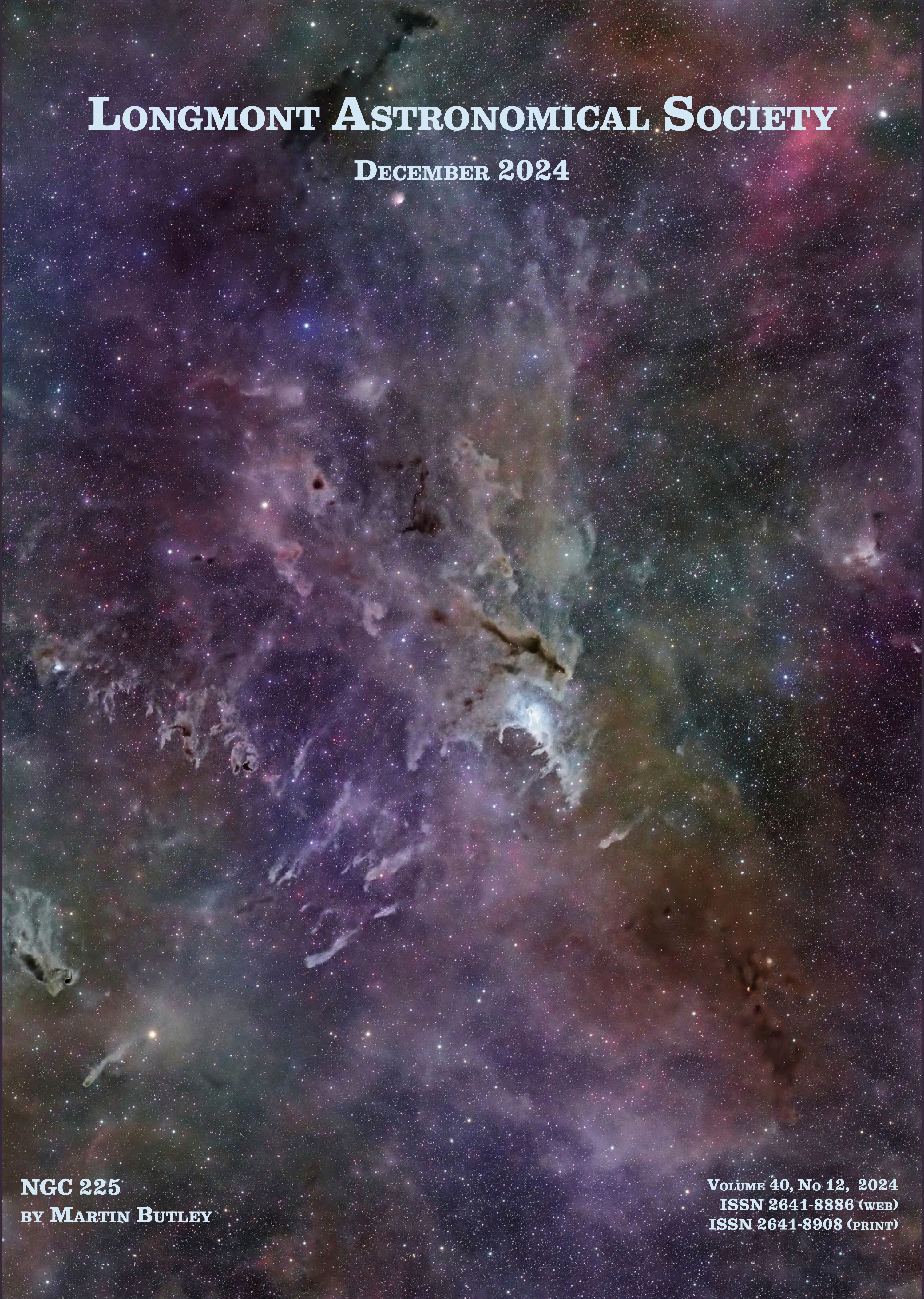
Longmont Astronomical Society

December 2024



NGC 225
by Martin Butley

Volume 40, No 12, 2024
ISSN 2641-8886 (web)
ISSN 2641-8908 (print)

No LAS Meeting in December!!!

Help Wanted!

- Public outreach coordinator – coordinates with various cities, libraries, Boulder Parks, scheduled events though out the year, sends out announcements about getting volunteers to attend and also attend star parties
- Vice President - schedule speakers for our meetings
- Volunteers to help with LAS 40th Anniversary Banquet
- We always need volunteers to help with the website and the newsletter

LAS Elections are in January

All positions are up for election each year. If you are interested in volunteering try to be at the January meeting or let a current officer know you are interested! (Note - even if you are not at the meeting you may get drafted!)

Officer Positions:

- President
- Vice President*
- Treasurer

* Currently no one has volunteered for this position

Board of Directors

- 5 Positions

About LAS

The Longmont Astronomical Society Newsletter ISSN 2641-8886 (web) and ISSN 2641-8908 (print) is published monthly by the Longmont Astronomical Society, P. O. Box 806, Longmont, Colorado. Newsletter Editor is Vern Raben. Our website URL is https://www.longmontastro.org and the webmaster is Sarah Davis. The Longmont Astronomical Society is a 501 c(3), non-profit corporation which was established in 1987.

The Longmont Astronomical Society is affiliated with the Astronomical League (https://www.astroleague.org). The Astronomical League is an umbrella organization of amateur astronomy societies in the United States.

Contents

LAS 2024 Execs

Vern Raben, President
Hunter Morrison, Vice President
Eileen Hall-McKim, Secretary
Bruce Lamoreaux, Treasurer

LAS 2024 Board Members

David Elmore, Gary Garzone,
Mike Hotka, Brian Kimball, and Tally O'Donnell

Appointed Positions 2024

Sarah Detty, Webmaster
Bruce Lamoreaux, Library Telescope Coordinator
Open Position, Public Outreach Coordinator

Vern Raben, Newsletter Editor
Eileen Hall-McKim, Newsletter Archives

Planets in December

Mercury

Mercury is visible naked eye low in the SE before sunrise from the 16 to 28th this month. It is magnitude 0.1 on the 16th and brightens to mag -0.4 on the 28th. Its apparent size decreases from 7.9 to 6.1 arc seconds.

Venus

Venus is visible in the southwest after sunset. It is about magnitude -0.42 to -4.4 in brightness and increases from 17 arc sec across to 23 arc sec during the month.

Mars

Mars is visible in the evening sky in constellation Cancer. It increases in brightness from -0.5 to -1.2 magnitude. Its disk increases from 12 arc sec to 14 arc sec across.

Jupiter

Jupiter is visible after sunset It is about -2.8 magnitude in brightness and about 48 arc sec across. It is at opposition with Earth on Dec. 7th. The following is a list of visible transits above 20° altitude this month:

- Dec 1 at 4:11 am altitude 57°
- Dec 2 at 12:03 am alt 73°
- Dec 3 at 5:49 am alt 20°
- Dec 4 at 1:41 am alt 65°
- Dec 4 at 9:32pm alt 55°
- Dec 6 at 11:10 pm alt 71°
- Dec 7 at 7:01 pm alt 28°
- Dec 8 at 4:57 am alt 25°
- Dec 9 at 12:48 am alt 69°
- Dec 9 at 8:39 pm alt 49°
- Dec 11 at 2:26 am alt 51°
- Dec 12 at 6:08 pm alt 23°
- Dec 13 at 4:04 am alt 31°
- Dec 13 at 11:55 pm alt 72°
- Dec 14 at 7:46 pm alt 43°
- Dec 16 at 1:33 am alt 57°
- Dec 16 at 9:25 pm alt 63°
- Dec 18 at 3:11 am alt 37°
- Dec 18 at 11:03 pm alt 73°
- Dec 19 at 6:54 pm alt 37°
- Dec 21 at 12:41 am alt 62°
- Dec 21 at 8:32 pm alt 57°
- Dec 23 at 2:19 am alt 42°
- Dec 23 at 10:10 pm alt 72°
- Dec 24 at 6:02 pm alt 32°
- Dec 25 at 3:57 am alt 22°
- Dec 25 at 11:48 pm alt 67°
- Dec 26 at 7:40 pm alt 52°
- Dec 28 at 1:27 am alt 48°
- Dec 28 at 9:18 pm alt 69°
- Dec 29 at 5:09 pm alt 26°
- Dec 30 at 3:05 am alt 28°
- Dec 30 at 10:56 pm alt 70°
- Dec 31 at 6:48 pm alt 46°

Saturn

Saturn is +1.0 magnitude in brightness and its disk is 17 arc sec across.

Uranus

Uranus is 5.6 magnitude and 3.7 arc sec across.

Neptune

Neptune is 7.9 magnitude and 2.2 arc sec across.

Lunar Phases in December

First quarter: Dec 8 at 8:28 am	Full Moon: Dec 15 at 2:03 am	Third quarter: Dec 22 at 3:19 pm	New Moon: Dec 30 at 3:28 pm

Images created with NASA Scientific Visual Studio's Moon Phase and Libration Tool.
See https://svs.gsfc.nasa.gov/5187/

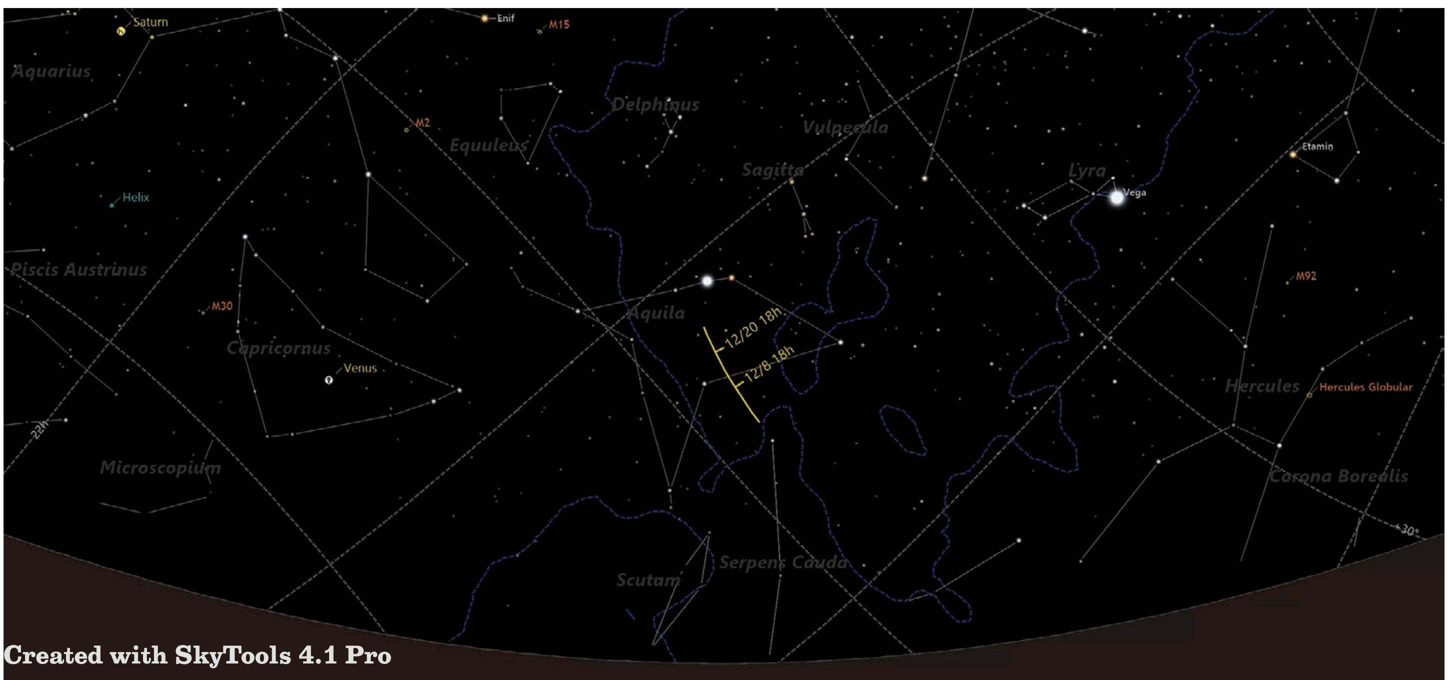
Showpiece Objects in December

- M31, Andromeda Galaxy in And, mag 4.3
- Bodes Galaxy M81 in UMa mag 7.8
- NGC 281, Pacman Nebula in Cas, mag 7.4
- NGC 253, Sculptor Galaxy in Sct, mag 7.9
- NGC 7662, Blue Snowball in And, mag 8.6
- NGC 40, Bowtie Nebula in Cep, mag 10.7
- NGC 7635, Bubble Nebula in Cas. mag 11
- NGC 1499 California Nebula in Per mag 5
- NGC 2264 Cone Nebula in Mon
- M1 Crab Nebula in Tau mag 8.4
- NGC 2024 Flame Nebula in Ori
- IC405 Flaming Star Nebula in Aur mag 10
- B 33 Horsehead Nebula in Ori mag 16.5
- NGC 1333 vdB 17 in Per
- NGC 2244 NGC 2239 in Mono mag 4.7
- M101 Pinwheel Galaxy in UMa mag 8.4
- NGC 2237 Rosette Nebula in Mon mag 9
- NGC 1909 Witch Head Nebula in Eri

Meteor Showers in December

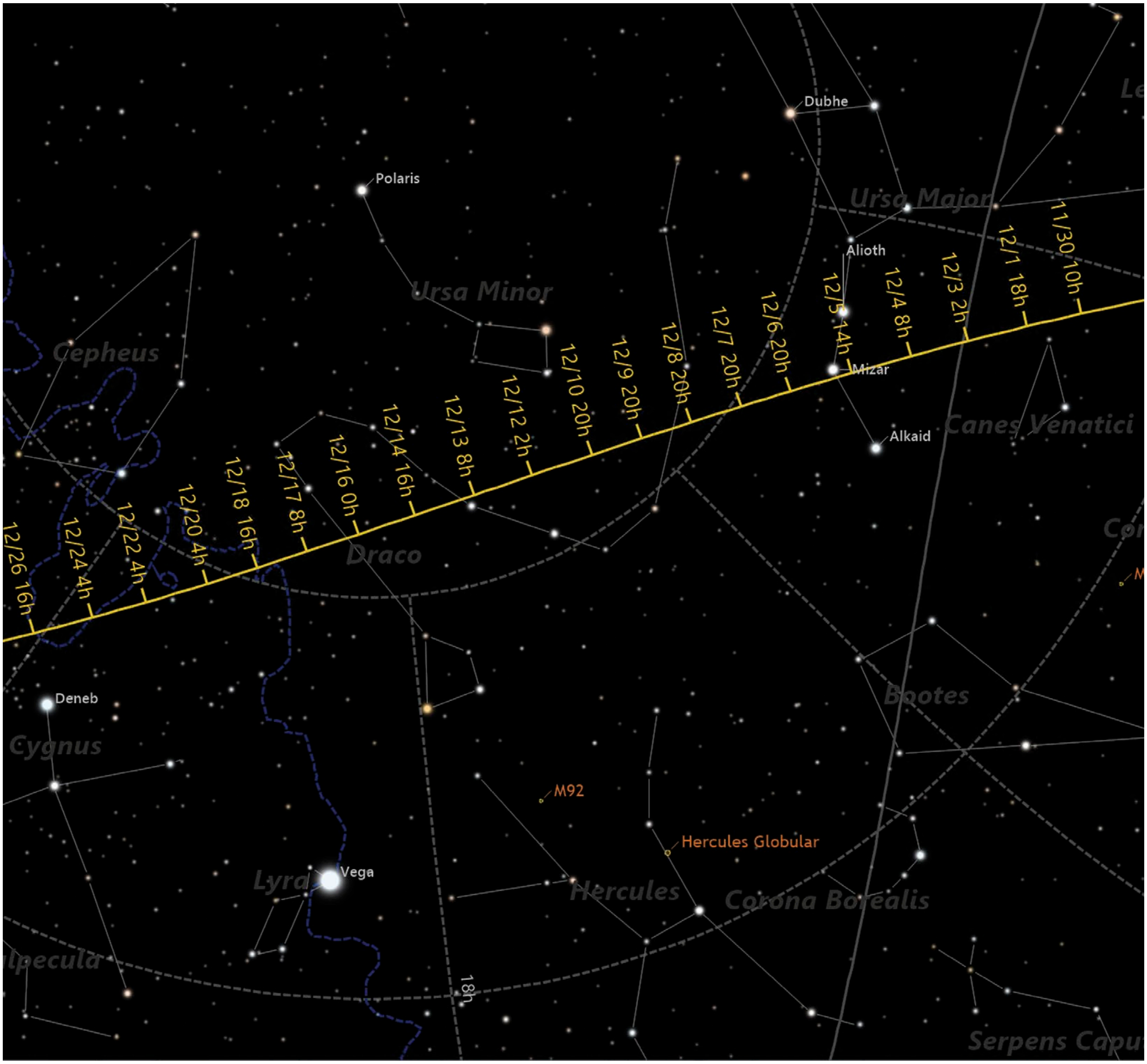
The Geminid Meteor shower is a type I (major) meteor shower which peaks on night of Dec 13/14. Typically over a hundred per hour may be seen from a dark location. Unfortunately this year the full moon is the following evening so not as many will be visible. Geminids are typically quite bright so it may be worth spending some time out in the cold.

