights of practice. Actually, a couple nights were not enough for me. They were low on the horizon and quickly were out of site. I never did get that breath taking images that I wanted. I should have been practicing much sooner.



On the night of December 21, I was setup and ready to go. It was quite hectic, with all of the media coverage, lots of my family and friends were calling with where and when to look. My oldest daughter lives in Ada, OK and they called and wanted to know where to look. So, I was busy explaining to them where to look in the sky, my grandson Nick was busy centering the pair in my 10" LX 200. While I was talking with them, as anyone in the younger generation would know, he suggested that we use FaceTime to show them the view on that scope. It worked very well. He was able to hold the camera on the iPhone over the eyepiece and they could see both planets. Wow, you got to love technology. The neighbors knew that I was preparing for the night because I had left my scopes out over night, they wanted to know if they could come down and view the event. It actually worked out rather well. My neighbor to the north came down with his wife, daughter, son-in-law, and two grandsons. All were careful and practiced social distancing as they looked through the LX at the planets. It is

always fun to hear their reactions to moons of Jupiter and rings of Saturn. They thanked me and quickly retreated back to warmth of their home. Next the neighbor to east asked to come down and see the planets. When he showed up, there were three couples that came along. It all worked out and no one got sick. It was an impromptu star party and I had a great time.



I did manage to get one nice wide field image. I merged one of the iPhone pictures Nick took into it. I like how it turned out. I did see really nice pictures in last month's Observer and definitely appreciate what it takes to get those images.

Did you go out and observe the triple conjunction of Jupiter, Saturn, and Mercury? I was able to see Jupiter and Mercury but was not able to see Saturn. It was another nice conjunction to view and I did take a couple wide field images.

I hope all of you Astronomy Club members will have fun in 2021 viewing other conjunctions and astronomical events. Even though 2020 was a mess with COVID and other political events, for me it was a great astronomical year. I got my best comet picture I have ever taken. Neowise was one of those once in a life time comets. Even with all major star party cancellations, I still enjoyed learning more about imaging deep sky objects in my backyard.

Stay safe and healthy.

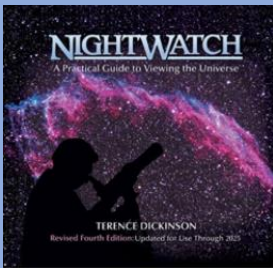
A fellow astronomical observer,  
Stan Davis



**Eric Kingery** is one of our newer club members. Being eager to learn all he can about astronomy, Eric has found some books that are very helpful to anyone wanting to get started our intriguing hobby. He volunteered to share some of them on our January Zoom meeting and offers the list below.

Eric shares a bit about himself: *“Nancy and I have now been married for over 50 years. We have always loved the natural world. One my earliest passions has been astronomy, and I am now returning to it since I first became fascinated at the age of 12. Other interests include geology, forestry, botany and history. For 35 years I was an avid backpacker and hiker in Scouting. I am still engaged in Scouting, teaching natural history merit badges. I was also a bagpiper for a couple decades with various local piping groups. Sadly, I have had to put the pipes down recently because of developing physical disabilities. But it has allowed me more time to pursue other things I love, especially astronomy. It is so great to be involved with a group of people who love science and share and support one another in this wonderful hobby.”*

### Books I've found useful for LEARNING THE ASTRONOMY HOBBY

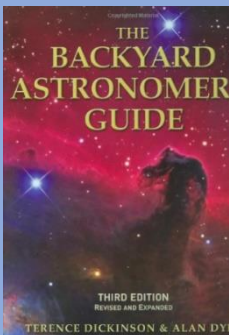


#### *Nightwatch – Terence Dickinson, 2006*

- This book is for people new to the hobby, eager to learn but not sure where to start.
  - Universe in 11 steps.
  - Basic celestial mechanics
  - Teaching the constellations starting with the Big Dipper.
  - Constellations by season.
- Binoculars and telescopes.
  - How to choose a telescope.
  - Deep sky objects and charts to find them.
  - Planets and how to observe them.
  - A bit on astrophotography
  - A great first book.

#### *The Backyard Astronomer's Guide Second Edition – Dickinson & Dyer, 2002*

*newer 3<sup>rd</sup> edition cover shown*



- This is for someone who is serious about this hobby, but not necessarily well informed.
- People ready to take the next step.
- Much more in depth than **Nightwatch**
- **Three parts:**
  1. Equipment: binoculars and telescopes
  2. Observing the night sky
  3. Astrophotography



## WHAT DO I WANT TO SEE? PLANNING AN OBSERVATION NIGHT

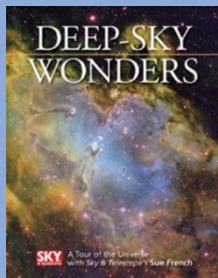
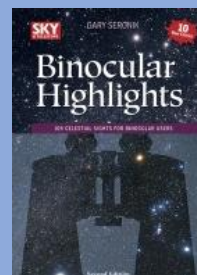
### *Turn Left at Orion – Guy Consolmagno and Dan Davis, 2000*



- What to observe, when, and how: binoculars and telescopes.
- A great way to plan a walk through the night sky with binoculars and a small telescope.
- It features 100 different objects.
- Photos of what you will see in the various phases of the Moon.
- What you can see when observing the planets.
- Drawings of what you will see in a finder scope and what you will see in a telescope at various powers.

### *Binocular Highlights – Gary Seronik, 2017*

- An observation planning guide specifically for binoculars.
- 109 objects best viewed through binoculars by season.



### *Deep-Sky Wonders – Sue French, 2011*

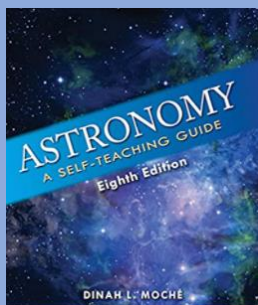
- Another observation planning guide, but this one is more in depth for deep sky.
- A compilation of Sue French from years of writings for Sky & Telescope
- Organized by month and seasons.
- Details many objects that premier books miss.

### *Sky & Telescope Pocket Atlas – Roger Sinnott, 2015*

- A star atlas that can help you navigate among the stars.
- It will help you particularly with deep sky objects.



### *Astronomy: A Self-Teaching Guide, Eighth Edition – Dinah Moche, 2015*



- If you enjoy reading Sky and Telescope or Astronomy magazine, but would like to understand more of what you read, going through this book will help you do just that.
- A non-mathematical approach to astronomical concepts.

## Sirius star gazing ! by John Land - et al



Our winter sky features the brightest nighttime star, **Sirius**, in the constellation of the Big Dog, **Canis Major**. It's likely the first star you will see in the SE after sunset and transits due south around 9:30 PM. It's easy to locate by following the belt of Orion down to the left. At magnitude **-1.44** it's 9.5 times brighter than a first magnitude star.

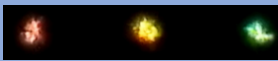
### Two factors account for its brilliance.

1. It is the 2<sup>nd</sup> closest naked eye star from our Sun. 8.58 Light years away. Alpha Centauri is closer but only 4.3 mag and too far south to see from Oklahoma.
2. Sirius is a hot type A1V star with a surface temperature of 9400 °K , 1.93 Sun diameters and 24 times brighter than the Sun.

*"Now that could cause some Sirius - sunburns ☹️"*

Member David Downs shared a Facebook post telling the origin of the expression *"Dog Days of Summer"* Sirius - the Dog Star - and the Sun rise together in mid-summer about July 2 ( 2021 ) the hottest period of summer. *"The Egyptians even went so far as to base their calendar on when Sirius was first visible in the eastern sky, shortly before sunrise. ...the Egyptians called Sirius the "Nile Star," because it always returned just before the river rose and so announced the coming of the floodwaters that would nourish their lands."*

We all recall the children's nursery rhyme *"Twinkle Twinkle Little Star"* Astronomers call this phenomenon "scintillation." It is caused by thermal irregularities in Earth's atmosphere. Packets of relatively warm and cool air act like prisms, spreading starlight into rainbow colors. Bright Sirius is well known for twinkling with many colors.