Comet C/2023 A3 (Tsuchinshan - ATLAS) in December



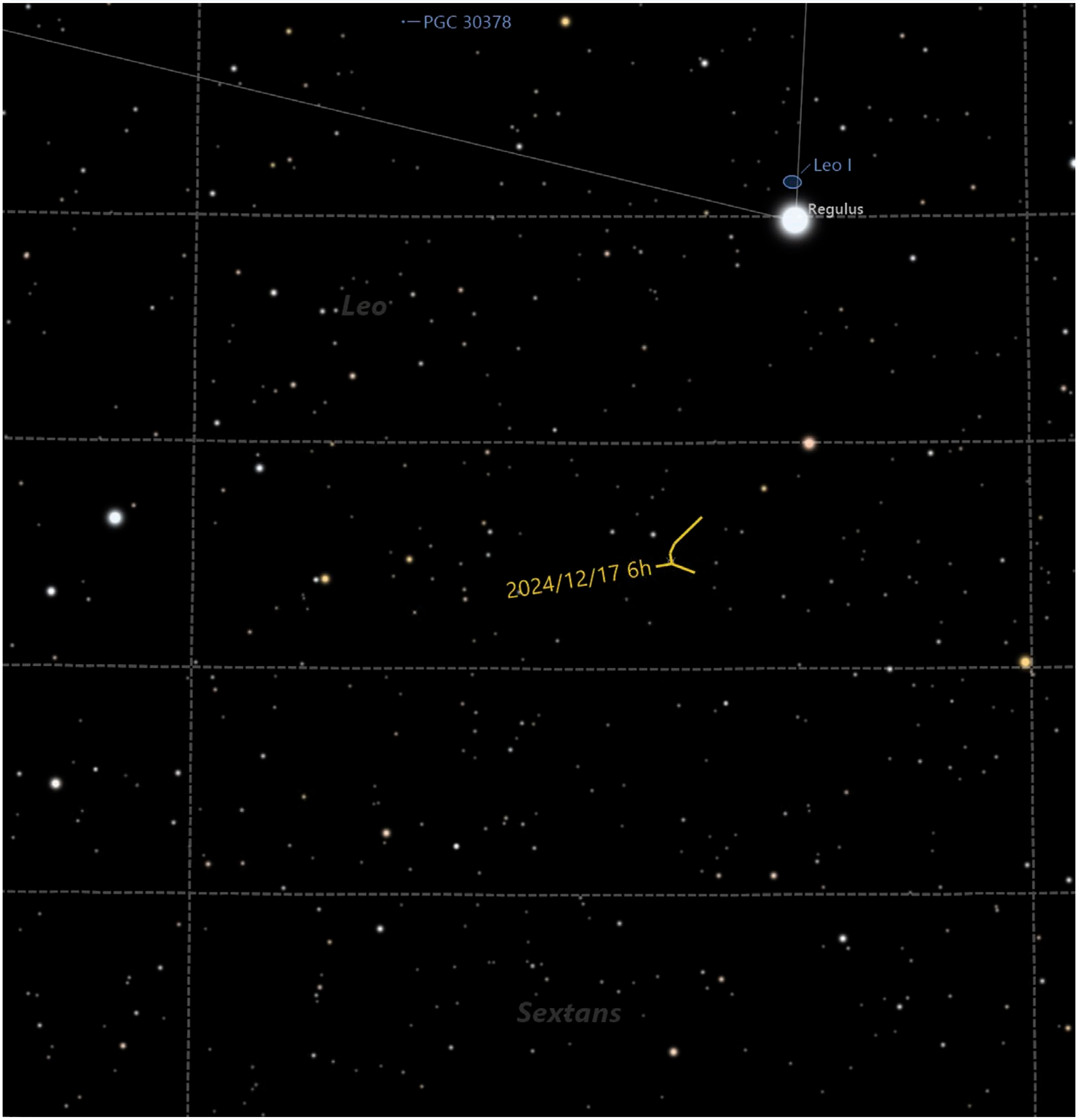
Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Dec 1	6:06 pm	19h10m19.6s	+04°33’54”	Aquila	9.2	2.3
Dec 7	6:06 pm	19h17m52.1s	+04°49’41”	Aquila	9.5	2.1
Dec 13	6:05 pm	19h24m46.1s	+05°08’34”	Aquila	9.8	2.0
Dec 19	6:07 pm	19h31m10.8s	+05°30’31”	Aquila	10.1	1.9
Dec 25	6:08 pm	19h37m11.6s	+05°55’31”	Aquila	10.4	1.8
Dec 31	6:10 pm	19h42m51.9s	+06°23’36”	Aquila	10.6	1.7

Comet 333P/LINEAR



Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Dec 1	5:25 am	12h37m58.8s	+44°20’03”	Canes Venatici	11.5	2.3
Dec 7	5:18 am	14h17m14.0s	+60°09’32”	Ursa Major	11.4	2.5
Dec 13	5:42 pm	17h36m21.8s	+66°10’34”	Draco	11.5	2.4
Dec 19	6:17 pm	19h53m13.0s	+59°23’25”	Cygnus	11.9	2.1
Dec 25	6:20 pm	20h58m15.6s	+50°25’26”	Cygnus	12.4	1.7
Dec 31	6:23 pm	21h30m13.8s	+43°33’32”	Cygnus	12.9	1.4

Comet 29P/Schwassmann-Wachmann

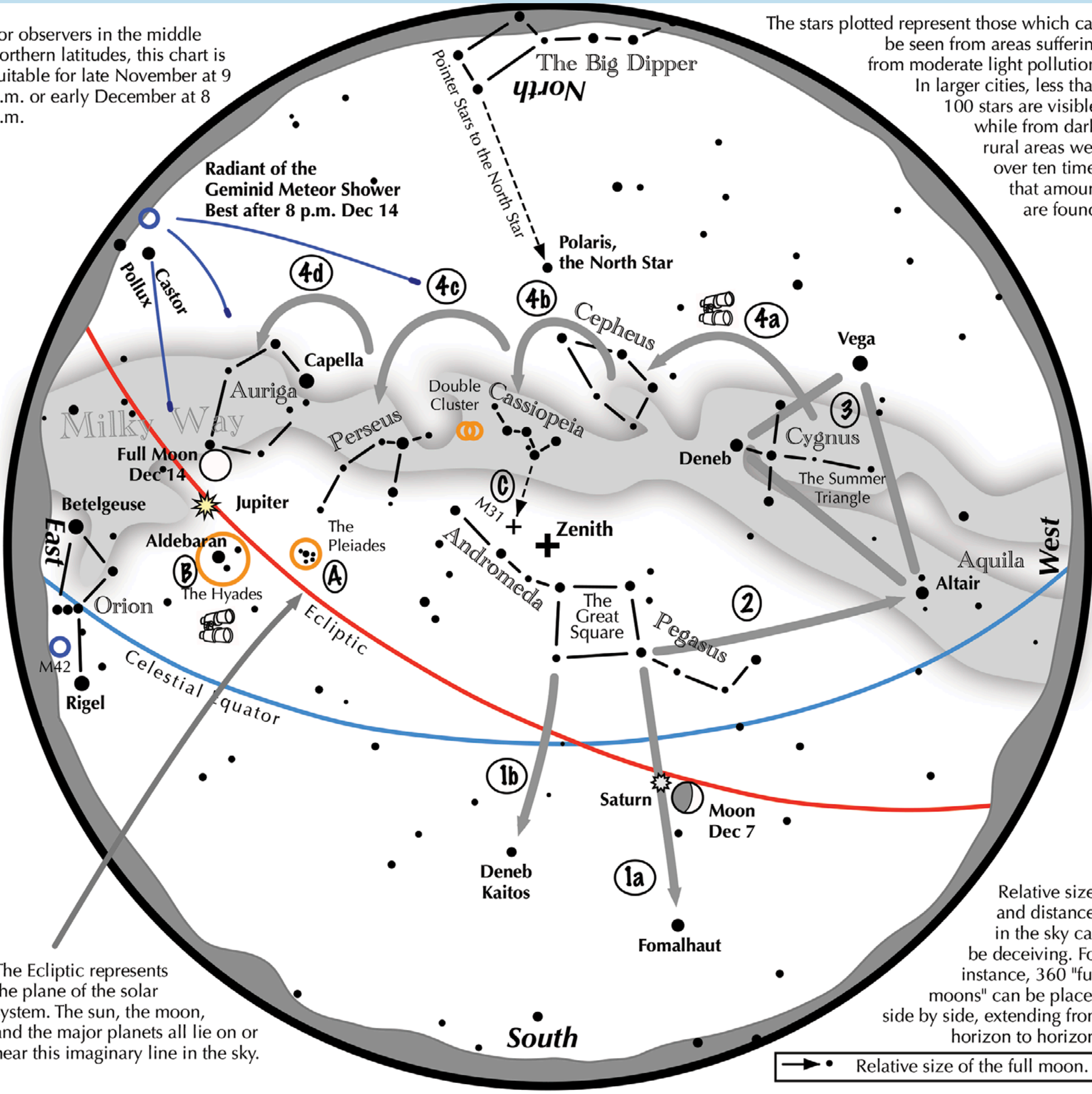


Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Dec 1	5:14 am	10h13m37.4s	+09°06'30"	Leo	12.0	1.5
Dec 7	5:02 am	10h14m07.4s	+08°57'50"	Leo	12.0	1.5
Dec 13	5:43 am	10h14m14.9s	+08°51'07"	Leo	12.0	1.6
Dec 19	5:29 am	10h13m59.7s	+08°46'28"	Leo	11.9	1.6
Dec 25	3:48 am	10h13m22.2s	+08°43'54"	Leo	11.9	1.6
Dec 31	3:27 am	10h12m22.3s	+08°43'21"	Leo	11.9	1.6

Navigating the December Night Sky by John Goss

For observers in the middle northern latitudes, this chart is suitable for late November at 9 p.m. or early December at 8 p.m.

The stars plotted represent those which can be seen from areas suffering from moderate light pollution. In larger cities, less than 100 stars are visible, while from dark, rural areas well over ten times that amount are found.



The Ecliptic represents the plane of the solar system. The sun, the moon, and the major planets all lie on or near this imaginary line in the sky.

Relative sizes and distances in the sky can be deceiving. For instance, 360 "full moons" can be placed side by side, extending from horizon to horizon.

Relative size of the full moon.

Navigating the December night sky: Simply start with what you know or with what you can easily find.

1 Face south. Almost overhead is the "Great Square" with four stars about the same brightness as those of the Big Dipper. Extend an imaginary line southward following the Square's two westernmost stars. The line strikes Fomalhaut, the brightest star in the southwest. A line extending southward from the two easternmost stars, passes Deneb Kaitos, the second bright star in the south.

2 Draw another line, this time westward following the southern edge of the Square. It strikes Altair, part of the "Summer Triangle."

3 Locate Vega and Deneb, the other two stars of the "Summer Triangle. Vega is its brightest member while Deneb sits in the middle of the Milky Way.

4 Jump along the Milky Way from Deneb to Cepheus, which resembles the outline of a house. Continue jumping to the "W" of Cassiopeia, to Perseus, and finally to Auriga with its bright star Capella.

Binocular Highlights

A and B: Examine the stars of the Pleiades and Hyades, two naked eye star clusters.

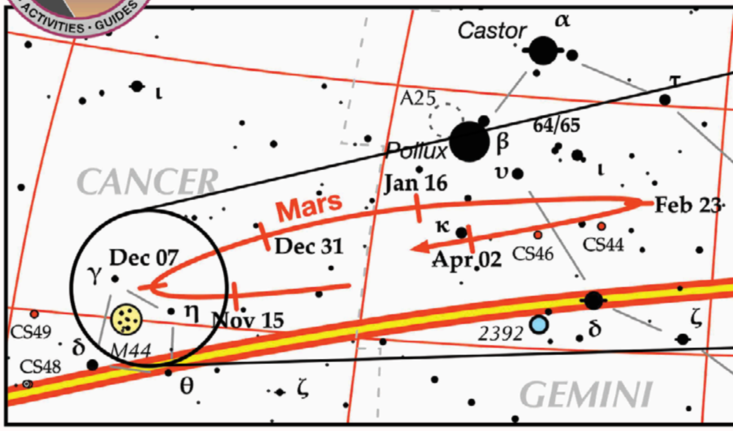
C: The three westernmost stars of Cassiopeia's "W" point south to M31, the Andromeda Galaxy, a "fuzzy" oval.

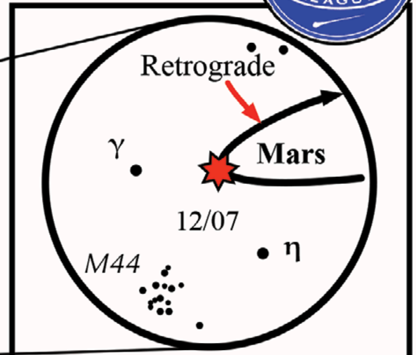
D: Sweep along the Milky Way from Altair, past Deneb, through Cepheus, Cassiopeia and Perseus, then to Auriga for many intriguing star clusters and nebulous areas.

Astronomical League *www.astroleague.org/outreach; duplication is allowed and encouraged for all free distribution.*

Observing Project: Retrograde Motion of Mars

See this for yourself!





Binocular view of Mars' retrograde motion

Relative apparent size of Mars

94% illuminated

Dec. 7, 2024
Magnitude: -0.6
Diameter: 12 seconds
Distance: 71 million miles

100% illuminated

Opposition
Jan. 16, 2025
Magnitude: -1.4
Diameter: 15 seconds
Distance: 60 million miles

94% illuminated

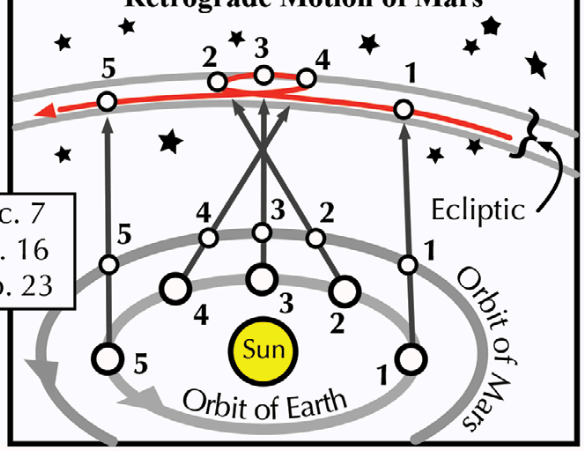
Feb. 23, 2025
Magnitude: -0.4
Diameter: 11 seconds
Distance: 76 million miles

Over the next four months, observe Mars using binoculars on every clear night, then plot its changing position among the background stars.

Mars nears M44, the Beehive star cluster, in central Cancer in early December. It reaches its closest point to it on December 7, after which it enters retrograde motion, inching westward each evening until February 23, 2025. Mars then lies in central Gemini.

Mars will also be growing in angular size as Earth slowly overtakes it on January 16, 2025. (Actually, the two planets are closest on January 11. The discrepancy is due to Mars' elliptical orbit.) At this time, it shows it largest angular size – 15 arc seconds – until April 2031. By February 23, the Red Planet ceases moving westward nightly, shifting its direction eastward (called prograde motion).

Retrograde Motion of Mars



2: Dec. 7
3: Jan. 16
4: Feb. 23

Mars at its brightest, largest & closest:
Jan. 11, 2025
-1.4 mag., 15 arc seconds, 59.8 million miles
It won't come any closer until Apr 11, 2031.

Why do this activity? This planetary dance can only be explained if both Earth and Mars orbit our sun following definable elliptical paths. Our view from Earth clearly shows this to those people who take the time to look carefully enough.

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November 21 LAS Meeting Notes by Vern Raben

I. Introduction

The November LAS monthly meeting was held in-person and by zoom on November 21st at the Longmont Lutheran Church, 803 Third Ave. President Vern Raben began the meeting with self-introduction of members attending in person. Twenty-four members attended in person, 14 attended on-line.

II. Main Presentation

Our guest speaker this evening is Dr. Thomas (Tom) Berger. Tom is the director of the University of Colorado Boulder Space Weather Technology, Research, and Education Center (SWx TREC). Prior to this position, he was the director of NOAA's Space Weather Prediction Center (SWPC) in Boulder. Tom recently became the Principal Investigator of the NASA Space Weather Operational Readiness Development (SWORD) center of excellence, working with the Universities of Michigan, Iowa, Alaska, and NCAR/High Altitude Observatory to advance predictive models of the geospace environment during space weather storms. Tom's original research was in solar physics as a member of the Lockheed Martin Solar and Astrophysics Lab in Palo Alto following his Ph.D. from Stanford University. He is originally from the Bay Area of California and has an undergraduate degree in Engineering Physics from the University of California Berkeley.

Tom's presentation takes us through the history of space weather and how we got to the point where we have a real time forecasting office here in Boulder operating 24/7 monitoring the space weather. It really is an interesting scientific detective story that spans the gamut of how we went from complete ignorance to where we are today monitoring in real time for technological impact of the space environment.

While the term "space weather" is relatively new to the scientific vocabulary, attempts to understand associated phenomena such as the aurora go back centuries and as recently as the mid-20th century there were still significant gaps in our understanding of how the Sun causes phenomena at Earth such as geomagnetic storms. In this talk, Tom reviews the history of our understanding of how the Sun and the Earth interact to create space weather, the many phenomena associated with space weather and their impacts on critical technological infrastructure, and what we need to do to increase our understanding of, and ability to mitigate, space weather impacts as we venture back to the Moon and eventually to Mars and beyond

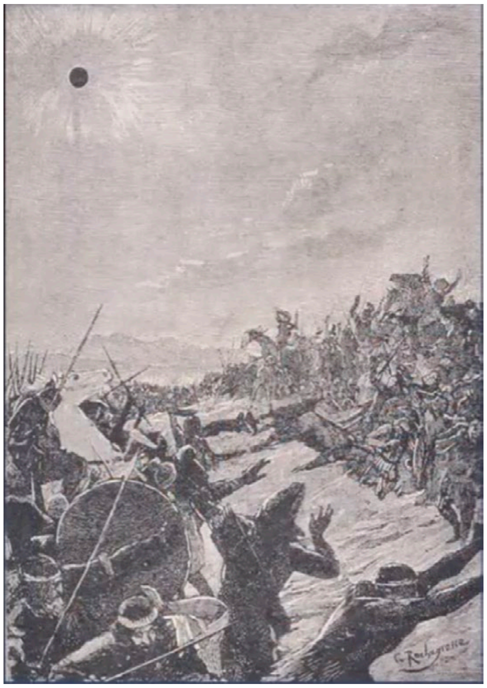
Space Weather: The History, Status, And Future Prospects For Understanding And Predicting The Space Environment
By Dr. Thomas Berger

Part 1: Space weather history – starts with the Aurora and Eclipses

This talk is about history of space weather. It is a very interesting journey of how we went from complete ignorance to the current real-time monitoring of the technological impacts of the space environment.

Earliest known record of aurora is around 957 BC when a 5-colored light appeared in the northern night sky corresponding to end of a Chinese emperor's reign (King Zhao in the Zhao dynasty). Throughout history there have been mentions of aurora. For example this engraving from the 1580s in Germany. Back then people were terrified of it. In the engraving people are shown cow towing to it. It was a very terrifying thing when the sky turned bright red. They had no idea what an aurora was.

Total solar eclipses also amazed and frightened people.



Battle of Halys River halted by eclipse of May 28, 585 BC

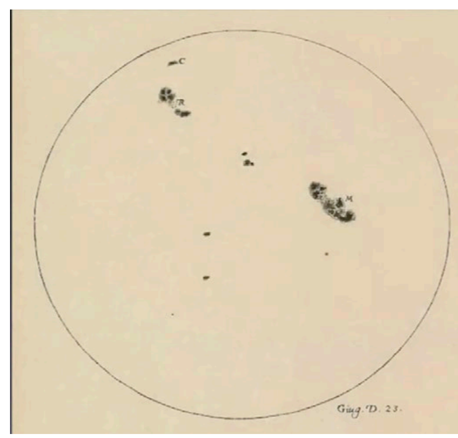
Solar Eclipse in Peru described by Juan Ponce de Leon as engraved by Picard Leonard

In 585 BC there was a famous battle in Turkey that was halted as they believed the gods had become angry because of the fighting. In the 1500s in Peru the engraving shows people whipping the dogs, playing drums and behaving crazy. They had no idea of what was going on or that the events were connected.

Galileo Galilea

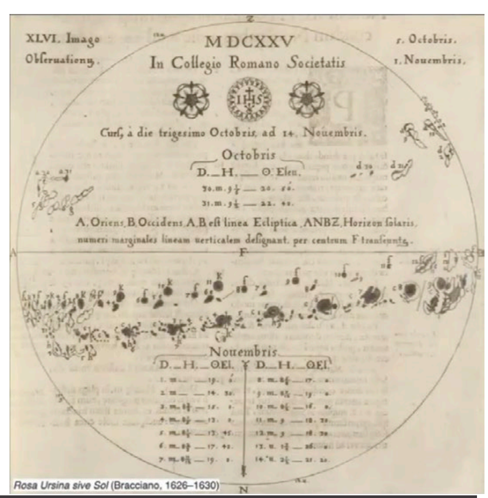
The modern science revolution begins in the renaissance with Galileo who builds himself a telescope in 1610.

He figured out how to project images of the Sun. He discovered the things that we now call sunspots which was a miracle at the time; they thought the Sun was a perfect orb.



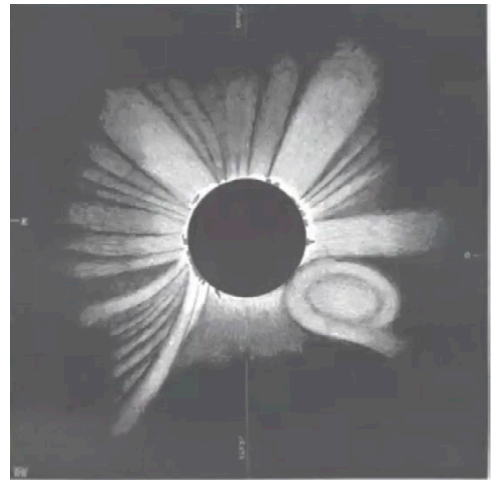
Christopher Scheiner

In Germany Christopher Scheiner, a Jesuit priest, astronomer, and physicist observed the Sun and concluded that the Sun rotates with a ~27 day period.