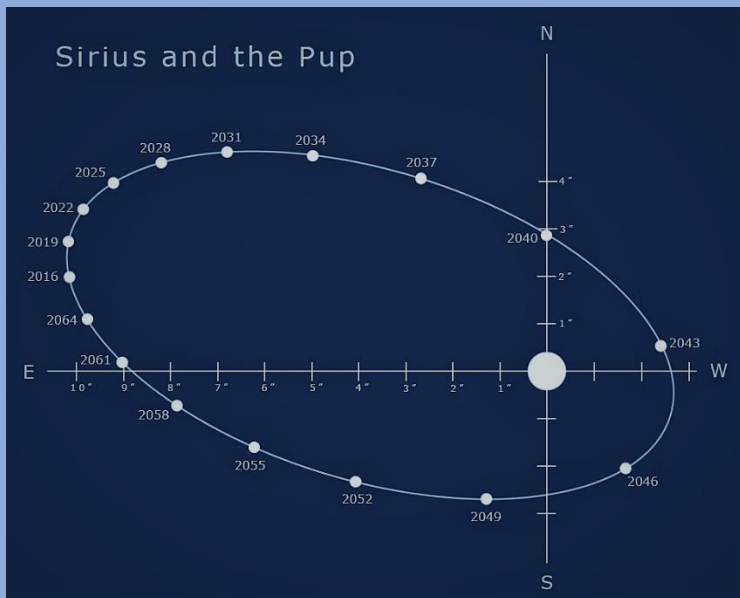


The [January 30 Space Weather](#) has an interesting montage image of its many colors made by Danish photographer Arne Recke.

**Sirius B "The Pup"** - By 1844 astronomers had discovered small variations in the motion of Sirius indicating that it was orbited by a smaller companion star. In 1862 Alvan G. Clark was finally able to see it using an 18½" refractor. The nature of this companion star stirred a great mystery among astronomers and physicists. Although they were the same distance from the sun, Sirius B star 10,000 times dimmer than Sirius A yet its mass was 95% the mass of the Sun. Calculations showed that its diameter was even smaller than Earth at about 7,450 miles and its surface temperature was nearly 5 times hotter than the sun at 25,000 °K Its surface gravity is 100,000 times stronger than Earth's !

As physicist finally began to understand how stars work, they were perplexed by this tiny, massive, searingly hot star. Stars like our sun get their energy by hydrogen fusion converting Hydrogen into Helium inside its core at about 15 Million °K. Even so the sun does not explode due to the crushing force of gravity from the overlying regions of the Sun. Our Sun is a Main Sequence stars in hydrostatic and thermal equilibrium. The force of gravity from its mass is balanced by the forces produced by the heat of fusion in its core. However, when eventually all its hydrogen fuel is exhausted there is no more fusion in the core. Then gravity has nothing to hold it up allowing it to crush the remaining material into a tiny super-hot **White Dwarf**. A White Dwarf is made of degenerate matter. The atoms have been compressed so compactly that they are no longer individual atoms but more like densely compressed protons, neutrons, and electrons.

The brilliant Indian physicist Subrahmanyan Chandrasekhar calculated that the core is in a state of [Electron Degeneracy](#). < (Very interesting read) The only thing stopping complete collapse is the electromagnetic force of the electrons repelling each other. Think of magnets when you try to push two like poles together, they repel each other. The stellar evolution of a star is much more complex than my simple explanation but hopefully you get the point. Stars with a final mass of less than 1.44 solar masses eventually will end up as White Dwarfs. Things get more spectacular once that mass is exceeded.! But you'll have to do that study on your own.



### Observing the white dwarf Sirius B.

At magnitude 8.4 the star is well within reach of smaller telescopes and even binoculars. By the problem lies with its proximity to its much brighter primary star.



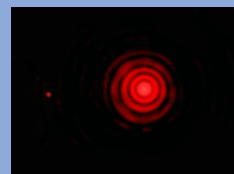
The image on right is by Amateur astronomer Thomas Ashcraft of New Mexico. See his video and more at [SpaceWeather Jan 31](#)

Sirius B has an elliptical orbit with a period of 50 years. The orbit takes it as close a 3" and as 11" separation. It is now near its maximum separation making the next few

years an excellent opportunity to observe this elusive dwarf.

To optimize your chances, choose a time when Sirius is near the meridian allowing for the least intervening atmosphere. Also allow your telescope to fully cool down to the outside temperatures. Choosing a night of good seeing and patience will be needed to wait the optimum moment of seeing.