Throughout the 1700s and 1800s the scientific revolution was in full swing. The only way that phenomena could be recorded was with drawings.

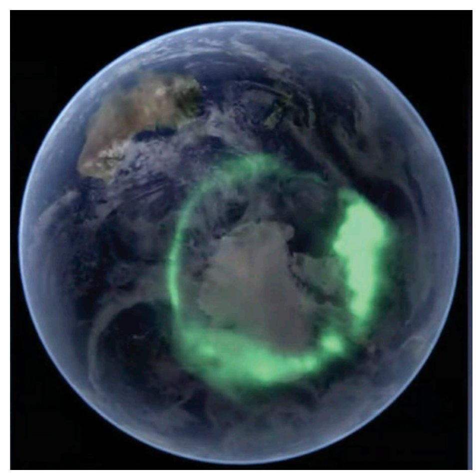
In 1736 Pierre Maupertuis led an expedition to Lapland (northern Sweden or Finland) to measure the size of the Earth using sticks. The artist recording the expedition included the aurora in the background.



Drawing of solar eclipse from July 18 eclipse from Torreblanco, Spain.

Vince Ledvina, University of Alaska, Fairbanks

Now with the digital photography we have incredible photos of aurora and lunar eclipses.



NASA Image mission

Image of the southern polar aurora from space.

We now know that there are aurora on other planets such as this image from the Hubble Space Telescope.

In the 1740s Anders Celsius correlates aurora with compass variations

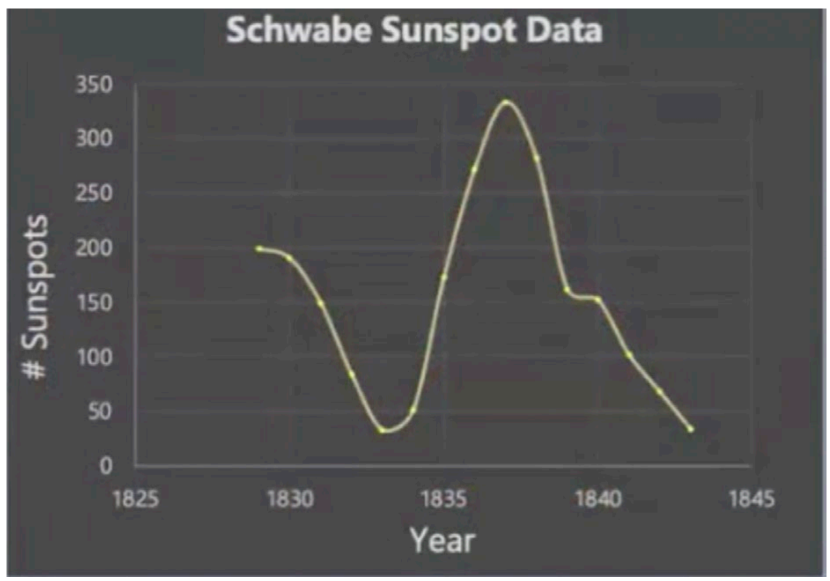
Anders Celsius

Anders who is most famous for his temperature scale noticed and published that compass variations were correlated with aurora observations.

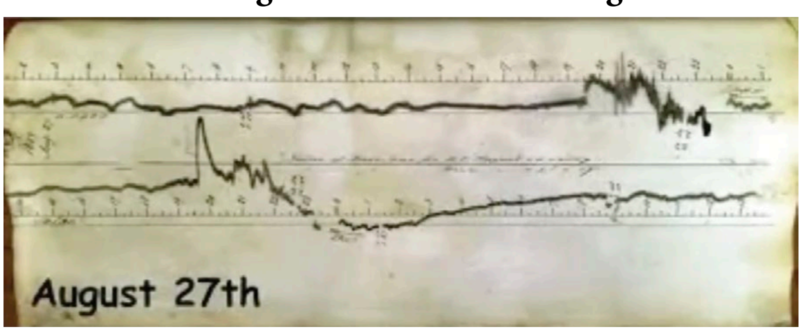
In 1843: the "Sunspot Cycle is established.

Heinrich Schwabe

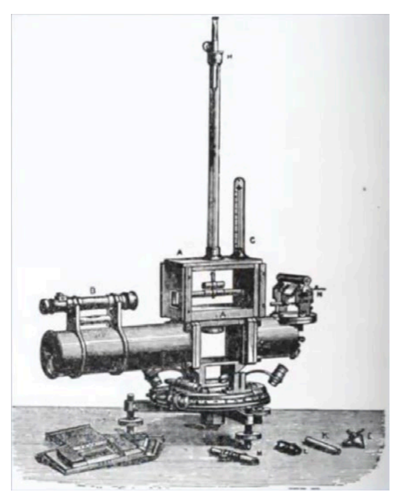
In 1843 Heinrich Schwabe from Germany established that not only did the Sun have spots and was rotating but the number of spots was also waxing and waning. This was a gutsy publication given that he had only one cycle of data.



In the 1850s "Magnetic Storms" are cataloged at Kew Observatory



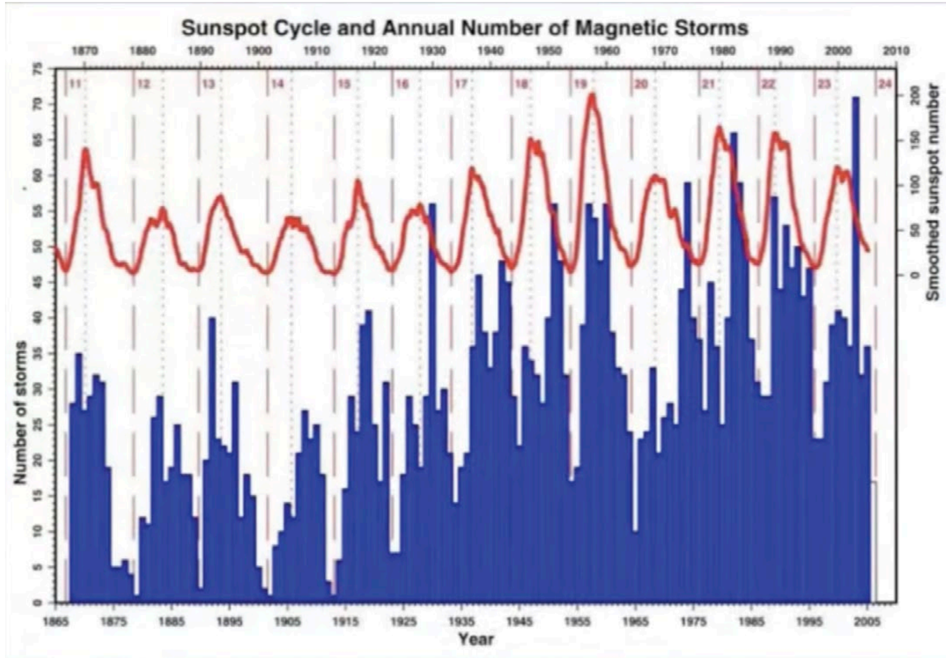
Kew Observatory, London 1859



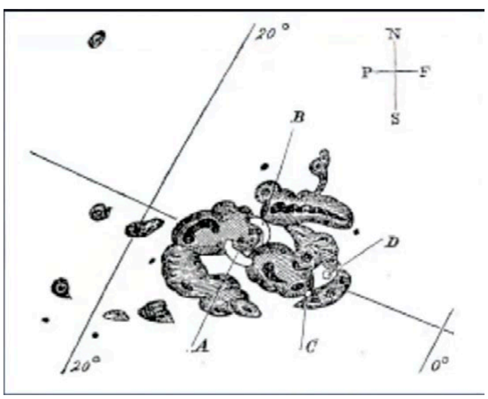
In the 1850s they started to measure the magnetic field of the Earth. The instrumentation was becoming extremely sophisticated. The plot above from the Kew Observatory in London shows the horizontal and vertical variation of the Earth's magnetic field.

In 1852 Edward Sabine of Kew Observatory shows that magnetic storms are correlated with sunspots.

Edward Sabine

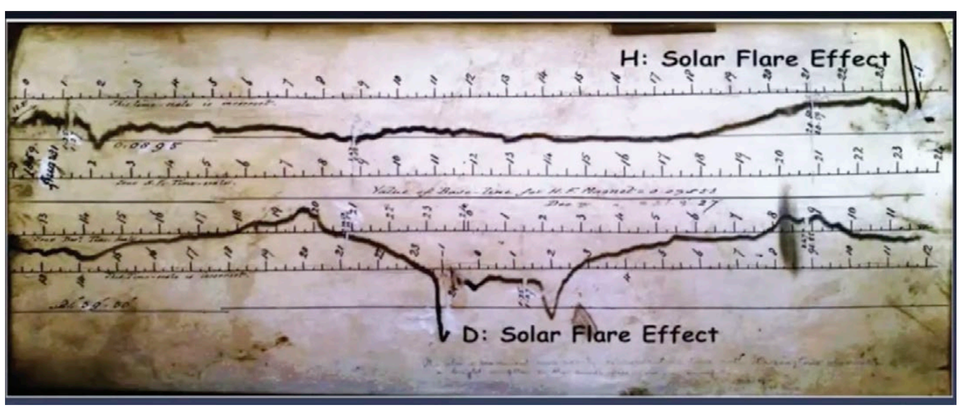


At the time there was no known physical explanation to explain a magnetic storm on Earth originating at the Sun. But then on September 1st, 1859 an astronomer and brew master named Richard Carrington was doing his daily sunspot drawings at his observatory in Red Hills Surrey England. He noticed a very large, complex sunspot and there were three very bright flashes coming out of the sunspot; flashes in sunspots had not been observed before.

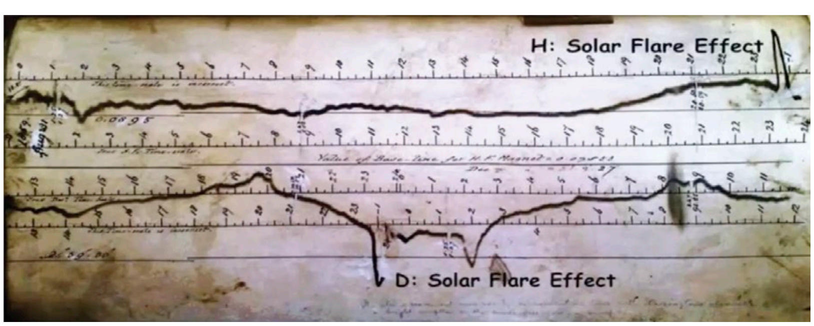


Richard Hodgson's Sketch Sept 1, 1859

Richard Hodgson in England also observed the flashes confirming the observation. (If you would like to learn more about Richard Carrington and solar astronomy in the 1800s the book, "The Sun Kings" by Stuart Clark is highly recommended). When they checked the records at the Kew Observatory they noted that 8 minutes after the observation of the flashes there was a large bump in the Earth's magnetic field.

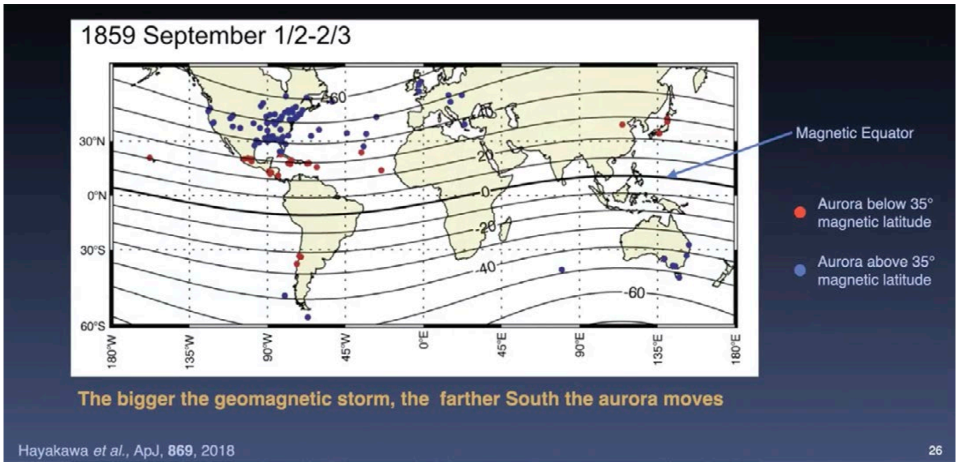


Kew Observatory Sept 1, 1859



Kew Observatory Sept 2, 1859

And then approximately 17.5 hours later a HUGE magnetic storm commenced -- the largest to this day that has ever been recorded. The magnetometer went off the charts and continued all day. The storm was recorded by magnetometer all over the world.



This was followed by auroral displays seen as far south as Honolulu and El Salvador. We now know that the bigger the magnetic storm the farther south it comes. Back then they did not know that there was a connection between what happened on the Sun and the aurora they were seeing.

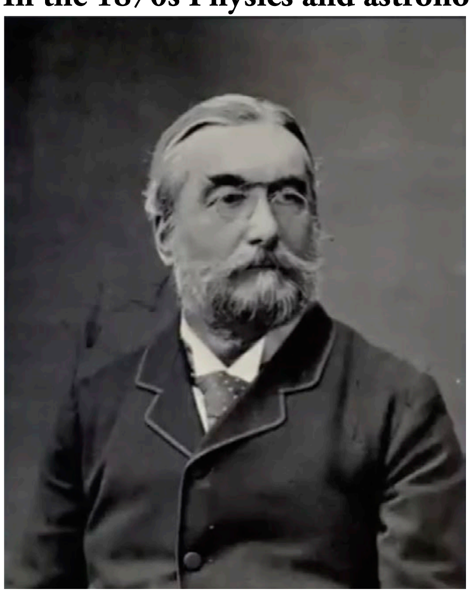
On Sept 2, 1859 in San Salvador "The red light was so vivid that the roofs and leaves of the trees appeared as if covered in blood". Newspapers in Denver reports of people being awoken with the sky so bright they could read newspapers by the red light from the aurora.

In 1861 Balfour Stewart proposes a link between Carrington's observation and the geomagnetic storm.

Balfour Stewart

In 1861Balfour Stewart, a British geophysicist noted that "..it would, perhaps, be wrong to consider this in any other light than a casual coincidence; but since general Sabine has proved that a relation subsists between magnetic disturbances and sunspots, it is not impossible to suppose that in this case our luminary was taken in the act." Everyone including George Airy, the Astronomer Royal, disputed this. The debate was squashed as at that time when the Astronomer Royal said you were wrong you better sit down. During the 1860s auroras were taught as apart of meteorology. It was regarded as a weather phenomena and not caused by the Sun and occurring in space.

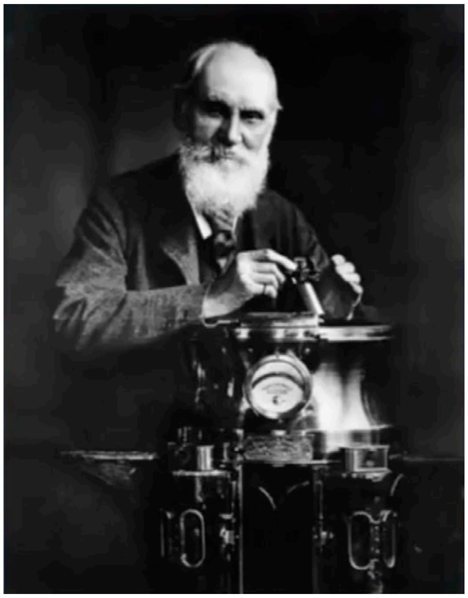
In the 1870s Physics and astronomy merge as disciplines to study eclipses.



J. Norman Lockyer

In the 1870s physics started to be combined with astronomy. Lockyer used spectroscopy for the first time. He used a spectrograph attached to the end of a telescope to look at the Sun during eclipses. He along with Pierre Jannsen in France found a strange spectral line that they had not seen before on Earth. He went out on a limb and said that it was an element on the Sun and named it "Helium". He became known as the first astronomical physicist.

In 1892 Lord Kelvin uses math ... and really bad physics to prove the Sun can't cause magnetic storms

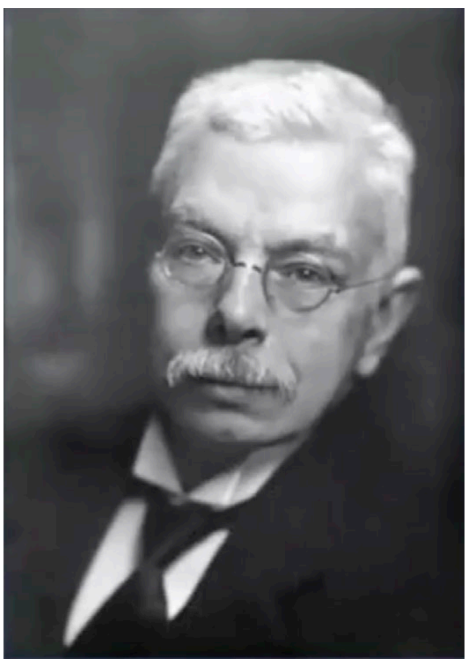


- Calculate the energy in a terrestrial magnetic storm.
- Assume that the Sun is the source of that magnetic energy.
- Assume the Sun emits this energy isotropically through all space.
- Then the energy output of the Sun in several hours = its normal output in 4 months!
- Therefore: the Sun cannot cause magnetic storms at Earth.

Royal Society Presidential Address, Nature, 47, 1892

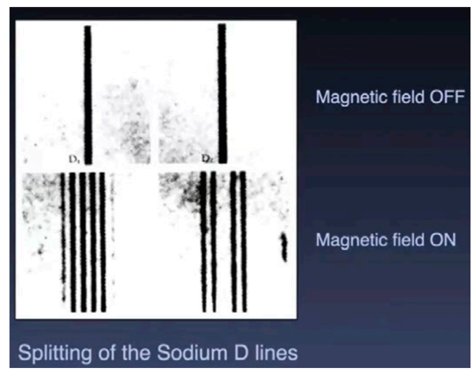
This put the kabosh on Sun-Earth connection research for years. Lord Kelvin is also known for his pronouncement that "heavier-than-air flying machines are impossible" -- this was 16 years before the Wright brothers first flight. So the best physicist in the world can be very wrong. This is a good lesson for us today as well.

In 1896 Zeeman discovers spectral line splitting in the presence of magnetic

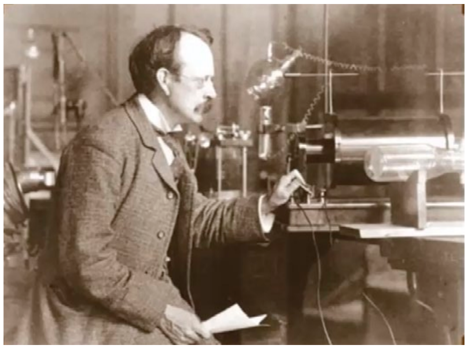


Pieter Zeeman

Pieter Zeeman in Holand was first to look at spectral lines in a magnetic field. The lines would split when there was a magnetic field between you and the source of the light.