A traditional method of observing "The Pup" is allow Sirius to just drift out of view and or design a sharp metal cut off mask near an eyepiece focal plane. While researching this article I ran across an article detailing a novel way to split the pair. Amateur astronomer Harry Roberts from Sydney, Australia was experimenting with using ordinary Red Wratten #25 to diminish the intense glare of bright Blue White stars like Rigel and Sirius. He was ecstatic to discover that he could see Sirius B easily by using this technique. See [His article](#) it's a very good read and has tips about seeing this and other challenging double stars.



☹ and of course, it's been cloudy every night since I read the article, so I haven't got to try my luck at seeing "The Pup"



**This article is distributed by NASA Night Sky Network      February 2021**

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit [nightsky.jpl.nasa.gov](https://nightsky.jpl.nasa.gov) to find local clubs, events, and more!

## **Landing On Mars: A Tricky Feat!**

David Prosper

The Perseverance rover and Ingenuity helicopter will land in Mars's Jezero crater on Thursday February 18, 2021, NASA's latest mission to explore the red planet. Landing on Mars is an incredibly difficult feat that has challenged engineers for decades: while missions like Curiosity have succeeded, its surface is littered with the wreckage of many failures as well. Why is landing on Mars so difficult?

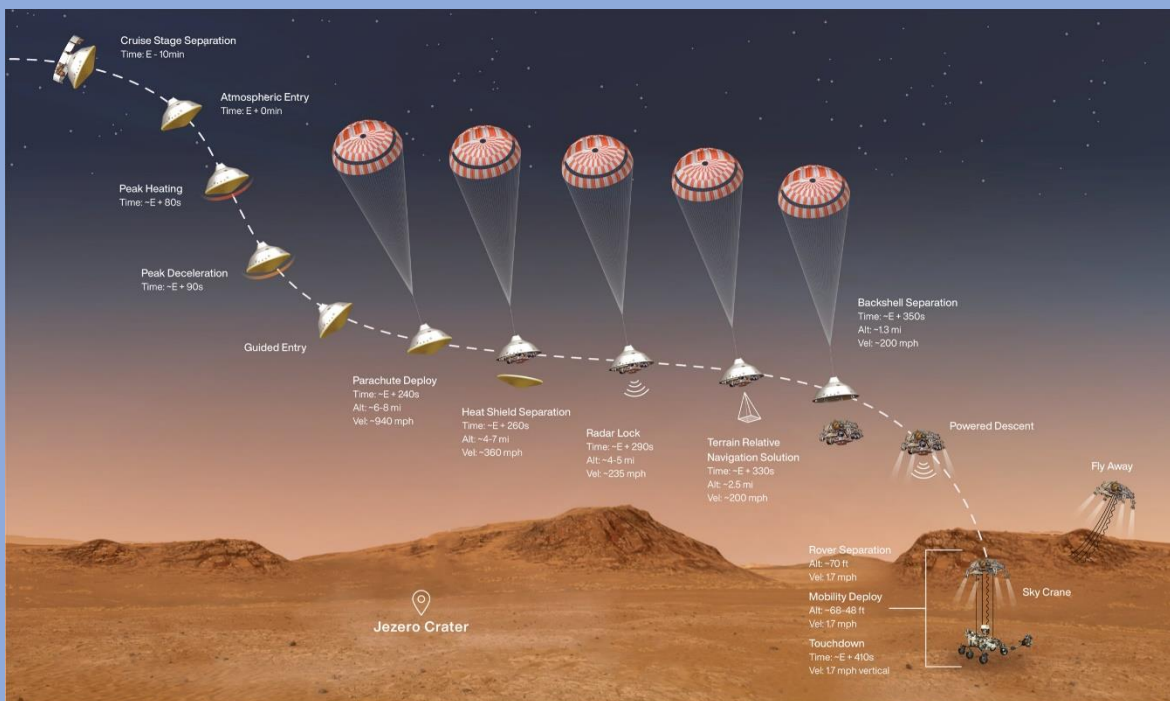
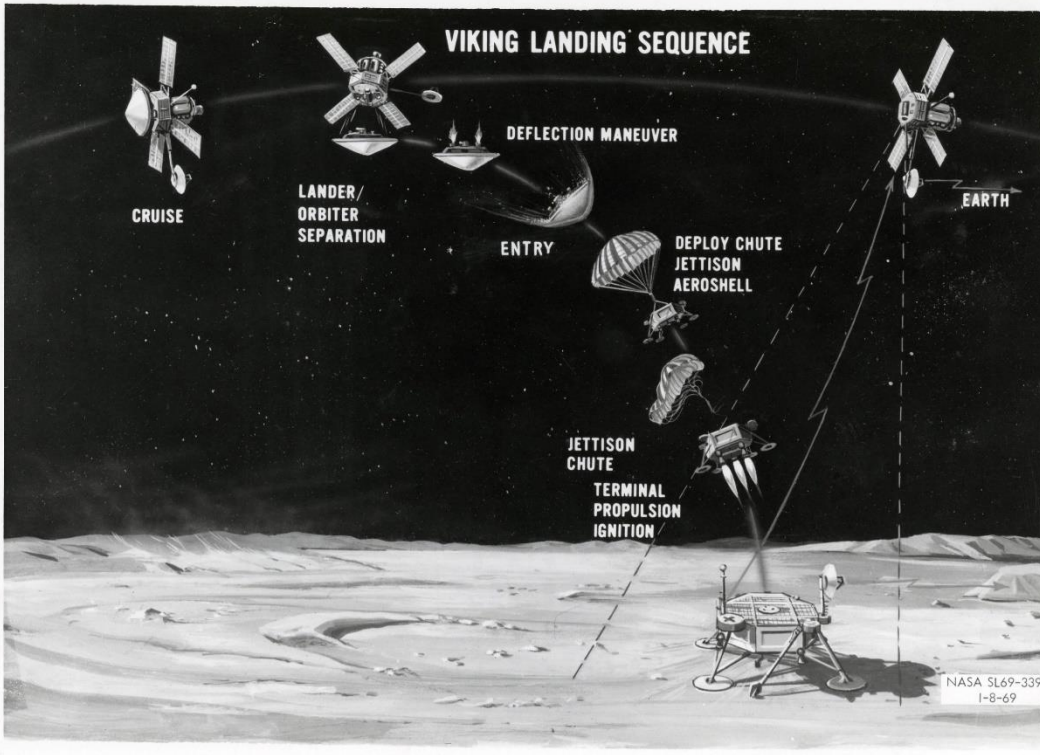
Mars presents a unique problem to potential landers as it possesses a relatively large mass and a thin, but not insubstantial, atmosphere. The atmosphere is thick enough that spacecraft are stuffed inside a streamlined aeroshell sporting a protective heat shield to prevent burning up upon entry - but that same atmosphere is not thick enough to rely on parachutes alone for a safe landing, since they can't catch sufficient air to slow down quickly enough. This is even worse for larger explorers like Perseverance, weighing in at 2,260 lbs (1,025 kg). Fortunately, engineers have crafted some ingenious landing methods over the decades to allow their spacecraft to survive what is called *Entry, Descent, and Landing (EDL)*.

The Viking landers touched down on Mars in 1976 using heat shields, parachutes, and retrorockets. Despite using large parachutes, the large Viking landers fired retrorockets at the end to land at a safe speed. This complex combination has been followed by almost every mission since, but subsequent missions have innovated in the landing segment. The 1997 Mars Pathfinder mission added airbags in conjunction with parachutes and retrorockets to safely bounce its way to a landing on the Martian surface. Then three sturdy "petals" ensured the lander was pushed into an upright position after landing on an ancient floodplain. The Opportunity and Spirit missions used a very similar method to place their rovers on the Martian surface in 2004. Phoenix (2008) and Insight (2018) actually utilized Viking-style landings. The large and heavy Curiosity rover required extra power at the end to safely land the car-sized rover, and so the daring "Sky Crane" deployment system was successfully used in 2012. After an initial descent using a massive heat shield and parachute, powerful retrorockets finished slowing down the spacecraft to about 2 miles per hour. The Sky Crane then safely lowered the rover down to the Martian surface using a strong cable. Its job done, the Sky Crane then flew off and crash-landed a safe distance away. Having proved the efficacy of the Sky Crane system, NASA will use this same method to attempt a safe landing for Perseverance this month!

**You can watch coverage of the Mars Perseverance landing LIVE starting at 1:00 PM CST on February 18 at [nasa.gov/nasalive](https://nasa.gov/nasalive). Touchdown is expected around 2:55 PM CST**

**Editor Note:** *I watched one of this LIVE landing events. There was a **significant time lag** from when the lander was scheduled to touch down until NASA actually got confirmation signal from the spacecraft. Mars will be 204 million Km from Earth so even after the signal is sent it will take 11.37 mins to arrive.*

NASA has great resources about the Perseverance Rover and accompanying Ingenuity helicopter on [mars.nasa.gov/mars2020](https://mars.nasa.gov/mars2020). See <https://www.nasa.gov/nasalive> for schedule of both pre- and post-landing conferences begin Tues Feb 16 through Friday Feb 19 and beyond.



*Illustrations of the Entry, Descent, and Landing (EDL) sequences for Viking in 1976, and Perseverance in 2021. Despite the wide gap between these missions in terms of technology, they both performed their landing maneuvers automatically, since our planets are too far apart to allow Earth-based engineers to control them in real time! (NASA/JPL/Caltech)*

# TREASURER'S and MEMBERSHIP Report

BY JOHN NEWTON



As of Jan 23, we had **214 members**. We welcome this month our newest members **Emily Bartel, Robert Knight, Janie Daigle, Ron Foster, Steve Boyls, Stacie Boyls, Kayte Anton, Kathleen Sisler, Ryan Dick, Dana Swift, Warren Miller, Marvin Biggs, Lee Schillinger, Brian Wattenbarger, and Jonathan Gross.**

Hello and welcome to ACT!

In addition, we want to recognize our long-term prominent and well-respected members who continue to renew their memberships with the club, even during these restricted times. We look forward to seeing you all at meetings, even if virtual by Zoom, and at club events throughout the year when possible.

## Accounts as of January 22, 2021

Checking: \$ 6,303.22

Savings: \$ 10,785.42

Investments: \$ 27,918.73 (Value tends to fluctuate with markets).

The club now has PayPal available for you to start or renew memberships and subscriptions using your credit or debit cards. Fill out the registration form at <https://astrotulsa.com/page.aspx?pageid=16>

Click **Submit** and you will be given the choice of either **mailing in your dues** with a check or **using PayPal** which accepts most major credit cards. A modest processing fee is added to PayPal transactions.

You may also renew your membership or join at one of our club events using your credit card by seeing one of our officers. We can take payments with the Square card reader. A small fee is also added on to these transactions.

**ALSO NOTE:** For our current members who are renewing their memberships, you can now go to a new link on the website to start your renewal process. On the home page, hover over the "Member" tab on the ribbon menu near the top of the page. Then select the "Membership Renewal" link and this will take to a page to fill out your information. Fill this out, submit it, then pay your dues by the method you choose.

**NEWS NOTE:** Both Sky & Telescope and Astronomy have free Digital subscriptions available with print subscriptions, or Digital subscriptions may be purchased separately. Details - Contact their websites

Membership rates for **2020** are as follows:

**Adults: \$ 45 per year, includes Astronomical League Membership.**

**Sr. Adult: \$ 35 per year for those 65 or older, includes Astro League Membership.**

**Students: \$ 30 with League membership; Students: \$ 25 without League membership.**

**Additional Family membership: \$ 20 with voting rights and League membership.**

**\$ 15 with voting rights but without League Membership.**

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

**Join Online** – Add or renew magazine subscriptions. <https://www.astrotulsa.com/page.aspx?pageid=16>

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

**Astronomy** is \$ 34 for 1 year, or \$ 60 for 2 years. [www.astronomy.com](http://www.astronomy.com)

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

**Sky & Telescope** is \$ 33 per year <https://skyandtelescope.org/>

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

You may renew Sky & Telescope subscriptions directly by calling their number -**be sure to ask for the club rate**

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NIGHT SKY NETWORK –  
**Open Position**

WEBMASTER JENNIFER JONES

Do you have ideas for our club ZOOM Meetings?  
Know someone who willing to be a Guest presenter?

We would also welcome YOU to do a short 5-10  
minute section of interest or new equipment you'd  
like to review.

Create a Cartoon on a Space Theme

Contact our Editor John Land  
[Tulsaastrobiz@gmail.com](mailto:Tulsaastrobiz@gmail.com)

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