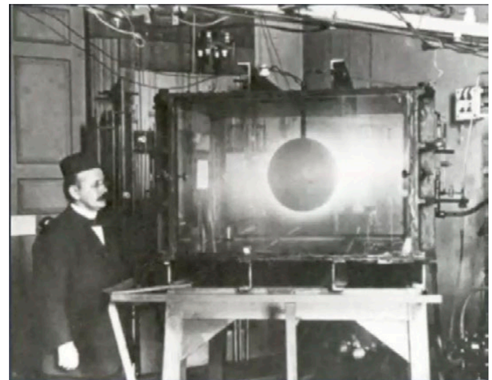
In 1897 Thomson discovers the "electron"



J. J. Thomson

British physicist JJ Thompson was first to show that something could transmit electron current through a vacuum. 22:26

In 1900 Kristian Birkeland from Norway proposes that electrons from the Sun cause the Aurora (22:16)

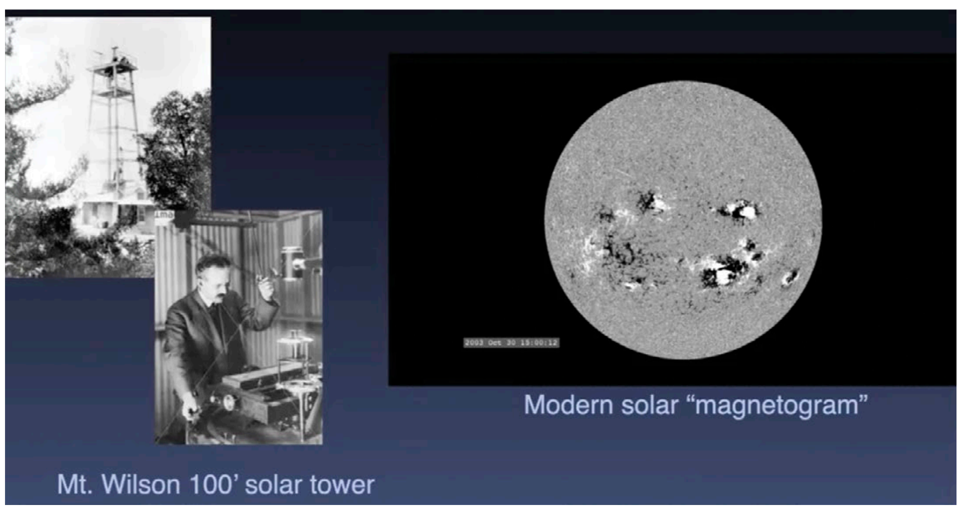


Birkeland's Terrella experiments
“Aurora in the lab”

Kristian Birkeland was a scientist who studied aurora his entire life. After heard of Thomson's discovery of the electron he decided to shoot electrons at a simulated magnet of the Earth and low and behold the electrons were attracted to poles of the globe and produced aurora like emissions. This led to his statement that aurora was caused by electrons from the Sun. To learn more about Kristian Birkeland's fascinating life and research the book : “The Northern Lights” by Lucy Jago is highly recommended. His work in plasma physics may have saved humanity. His invention of the fixation of nitrogen from an electric arc in the air was the first time nitrogen was produced artificially. Prior to that the source of nitrogen was from iguano caves and the world was running out of it.

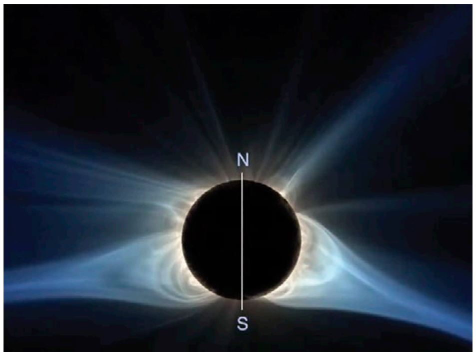
In 1906 Hale invents the spectroheliograph and measures the Zeeman effect in sunspots: the Sun is magnetic!

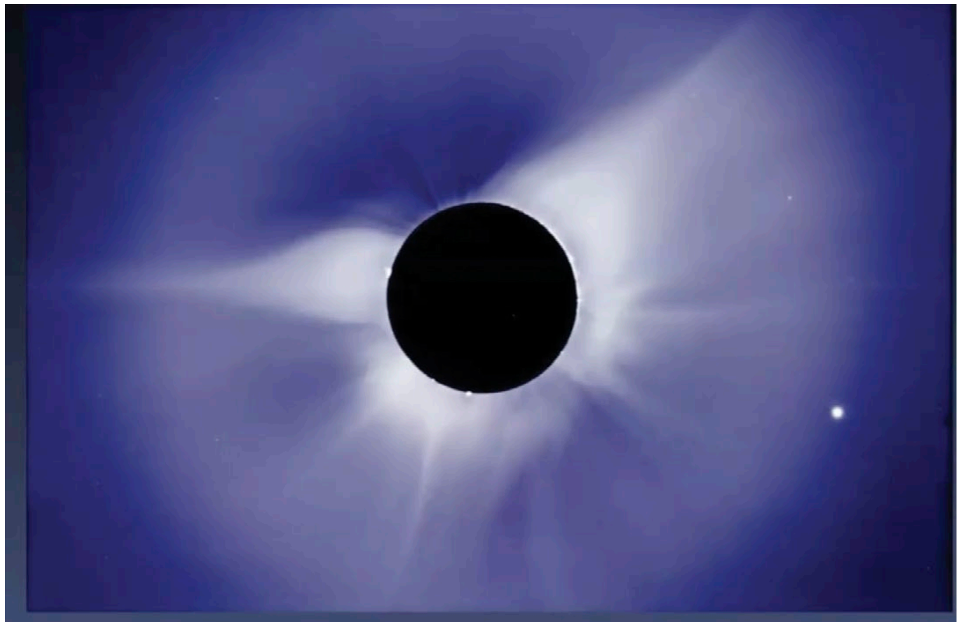
George Ellery Hale



Around 1908 George Ellery Hale received private donations to build a giant 100 foot solar tower near Los Angeles. On it he installed a solar spectrograph to look at the Sun's emission and discovered the Zeweman effect in the emission lines coming out of the photosphere. The Sun was indeed a magnetic star. On the right in the images above is a modern magneto-gram which shows the magnetic field of the Sun using the Zeeman effect. You may still go to Mount Wilson and see the tower he built as well as the 200 foot solar tower.

In the 1920s the solar "corona" is studied during eclipses and shown to have a temperature of 1 million K, i.e. it is a plasma and the structure seen in the "corona" during eclipses is due to large-scale bipolar magnetic field



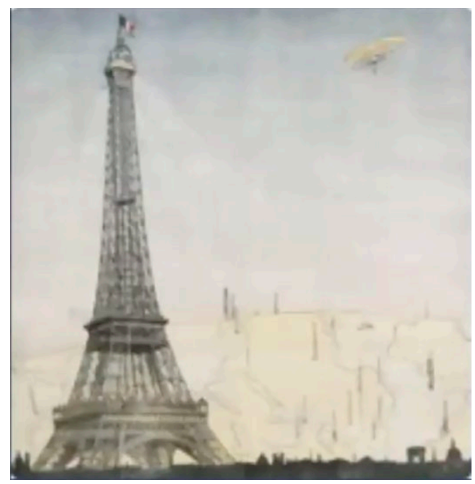


HAO Eclipse Expedition: 12 November 1966 at Pulacayo, Bolivia (altitude 13,000 ft).

In the 1920s the Sun, its sunspots and occasional "flares" impacts the new technology of transoceanic radio invented by Marconi

Guglielmo Marconi

In the 20s Marconi was sending radio signals back and forth to the United States from the Eiffel Tower. They noticed that solar activity was interfering with the radio signal. They started monitoring the Sun from the Eiffel Tower to determine if radio conditions were favorable or not. Perhaps this was the first "space weather" report?



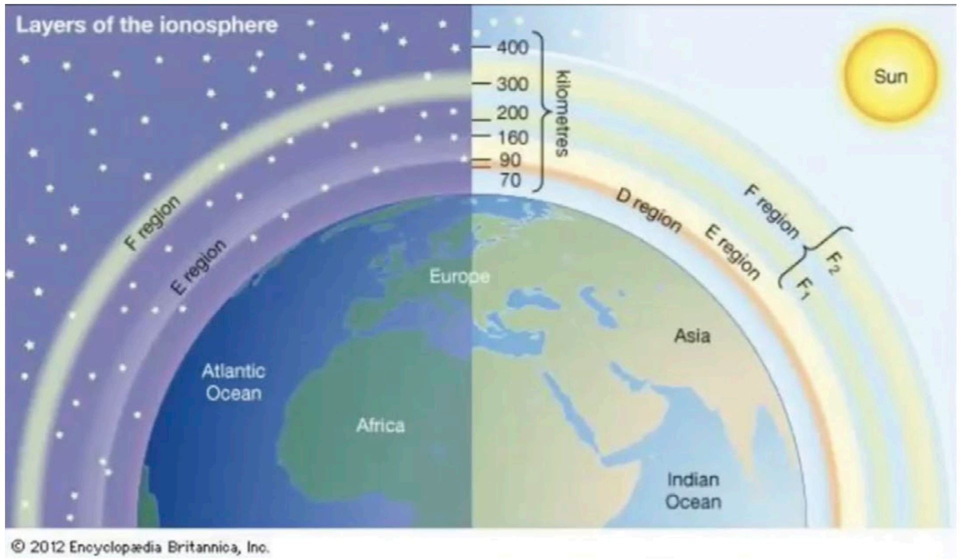
First "atmospheric monitoring" antenna installed on the Eiffel Tower. The first "space weather report?"

In 1921: Another Carrington Event?

There was probably another Carrington level event. There were lots of electrical disturbances. There was a fire in the Long Island train system due to ground currents from the geomagnetic storm. The aurora was seen as far south if not further than in the 1908 Carrington event. It was seen in the day in Sydney Australia. Afterwards there was a real need to understand and predict consequences of solar events.

In 1927 the "ionosphere" is discovered by Appleton

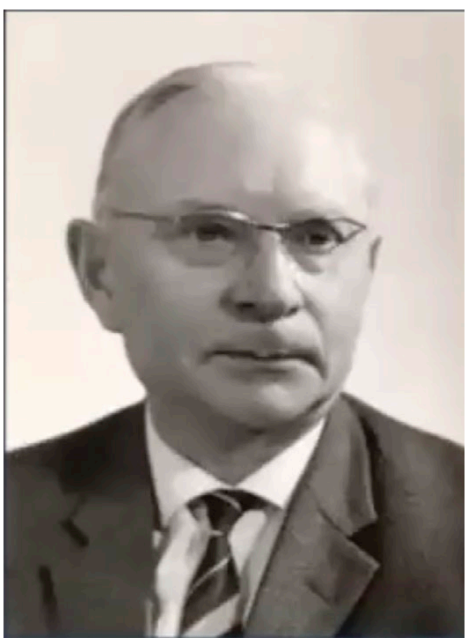
Edward Appleton



An electrically charged layer of the upper atmosphere that reflects radio waves to allow "Over the Horizon" communications

In 1927 Edward Appleton was the first to discover the "ionosphere", a charged layer of the upper atmosphere that allows radio waves to bounce across continents. He was awarded the Nobel prize in 1947 for this work. He was able to show it was solar ultraviolet light that was creating the ionosphere from the neutral atmosphere of the Earth.

In 1932 Bartels discovers 27-day periodicity in geomagnetic storms



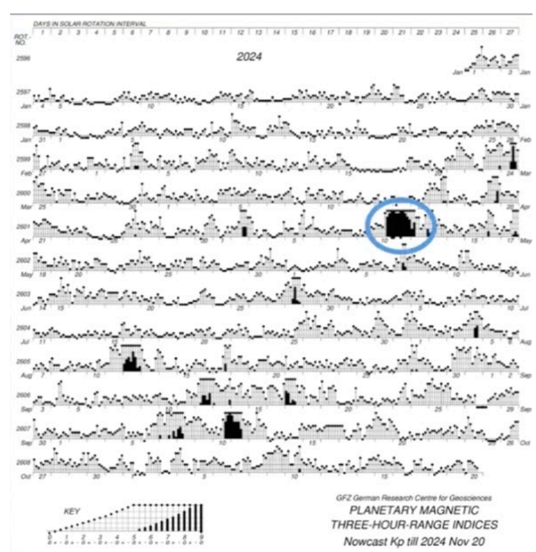
Julius Bartels

Julius Bartels a German geophysicist who also worked in America discovered, that there is a 27 day periodicity to geomagnetic storms. The number of storms was related not only are the number of storms correlated with sunspots but that the storm repeat cycle has something to do with the Sun's rotation. Sunspots were a key culprit but not the only one.

He was the first to "rediscover" the Carrington event and publish about it.

In 1939 Bartels defines the "Kp index" to quantify geomagnetic storms

He took a 3 hour average from geomagnetic stations around the world and scaled them 0 to 9 in thirds (1-, 1o, 1+,.... 9-, 9o, 9+) and plotted them on a log 3 scale. When the average gets above 5 they call it a storm and color it dark.

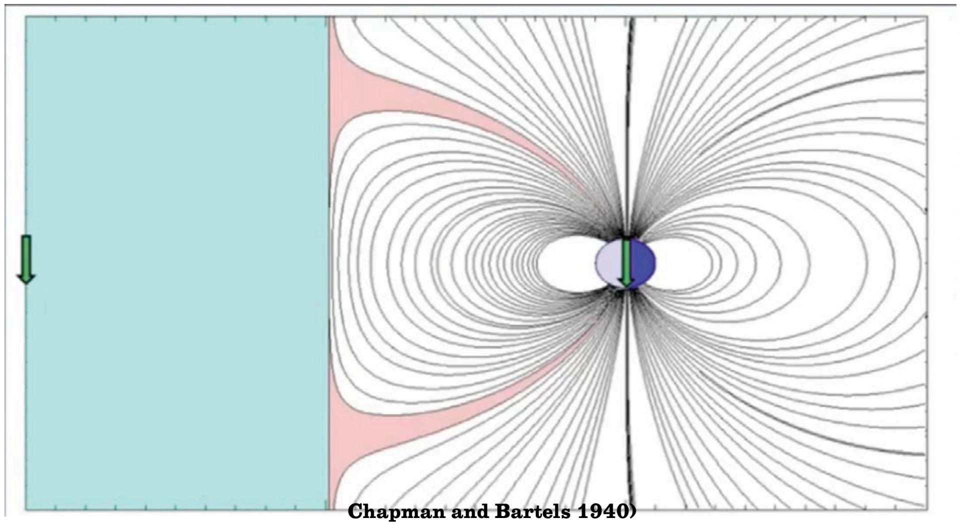


Bartel's Music

In 1940 Chapman and Bartels suggest coronal plasma ejected during a solar flare can impact and compress the Earth's magnetic field

Sydney Chapman

In 1940 Sydney Chapman who was a British geophysicist and mathematician got together with Bartels and said what if Sun pushed its magnetic plasma outward what would it do if hit the Earth's magnetic field? Just theory but maybe this what was causing magnetic storms.



Chapman and Bartels 1940)

In the 1940s Edlen, Grotrian. and Alfvén use spectroscopy to show the solar corona is 1,000,000° K

Hannes Alfvén

Finally in the 40s Hannes Alven settled the debate about the corona of the Sun and showed that the solar corona is a million degrees K. He won the Nobel prize for his study of magneto-hydrodynamic fluid.

WWII - Solar flares monitored for transatlantic radio transmission impacts

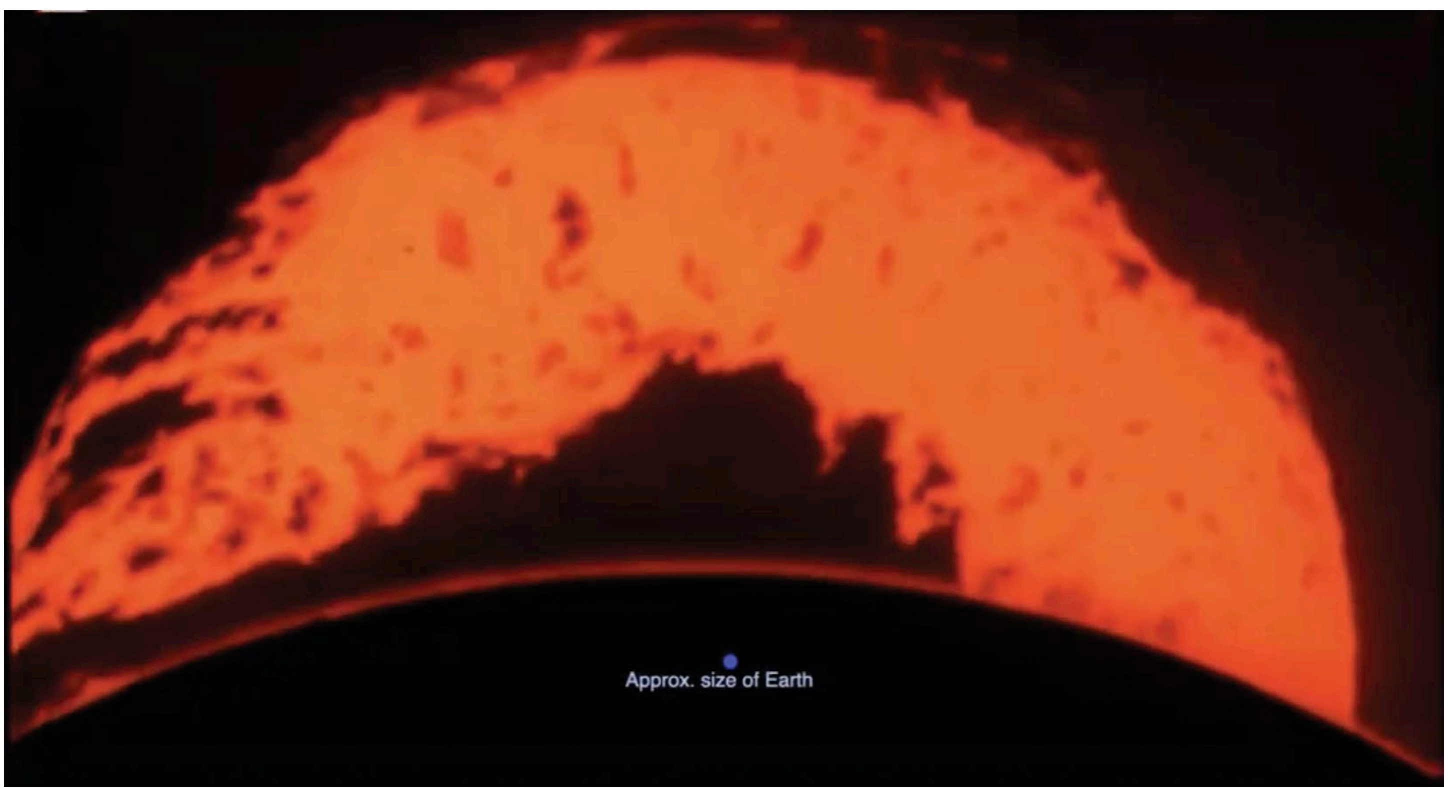
It was known that the Sun had million degree plasma, it rotated, geomagnetic activity waxed and waned so during World War II they realized that they needed to monitor the Sun because of the radio disturbances and effect on communications especially to Europe.

A young graduate student from Denver Colo. was attending Harvard University was assigned the job of monitoring the Sun with a solar telescope in Leadville, Colorado and to report on flares and other solar activity. This was the first use of a solar coronograph in the United States.

Walter Orr Roberts

Walter Orr Roberts was the founder of the National Center for Atmospheric Research, NCAR. He is shown above at the completion of the Mesa Lab west of Boulder, Colorado in 1967. The solar physics part of NCAR predated the weather research.

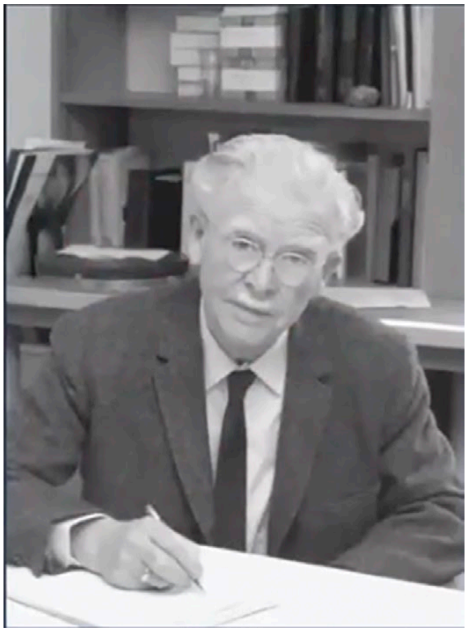
Above is Walter and Janet Roberts skiing in deep snow in Climax, Colorado. In the background is the cone-shaped dome of the solar coronagraph.



"Grandpa": the largest solar eruption ever recorded. Leadville, CO 1945

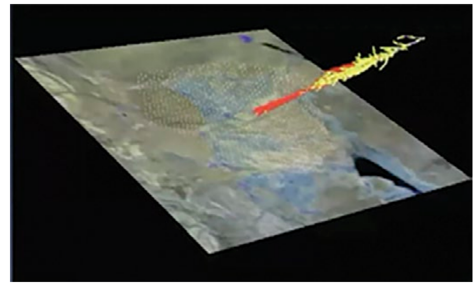
The image is from one of the movies Walter Roberts made in the 40s from Leadville, Colorado using the coronagraph

In 1946 Forbush reports “Solar Energetic Particles” detections in ground-level neutron measurements after large flares



Scott Forbush

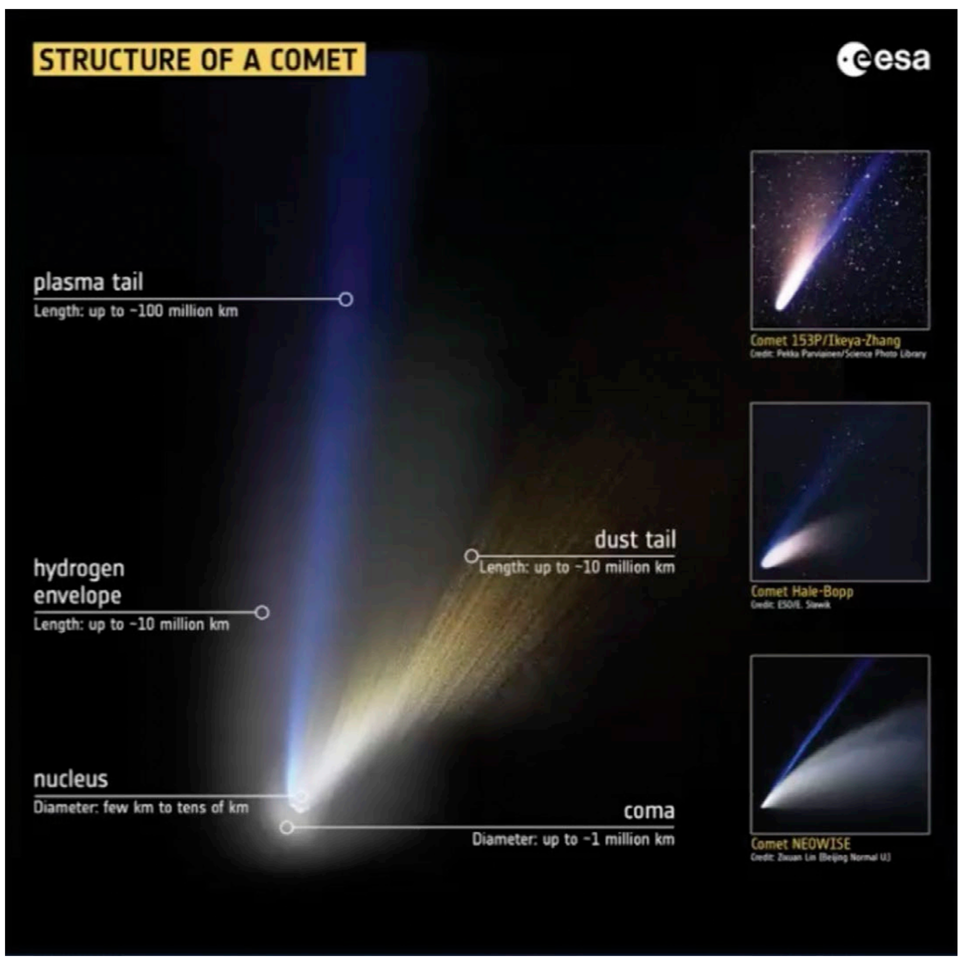
In 1946 Scott Forbush who was one of Bartel’s colleagues at the Department of Terrestrial Magnetism at Carnegie Institute was monitoring neutrons on the ground as consequence of atomic weapons testing. He noticed that occasionally there were large cosmic ray increases and correlated them with solar flares. The large cosmic ray increases were possibly due to the Sun was putting out charged particles.



Phys. Rev., Vol. 70, 771-772,

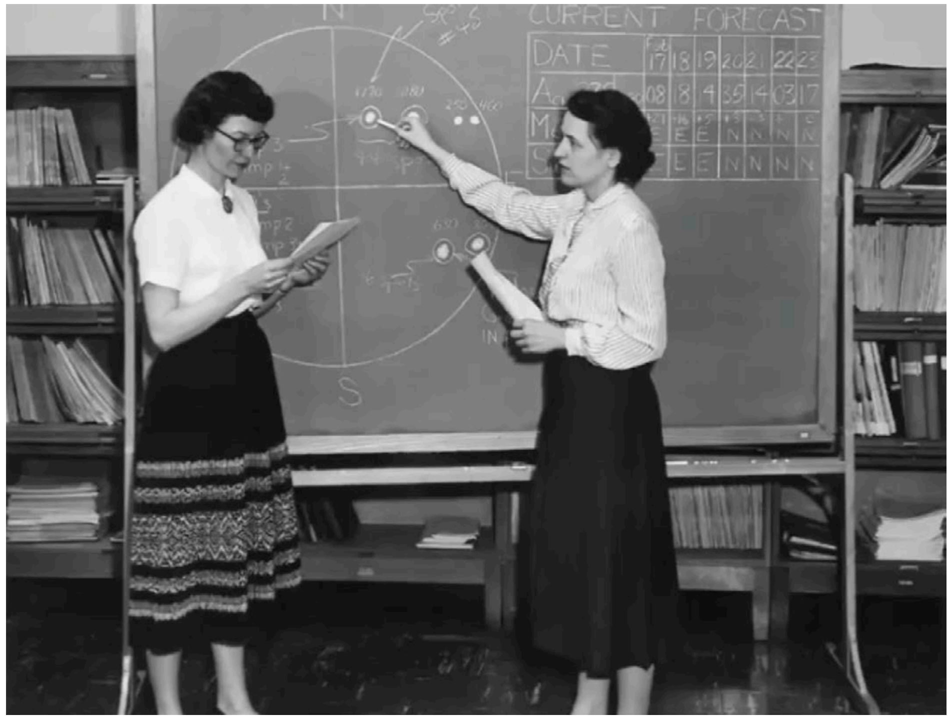
In 1947 Hans Biermann hypothesizes a “corpuscular wind” from the Sun due to comet observations

In 1947 Hans Bierman was doing comet observations and realized that the ion or plasma tail always pointed away from the Sun and speculated that something was pushing it away. He speculated as did Berkland that corpuscular radiation or electrons or something from the Sun was pushing the comet tail away.



In the 1950s Sunspots are Tracked for Radio Propagation Forecasting

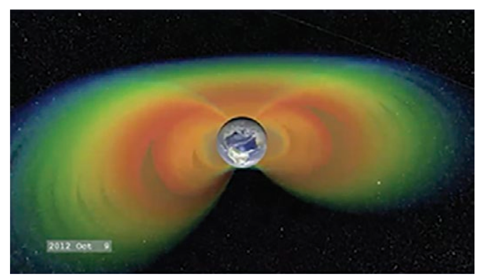
The first Inter-service Radio Propagation Laboratory was established at the National Bureau of Standards in Washington, D.C., They began constant monitoring of the Sun. They began numbering of sunspots, tracking flares. This was later named the Central Radio Propagation Laboratory and moved to Boulder, CO as part of the Bureau of Standards. (This was the ancestor of the current NOAA Space Weather Prediction Center).



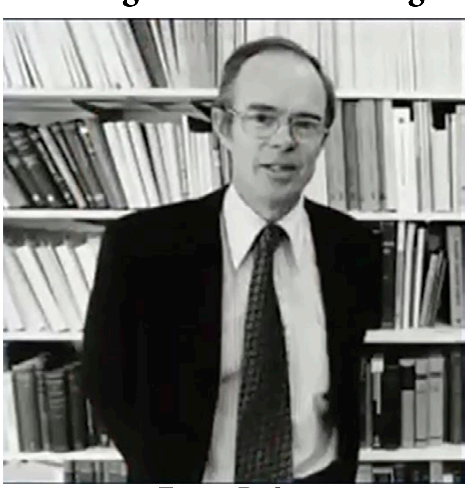
1958: Explorer I discovers the Van Allen Radiation Belts


James Van Allen

In 1958 James Van Allen and company put up the first satellite from the US and discovered what is now known as the Van Allen radiation belt as it now is known. The radiation belt was unknown and unexpected. We still do not know how the radiation belts are charged. The Van Allan Probes mission showed that they are quite dynamic and change in response to solar conditions.

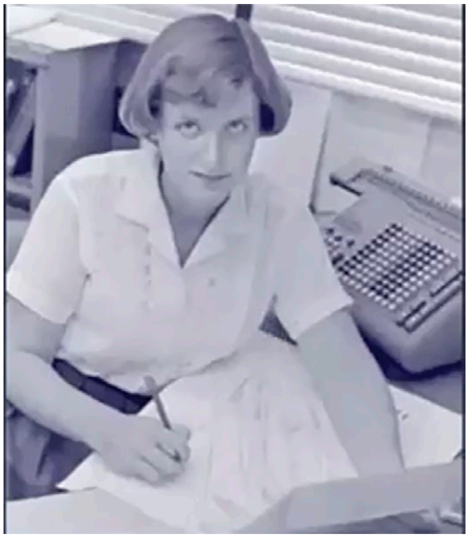


In 1958 Eugene Parker theorized a supersonic magnetized "Solar Wind" which is caused by the solar magnetic field funneling a million degree Kelvin coronal plasma


Eugene Parker

Also during 1958 an American astrophysicist, Eugene Parker theorized (from a suggestion by Bierman) that if you have a million degree K solar corona and a magnetic field that shapes it that you would get a supersonic outflow of the plasma gas. He was a graduate student at the University of Chicago and tried to publish this in the Astrophysical Journal and it was rejected by the reviewers three times. Finally the editor in chief over-rode the review and published it .. and as it turned out it was true.

In 1962: Neugebauer confirms solar wind in Mariner 1 data!*

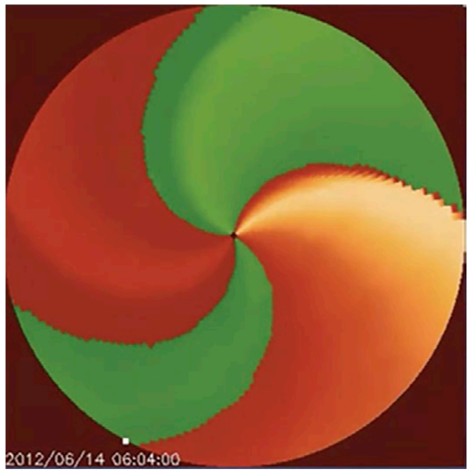


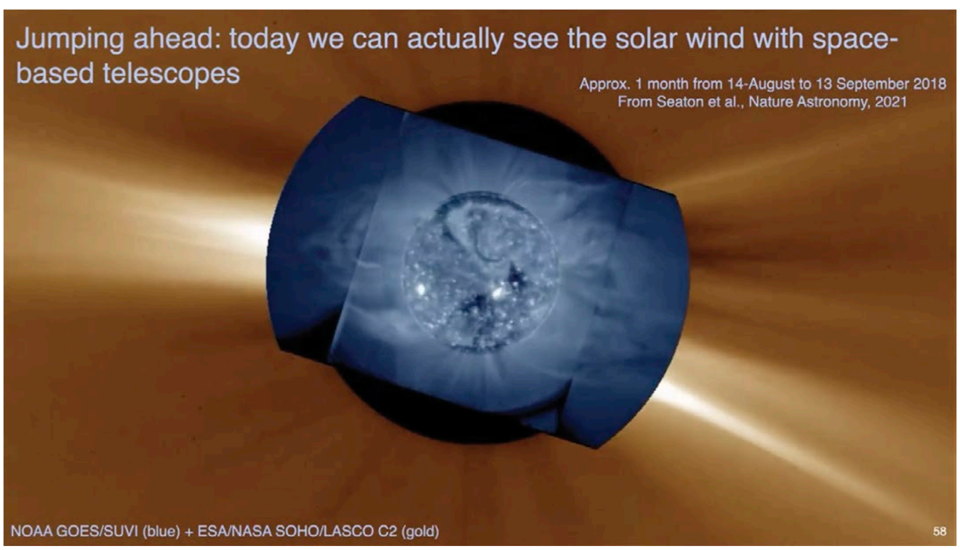
Marcia Neugebauer

In 1962 Marcia Neugebauer was looking at the Mariner mission to Venus and noticed that there was a flow of plasma data of 400 to 700 km/sec from the direction of the Sun. Parker was proven right.

Mariner II Spacecraft

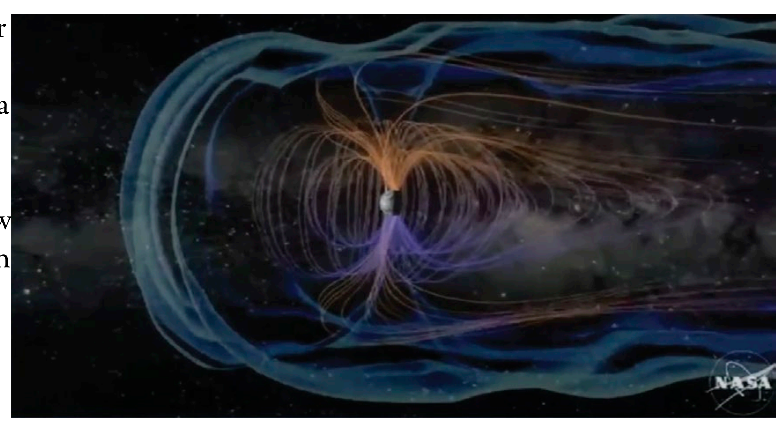
We now know the solar wind caries alternating positive and negative magnetic polarity radially outward and because the Sun rotated, the "garden sprinkler" effect creates the "Parker Spiral" of magnetic fluid.

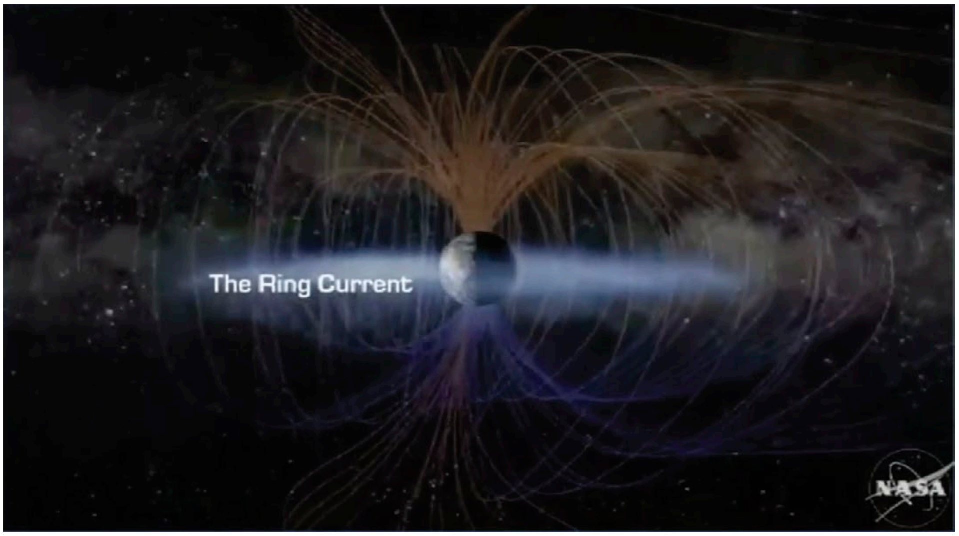




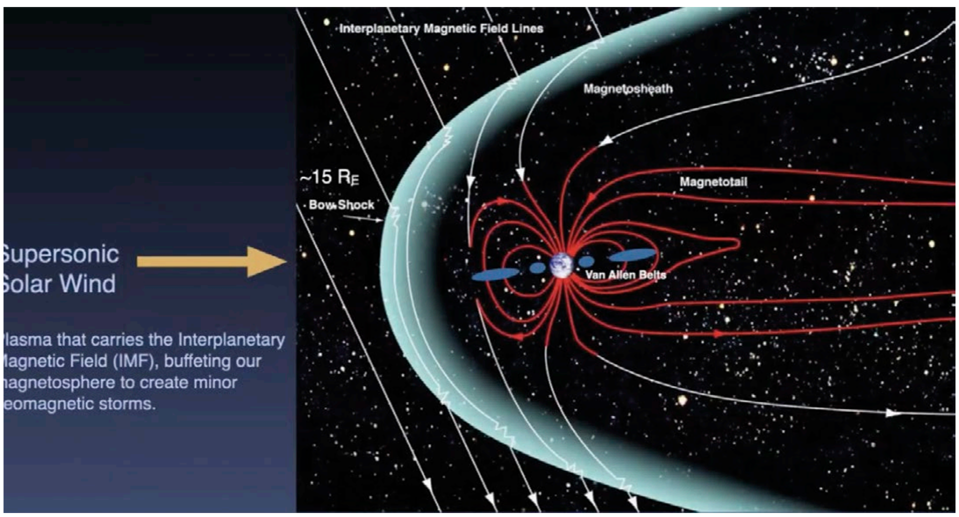
Today using space based telescopes such as NOAA GOES/SUV1 and the SOHO C2 imagery we can actually see the solar wind streaming from the surface of the Sun outward.

In the 1950s it was understood that the supersonic solar wind interacts with the Earth's magnetic field and causing it to vary. The solar wind is not constant, the plasma interaction is changing, the dynamic pressure varies, and mechanism of magnetic storm was becoming clearer. Because it is supersonic it is going to form a bow shock and pull the magnetic field of the Earth back with the solar wind so you get what is called magneto-pause and a magnetic tail in the back.





We have a plasma-sphere from some of the solar wind getting trapped in the magnetic field. The ring current is charged particles that are trapped in the magnetic field. The Van Allen radiation belts are now considered to be particles from both the solar wind and locally generated by dynamics of the magnetic field itself.



This is why we call the magnetosphere of the Earth. It is the magnetic field of the Earth in the space shaped by the solar wind.

The supersonic solar wind causes a bow shock has a "tad-pole" shape of the magnetic field of the Earth as a result.

We still didn't understand the giant solar storms and how they relate the aurora was still unknown as late as the 60s.

On Dec 1, 1965 was the first daily report and forecast of solar conditions from the "Space Disturbances Forecast Center" in Boulder, Colorado.

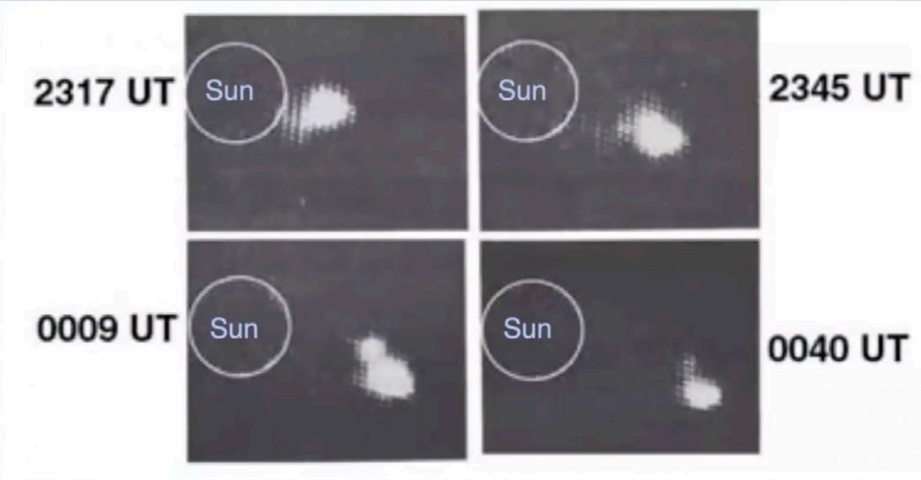
The forecasts were issued in support of the Gemini mission in 1965. Summing up by the mid 1960s we knew the Sun was a magnetic star. Every 11 years sunspots and magnetic field peak and then they wane. During solar max there were more sunspots and magnetic storms.

We understood that the Sun's corona is over 1,000,000 K in temperature and flows into space as a magnetized plasma called the "solar wind". We understood that Earth's magnetic field interacted with the solar wind to form the "magnetosphere" - a dynamic magnetic cocoon that contains the Van Allen Radiation belts.

We knew that sunspots were strongly magnetic, occasionally they "Flare" and perturbed the ionosphere to interfere with transatlantic radio transmissions. Major flares were definitely correlated with large flares but usually only occurred after a 24-48 hours delay. That was not understood then, what was it that was propagating?

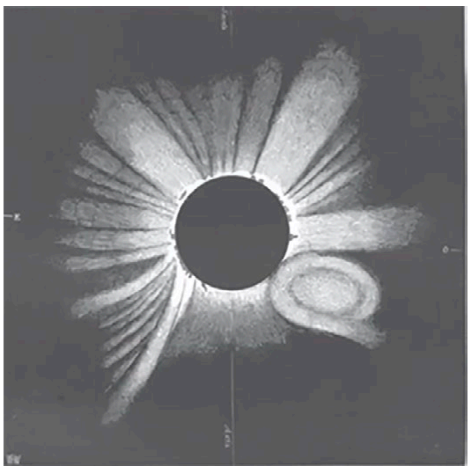
Geomagnetic storms sometimes recur with 27 day regularity due to solar wind patterns repeating with solar rotation -- but what causes the solar wind patterns to repeat. It was not sunspots.

In 1969 radio observations of the Sun indicated some kind of plasma expulsion



A radio observation of the sun indicated a big plasma blob of some kind coming off.

In 1971 the orbiting solar observatory had the mission to study with a solar coronagraph. It showed that there was something coming off as blobs of the corona were observed. Eventually they were named coronal mass ejections. It was clear that pieces of the corona were being ejected.

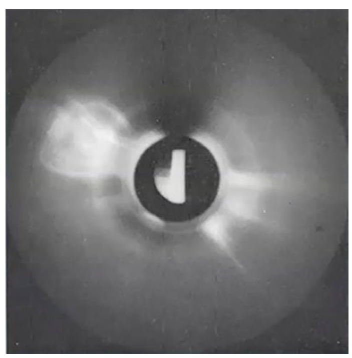


G. Tempel, 18 July 1860 eclipse, Torreblanco, Spain

Perhaps the first coronal mass ejection was observed at a solar eclipse on July 18, 1860 -- note the weird roll thing on the lower right of the disk. Perhaps there was a CME at the same time as the solar eclipse.

In 1973 Skylab confirms CMEs

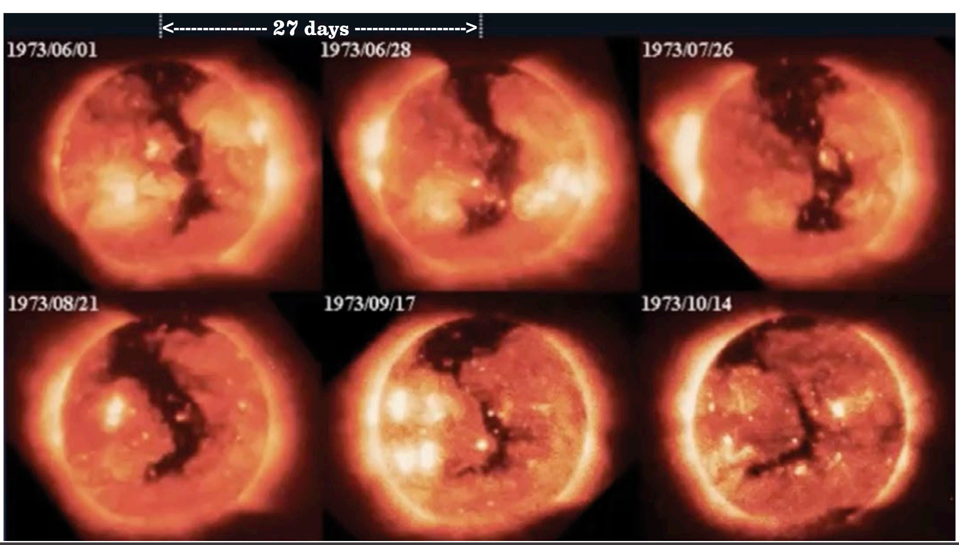
In 1973 we launched Skylab and it included a solar coronograph built by NCAR in Boulder. It was able to confirm coronal mass ejections.



June 10, 1975

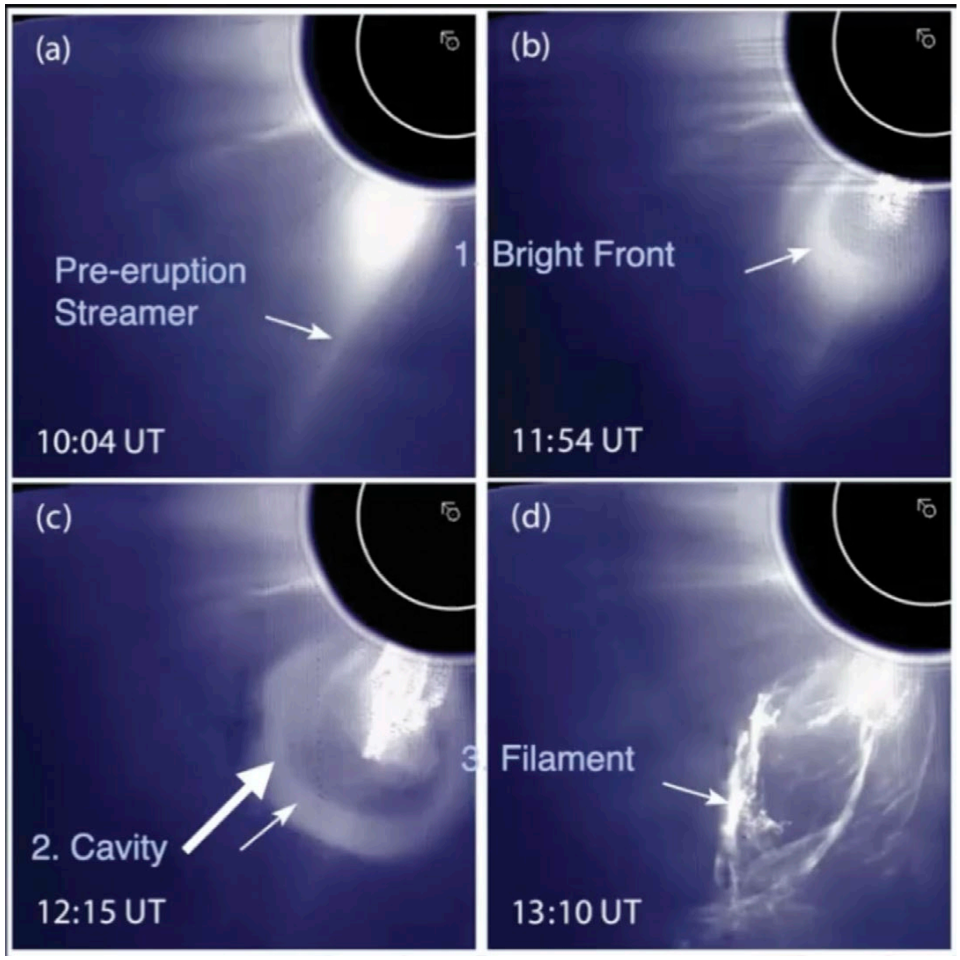
The X-Ray telescope discovered things called coronal holes -- big gaps in the corona that are dark and occur every 27 days.

Below is a coronal hole that is visible for 6 rotations and its visible the entire time.



In the 1980s the Solar Maximum Mission 48:00

The Solar Maximum Mission in 1980 had an HAO instrument looking at coronal mass ejections. It provided higher resolution images. We began to understand that they are 3 part structures: a pre-eruption streamer, a big bright front, and a cavity following that. Inside the cavity is a filament mass.

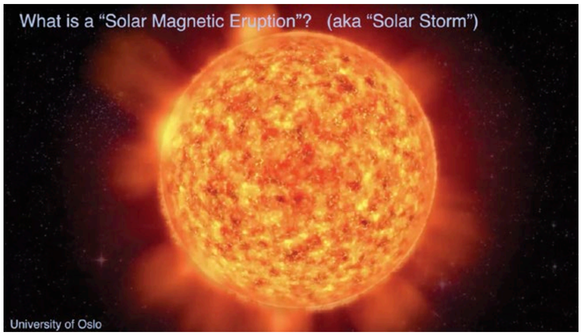


In 1993 Jack Gosling publishes "The Solar Flare Myth"

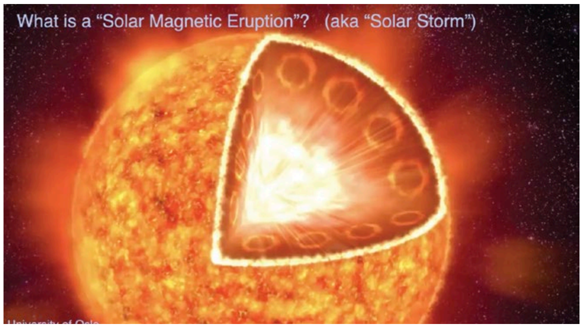
John "Jack" Gosling

In 1993 there was a famous paper published by John "Jack" Gosling at Los Alamos Nation Labs called the "The Solar Flare Myth". Up to that time it was believed that solar flares cause geomagnetic storms. We see the flare and a geomagnetic storm starts some hours later. Photons aren't magnetic so how do photons coming off the Sun cause a magnetic storm? Jack was the first to state that it was not the flare, it is the plasma that is coming off at the flare that is causing the geomagnetic storm. It was a controversial paper at the time but one of those that turns out to be correct.

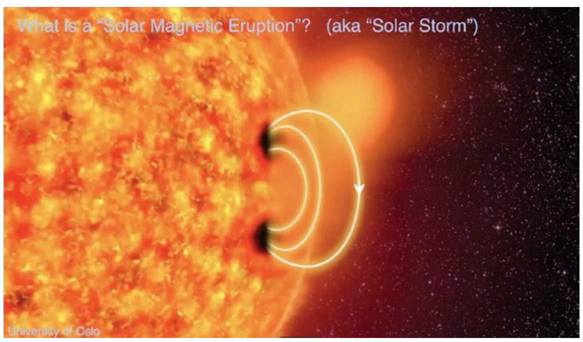
What is a “Solar Magnetic Eruption”? (aka “Solar Storm”)



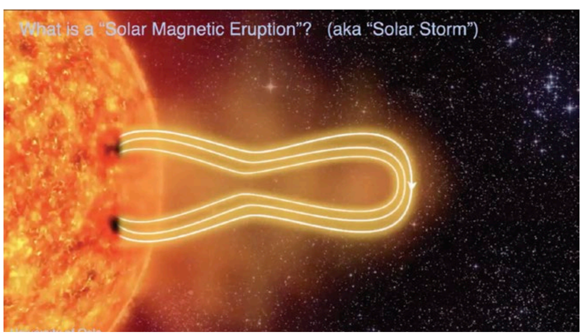
Dr. Berger showed an animation illustrating the structure of the Sun



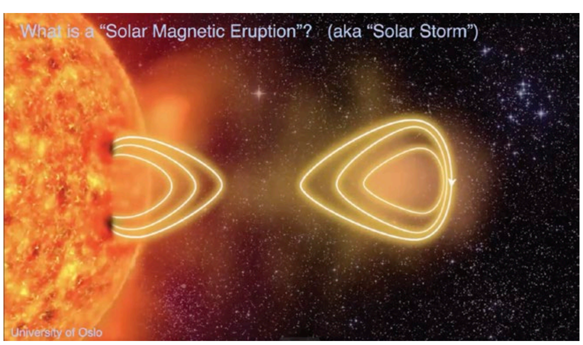
At the fusion core of the Sun causes convection of heat to the surface. You get large scale convection “rolls” which form magnetic fields.



When they come out on the surface in the form of sunspots. They are of opposite polarities so there are magnetic field lines between the sunspots.

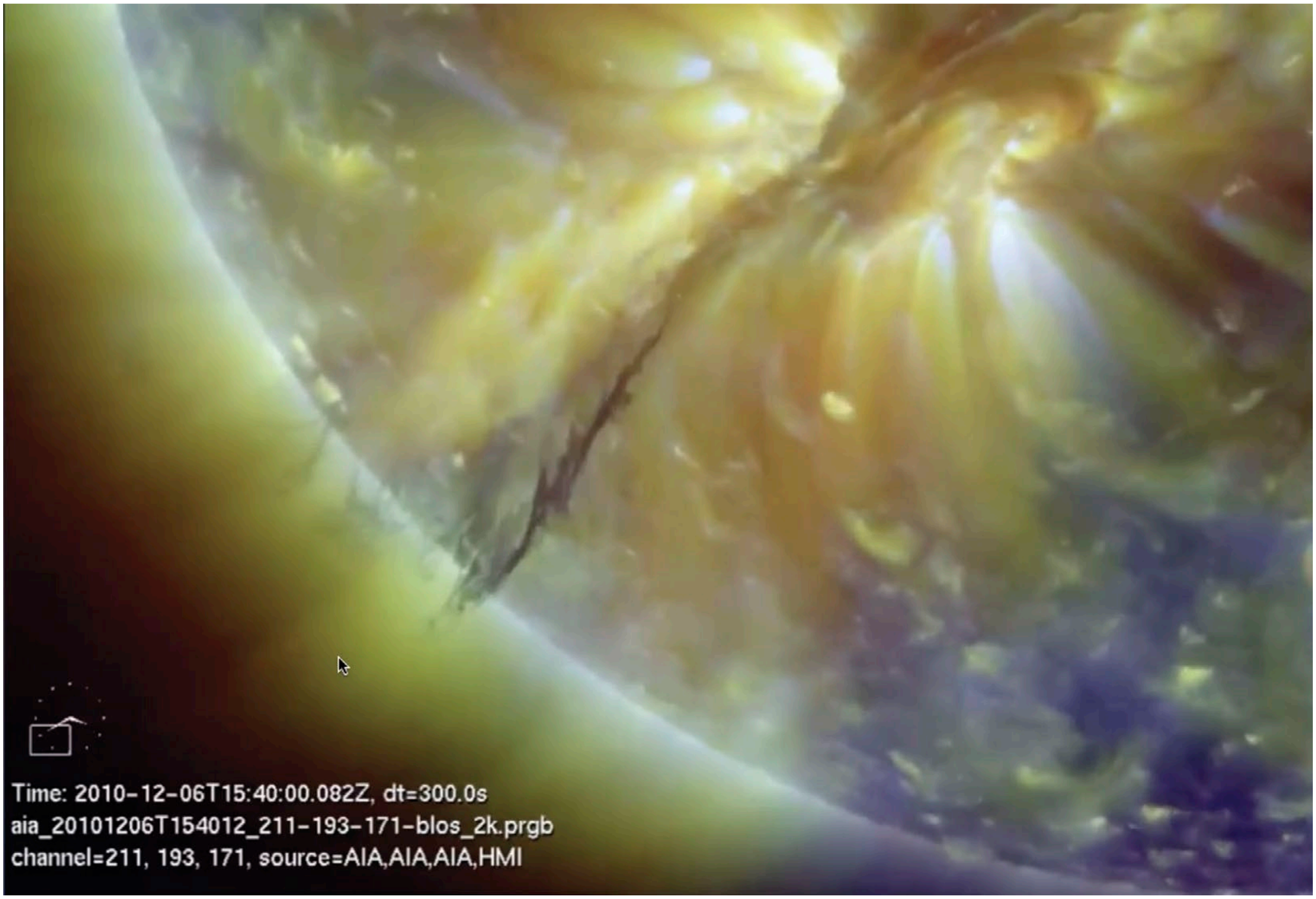


The convection can make the sunspots twist and the magnetic field lines twist



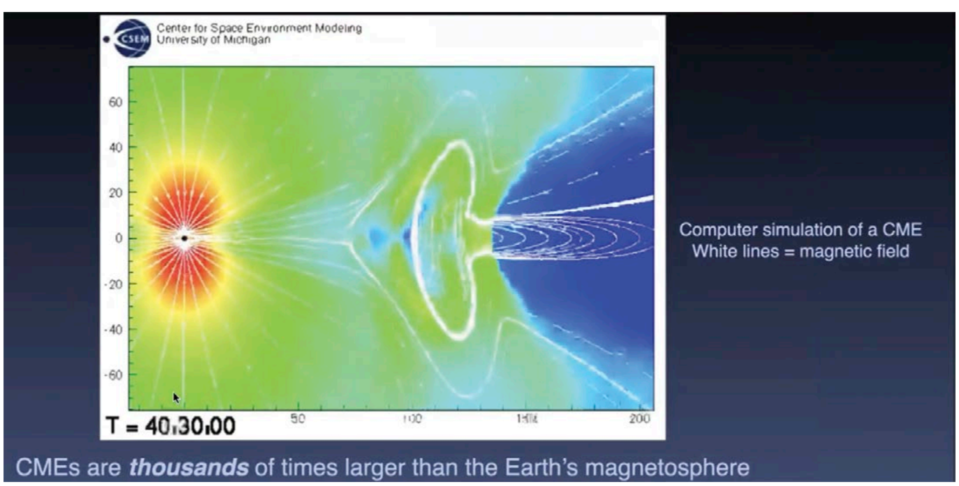
Sometimes to the point where they snap and break off. This is what causes a coronal mass ejection. Magnetic re-connection is the formal physical term we now use to describe what is happening in the corona to cause expulsions of plasma which also contain magnetic field. The solar wind also drags out a magnetic field but it is not nearly as strong as a coronal mass ejection.

Another type of SME - "Filament Eruption" -- No sunspots required.



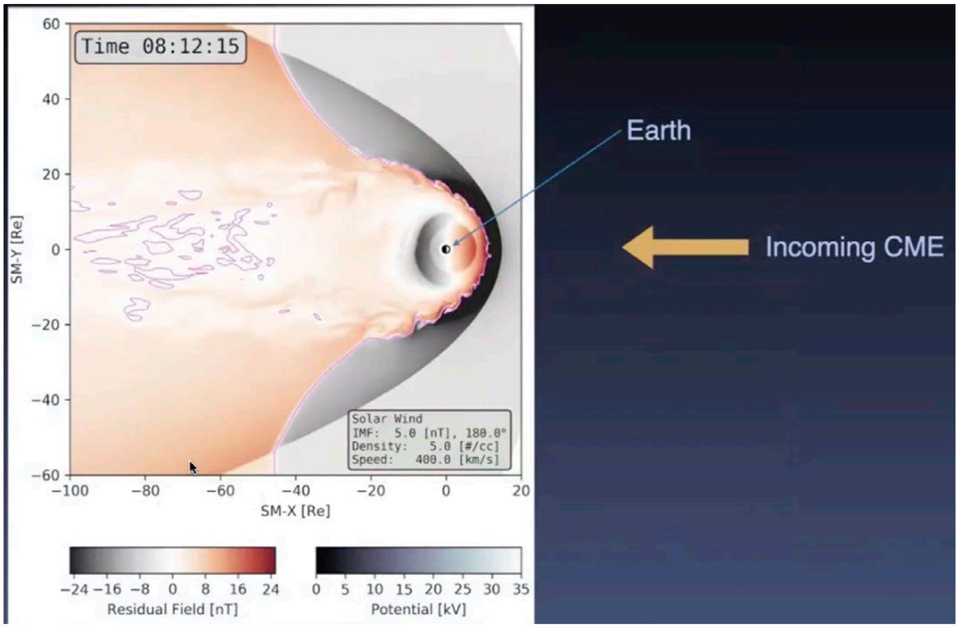
We know that the Sun can erupt in ways that do not involve sunspots and flares. Filaments that form outside of sunspot regions can build up energy and erupt off the Sun. They tend to be much slower but can still form coronal mass ejections causing plasma material to go off into space. Geomagnetic storms are caused by explosions on the Sun ejecting plasma. The flares are photons accompanying that explosion; they are not causing the geomagnetic storming.

The spatial scale of Solar Storms is incredible



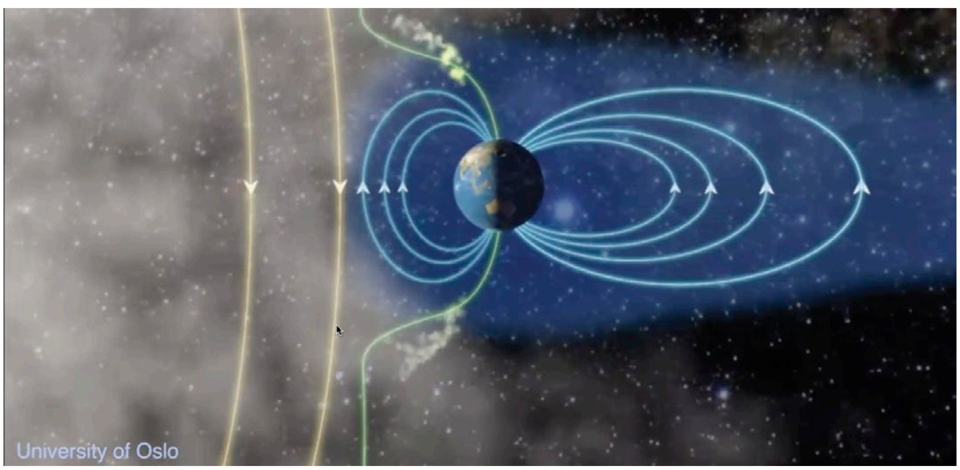
This is an accurate model of the CME being ejected from the corona out into space. The x-axis on the graph is solar radii. The Earth is at about 200 solar radii. CMEs are thousands of times larger than the Earth. They can easily manipulate the Earth's magnetic field as they are much more sizable and powerful.

What a CME does to the magnetic field of the Earth.

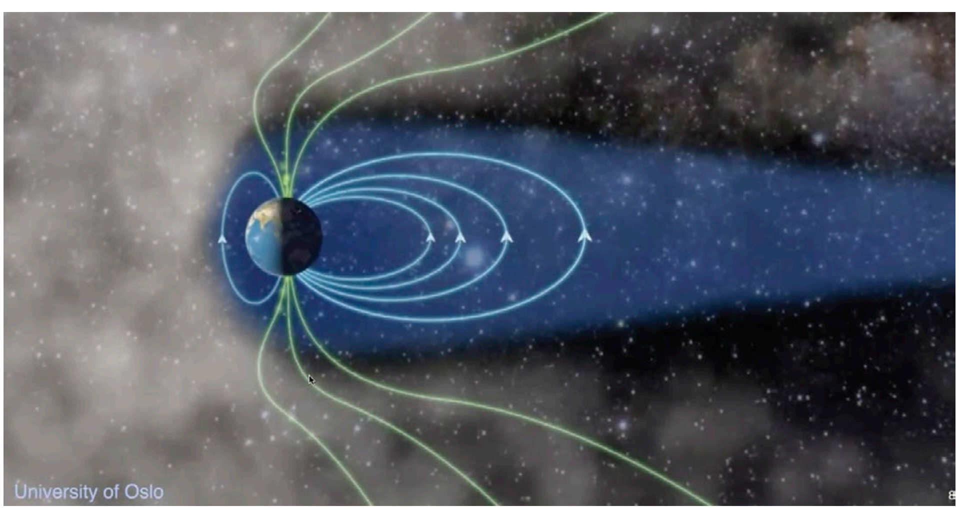


This is model showing a CME hitting the magnetosphere and all the dynamics the magnetosphere undergoes including the flows along the edge where the solar wind is now dragging the plasma and the magnetosphere along causing Kelvin-Helmholz rolls. In the back you can see the magneto tail has these crazy flows going towards the Earth, opposite the solar wind CME velocities and stuff is being injected into the Earth's inner magnetic field. The interaction is very complicated. The magnetosphere itself starts having magnetic reconnection

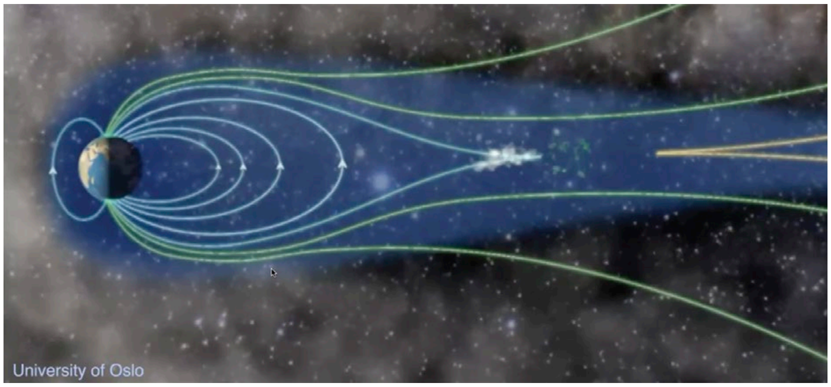
Putting it all together ...



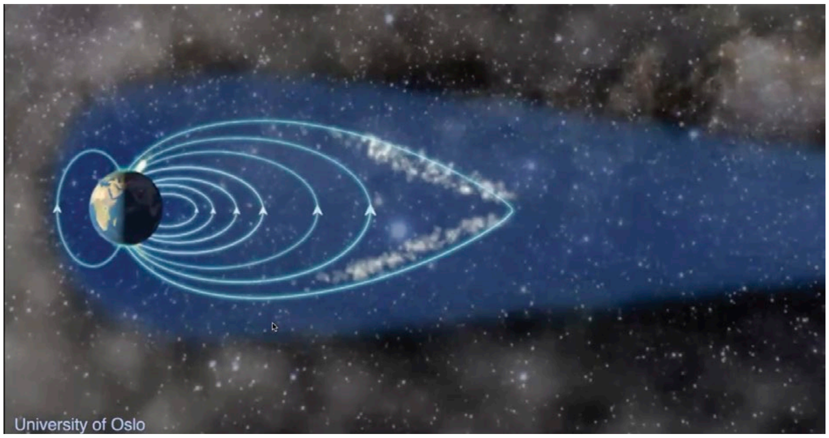
When a CME hits the Earth and the magnetic field is oppositely oriented it very efficiently reconnects so the cloud of plasma from the CME is able to go down the magnetic field lines into the polar cusp region.



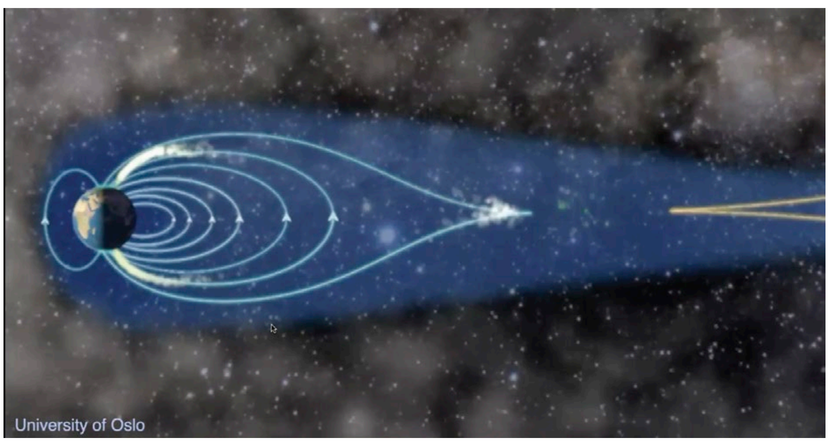
It also interacts with magnetosphere to pull back the magnetic lines.



They also interact and undergo magnetic reconnection and snap back



and throw particles backwards



into the magnetic field of the poles

causing the night time aurora. The whole story was put together in early the 1990s or early 2000s

This was the end of part I. Dr. Berger answered questions from members.

As this was a long presentation part 2 of his talk will be in the January 2025 edition of the LAS newsletter.

You may view the meeting video on the members.longmontastro.org website.

III. Business Meeting - Treasurer Report by Bruce Lamareuax

Longmont Astronomical Society

P.O. Box 806
Longmont, CO 80502-0806

LAS Treasurer's Report - Bruce Lamoreaux **11/21/2024**

Main Checking Account (xxx-1587)

Begin Balance:	$ 7,960.00	**10/3/2024**
Deposits:	$ 175.00	Membership
Expenses:	$ (235.00)	Bank Charges, PO Box
Current Balance:	**$ 7,900.00**	**11/4/2024**

2-Year Savings Account (xxx-1478) (matures 10/23/23)

Past Balance:	$ 8,230.00	**6/28/2024**
Interest:	$ 15.00	
Balance:	**$ 8,245.00**	**9/30/2024**

Telescope Fund (xxx-0165)

Past Balance:	$ 1,100.00	**9/27/2024**
Deposits:	$ -	
Expenses:	$ -	
Balance	**$ 1,100.00**	**10/30/2024**

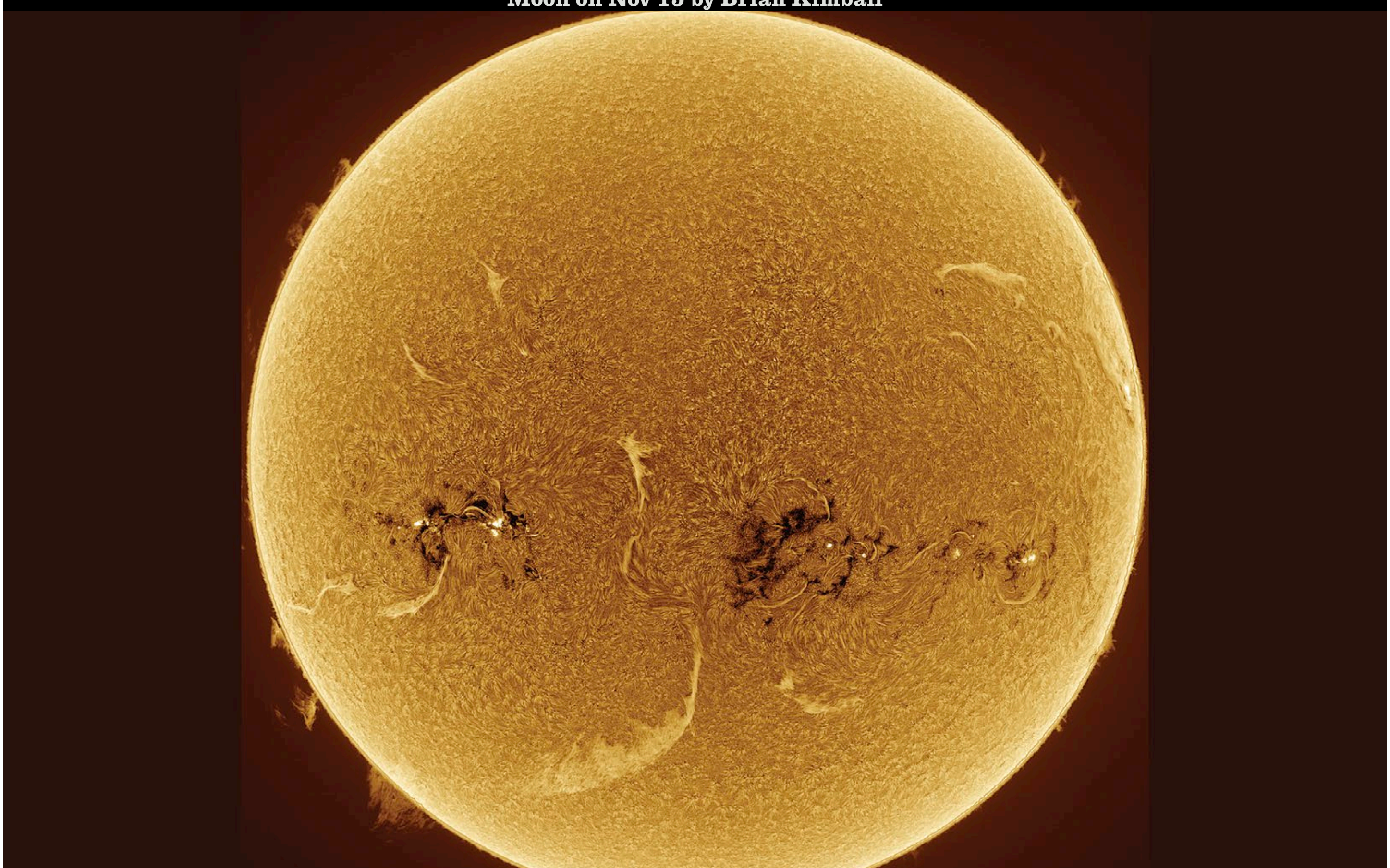
Petty Cash

Past Balance:	$ 50.00
Deposits:	$ -
Expenses:	$ -
Balance	**$ 50.00**

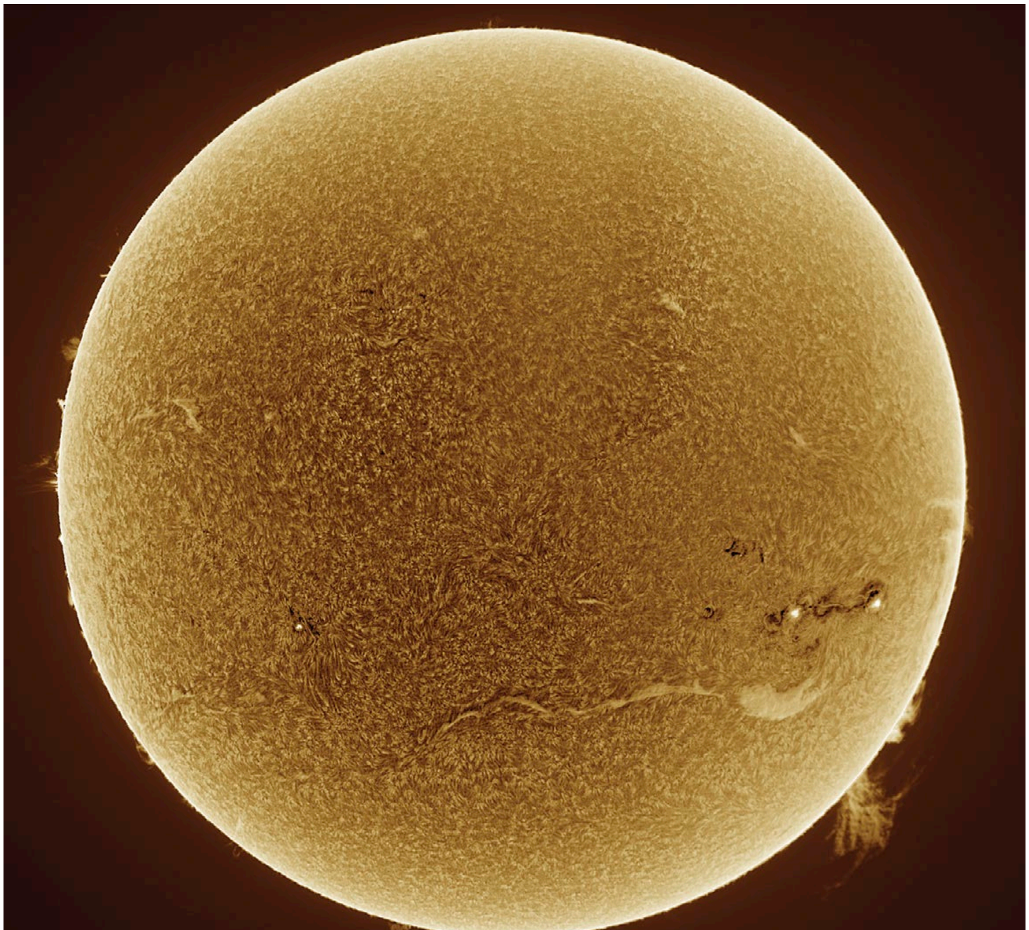
Total Assets	**$ 17,295.00**	$ 40.00 Down from October

Active Membership:	**97**
Student Membership:	**1**
Total	**98**

Moon on Nov 15 by Brian Kimball

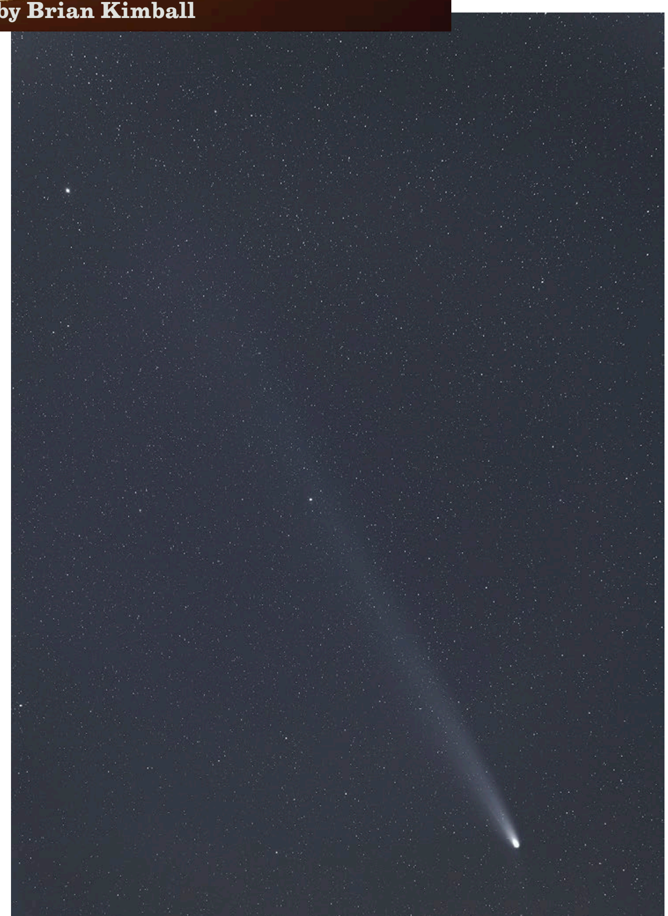


Sun in H-Alpha on Nov 10 by Brian Kimball

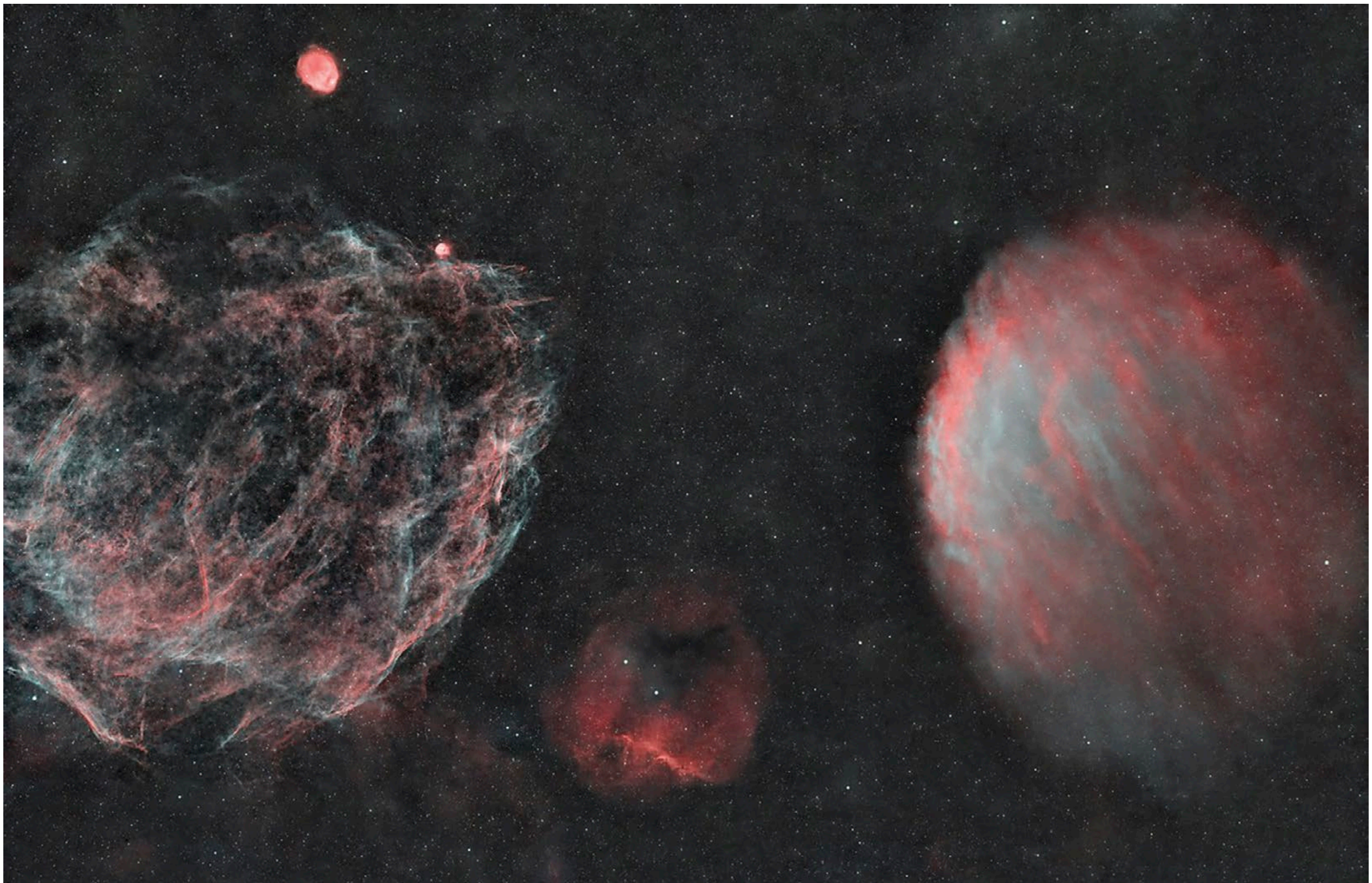


Sun in H-Alpha on Nov 16 by Brian Kimball

M31 by Aref Namari on Nov 12



C/2023A3 (Tsuchinshan/ATLAS) on Nov 3
by Brian Kimball

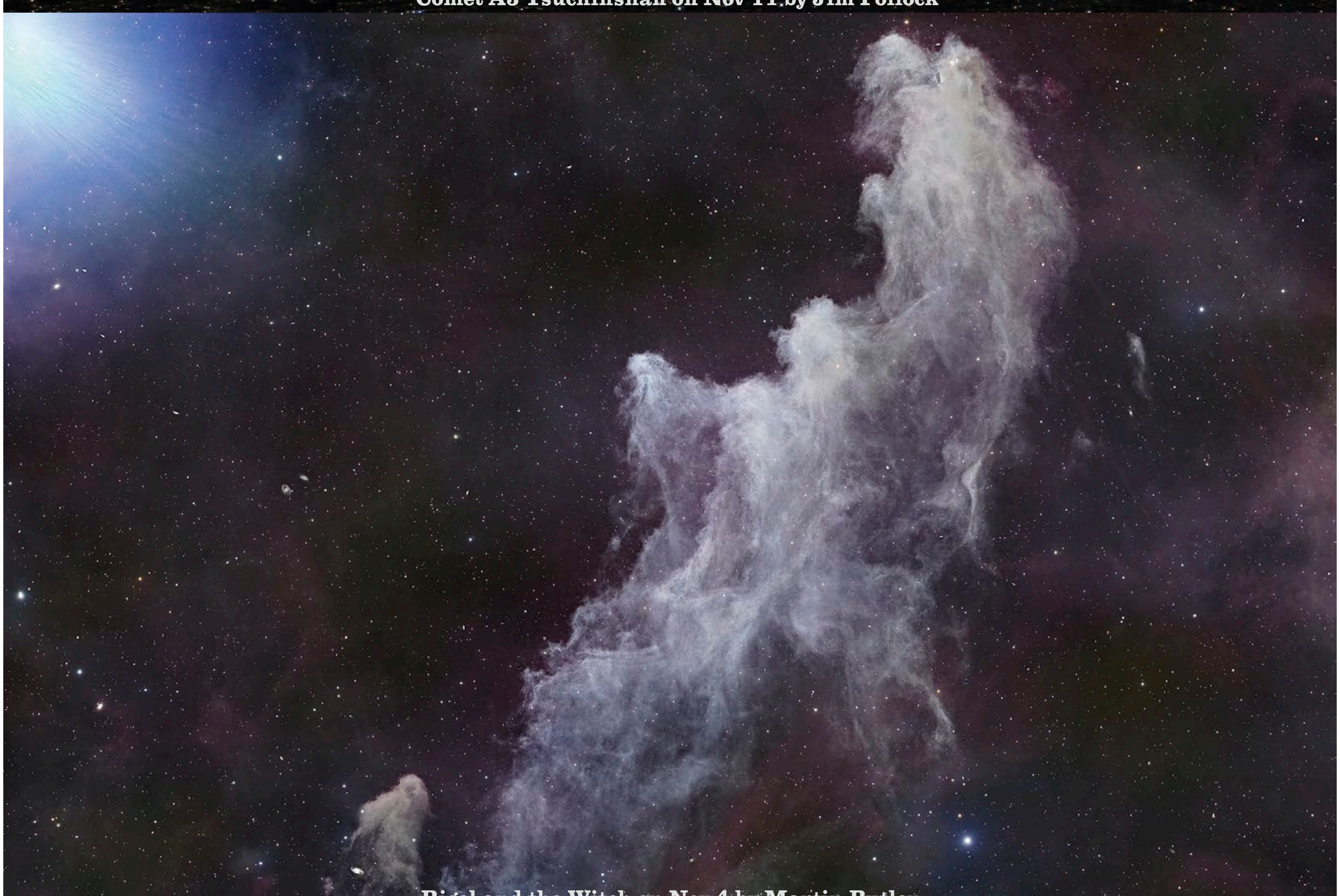

SH 2-216-21 by David Elmore on Nov 4 (HSOSO_15xHa_11xOIII)


SH 2-218 on Nov 11 by David Elmore_(RGB_24xNGS1__LRGBCombo)


NGC 1365 on Nov 6 by Eddie Hunnell


Abel 2151 on Nov 10 by Eddie Hunnell

Comet A3 Tsuchinshan on Nov 11 by Jim Pollock



Rigel and the Witch on Nov 4 by Martin Butley

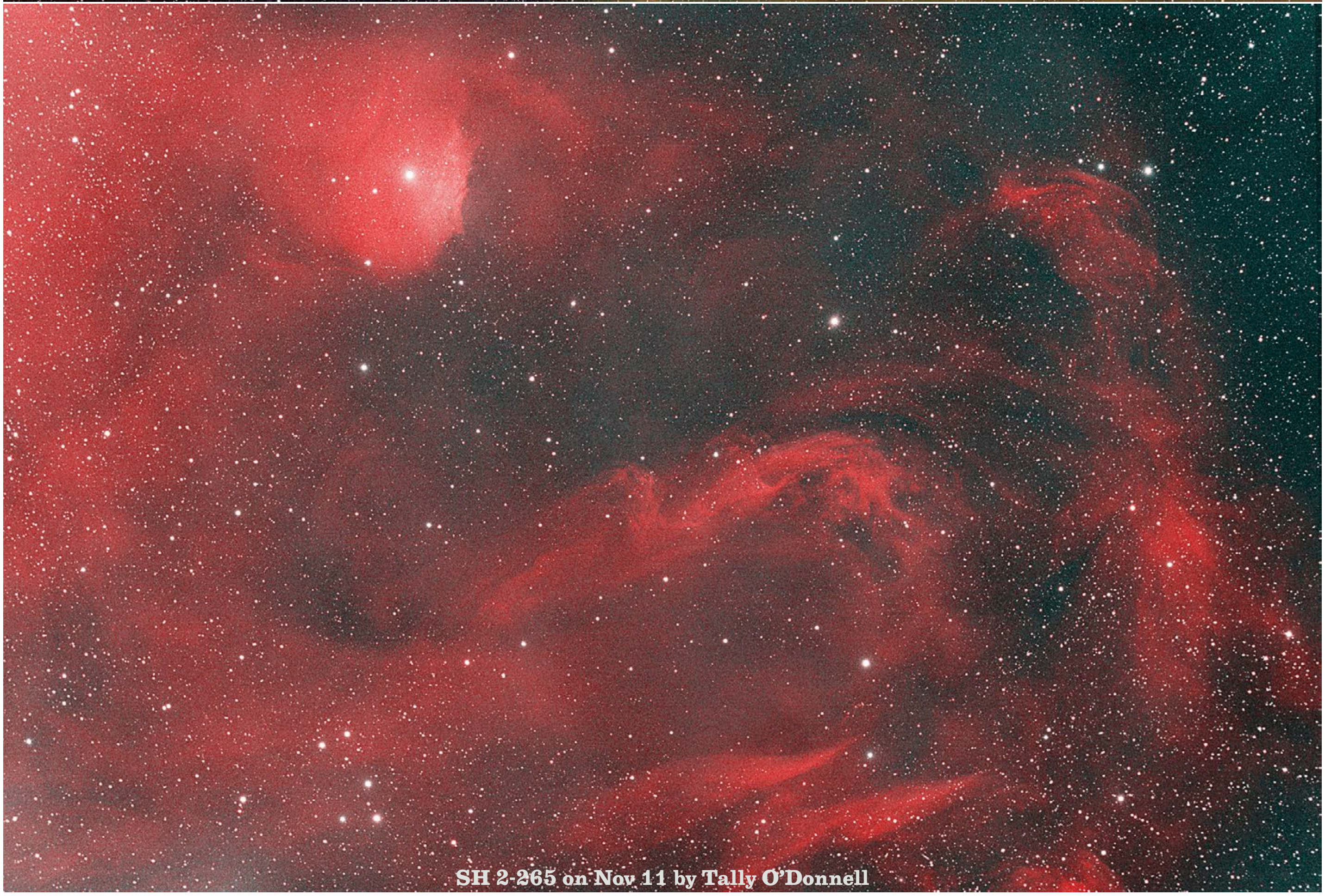
NGC 1232 on Nov 8 by MJ Post (HRGB)

HFG1 on Nov 11 by MJ Post (HOORGB)

NGC 1073 on Nov 9 by MJ Post (HRGB)

Spider and Fly in H-Alpha on Nov 5 by Stephen Garretson


SH 2-234 on Nov 7 by Tally O'Donnell


SH 2-265 on Nov 11 by Tally O'Donnell

Newsletter Archives by Eileen Hall-McKim

30 Years Ago December 1994

The November meeting of the LAS was started at 7:40 on 11/15/94 with opening and general discussion by Jim Sharpe, President. Bob Spohn, Vice President, discussed the upcoming LAS banquet on Saturday, December 10th. Dr. Stencel is our guest of honor and keynote speaker.

Officer reports were given. Bob Ross, secretary-treasurer noted we have $562.00 in the treasury and handed out some recent mail. Dan Cochran, ALCOR, stated we are in good standing with the AL and we are expecting some Messier awards from them before the banquet. Keven Brose, Editor, will be working on an e-mail membership listing for a future newsletter.

Jerry Wilkinson mentioned he was buying a book from Willmann-Bell and suggested others consider the book on star testing optics; the club voted and purchased a copy for the membership. Nominations were held for 1995 officers. Additional nominations are welcome at the December meeting. Voting will be at the December banquet meeting.

Randy Cunningham followed the break with an excellent presentation about deep sky filters. His presentation covered theory, construction and use of deep sky filters. Bob Ross followed Randy with Observing Techniques, part II. This portion of his presentation covered observing of dark nebula, supernova remnants, emission and reflection nebula, and galaxies.

20 Years Ago December 2004

View from up Here by Bob Spohn

Dear members and friends,

Here we are in December, at the end of an incredibly successful year for the L.A.S. It cannot be stressed enough how important involvement from the membership is to the success of a volunteer organization. Having said that, I'd first like to thank this year's officers for their hard work and commitment:

- Vice President Melinda Diehl: Thank you for all of your contributions, and good luck in the future.
- Secretary Mark Propp: Great job getting us on our own server and setting up the mailing list – that is so nice to have, not to mention all of the other secretary functions and no sleep this year!
- Treasurer Monica Martens: I am grateful for your organizational skills again this year, and for being such a conscientious trustee of our funds.
- Newsletter Editor Philippe Bridenne: That title does not come close to doing you justice for all you continue to do for this organization. Thank you, my friend.
- Astronomical League Correspondent Bill Possel: Your very busy schedule may have kept you from a few meetings, but you had the pleasure of presenting several more observing awards this year. Thank you for your dedication to this important position.
- Publicity/Fundraising Chair Ray Warren: Ray, what can we say?! Your enthusiasm, energy, and sense of humor, in addition to all of your hard work and presentations has really made the meetings fun to attend this year – thank you so much!
- Equipment Chair Leigh Pierson: Thank you yet again for your friendly hospitality this year. I believe the membership is finally getting a feel for the magnitude of the work you and Don Bunker are putting in on the telescope project. And your willingness and patience to mentor and assist all those who come to you is truly an inspiration.
- Webmaster Steve Albers: Thank you for providing yet again a consistently high quality web site. And it's great to have you up front at the meetings again sharing your knowledge and adventures with us!
- I would like to add honorable mentions to Mike Hotka and Gary Garzone for being members of the board and planning committee; enthusiasm is contagious, and you guys made sure we stayed pumped up! Michelle Lavers – thanks for all of your efforts with the public and school outreach in the Tri-Town area; we are seeing growth from out there

due to your efforts. Tim Brown, thanks for your help also with the telescope project and your presentations.

- And to all of the rest of you who attend the meetings, provide input, go to the star parties, talk to school kids and co-workers, give presentations, donate money, invite people over and share your time and love of astronomy, I say Thank You Very Much. It has been an honor and a privilege to be the president of your Society these past two years. I am proud of the progress we have made together as an organization, and even prouder to call you my friends. Here's looking forward to an even brighter future for the L.A.S. Happy Holidays to you all! With Kindest Regards, Bob Spohn, President

Tim Brown, Senior Scientist High Altitude Observatory at NCAR, smart guy! Recently published article in S&T magazine. Tonight presentation on Extra solar Planets. Location, Location, Location! New real estate being found in the universe. Interested in stars with planets, how do we find? Article on this topic in this month's S&T magazine. Belgian amateur with light curb nearly as good as ours. Within reach of amateur equipment, nice that way. Very interesting, thanks Tim!

- Mike Hotka received master observer award from AL! See officers to learn how to get started on observing programs. First Hershel 400 book donated by Mike H, adding to the drawing.
- Web Master, Steve Albers. Tempted to say "no report" but thinking of something! Added another Cassini link, updated astro references and resources link also. New link to Cassini timeline, document outlines orbital parameters for all of the 40 some odd orbital fly-bys, statistics on every Saturn moon flyby, phase angles, so you can anticipate lighting for pictures. Dovetails with planetary maps Steve showed in May(?). Gathering Titan images, approach image sequence, base map, adding high resolution flyby image, we will see how it turns out.
- Fiske Planetarium, Tonight and tomorrow night, Josh Caldwell giving interesting Cassini presentation, tickets going fast, get your tickets reserved on credit card. Looking forward to getting bigger exhibits into planetarium this summer, add helioscope for Sun observing in daytime. Sending out emails to BASS and LAS email list, make sure you are on the mailing list. Our next LAS meeting in Dec. is in planetarium. BASS met last time and showed Hale Bopp presentation and aurora borealis, 30 members showing up. New CU student astro-group starting up.

Image by Brian Kimball. This was taken the last couple of nights Boy was it cold. It is a RRGB = 60:60:60:60 minutes. The Takahashi Sky90 and the SBIG ST2000XM was used.

10 Years Ago December 2014

There will be no meeting this month as our normal 3rd Thursday meeting night would be just a week before Christmas. Many of us will be busy attending parties, buying presents for family, attending church services, and of course shopping for last minute imaging and other telescope goodies!

It is time to think about volunteering to be a club officer or board member! All positions are open for nomination every year. The offices to be filled are:

- President – conducts meetings & arranges for speakers
- Vice President – conducts meetings in absence of president
- Treasurer/ALCOR – maintains club bank accounts and coordinates with the Astronomical League
- Secretary – keeps minutes for meetings
- Board member-at-large (3 positions) – vote on purchases and other issues
- Volunteers are also needed to help with the newsletter and website.

Volunteers needed to support the following events:

- Northridge Elementary, 1200 19th Ave. Longmont, on Monday, December 8th at 6:30 pm.
- LAS annual banquet meeting and elections Jan 18? (TBA)
- Superior Brings Night Sky to You on Jan 24, 2015 at 6-8 pm

Meteor Showers – The peak of the Geminids meteor shower is the evening of December 13th. Moon rise is at 11:33 pm so take a look before then. The Geminids radiate is at 7h 28m, Decl. 32.2° (just below Castor) so it is well placed for viewing after about 10 pm. Geminids are usually the strongest meteor shower of the year. They are often bright and intensely colored. In dark locations about 60 to 70 meteors per hour may be seen.

The Great Orion Nebula
by Gary Garzone

Longmont Astronomical Society
P. O. Box 806
Longmont, CO 80506

NGC 2024 by M. J. Post