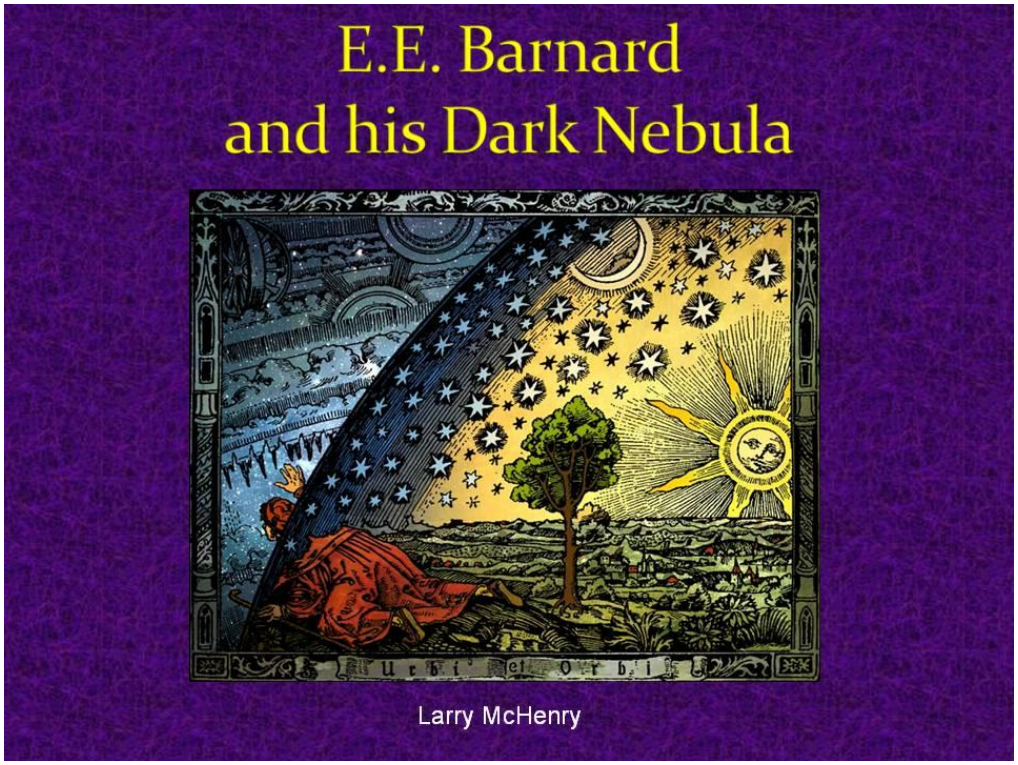
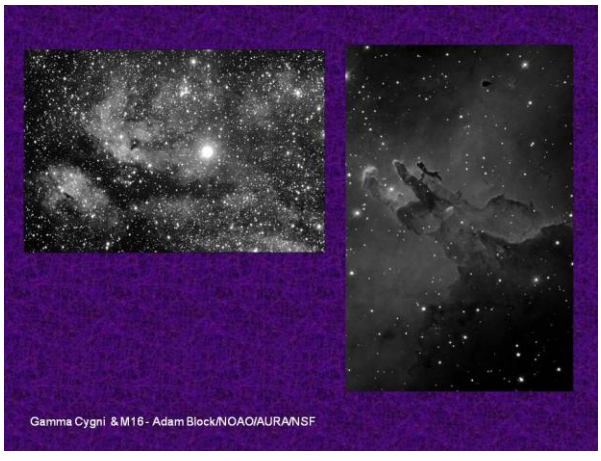
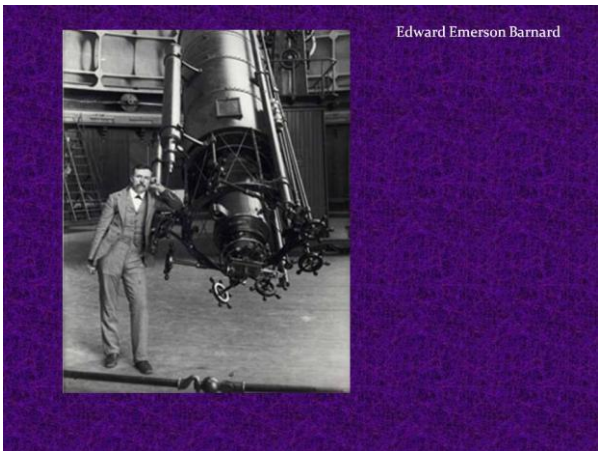
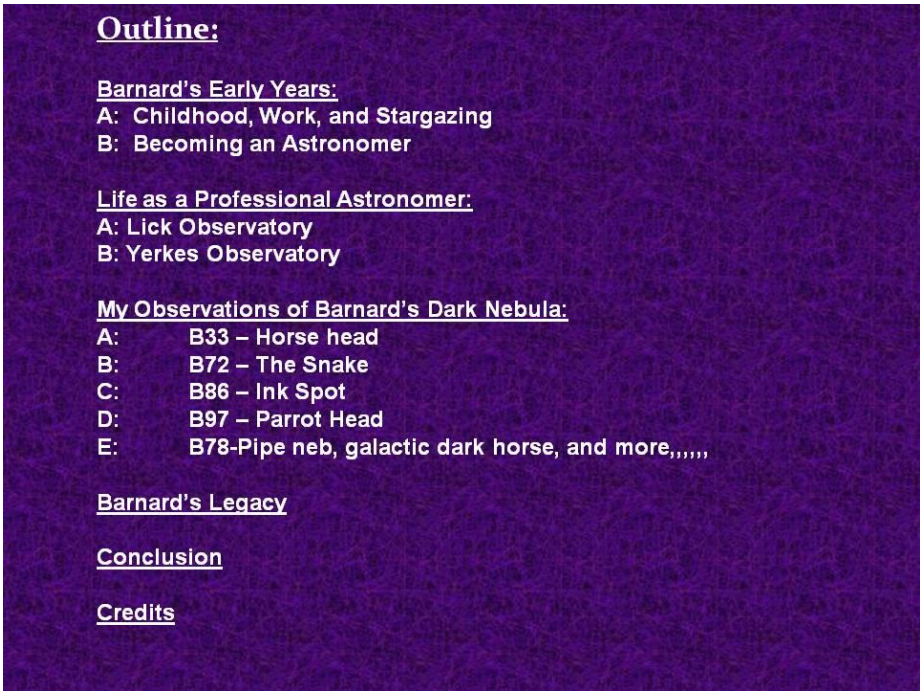


Visible throughout our galaxy are clouds of interstellar matter, thin but widespread wisps of gas and dust. Some of the stars near nebulae are often very massive and their high-energy radiation can excite the gas of the nebula to shine; such nebula is called emission nebula. If the stars are dimmer or further away, their light is reflected by the dust in the nebula and can be seen as reflection nebula.
Some nebulae are only visible by the absorption of the light from objects behind them.
These are called dark nebula

Edward Emerson Barnard was a professor of astronomy at the University of Chicago Yerkes Observatory. As a pioneer in astrophotography, he cataloged a series of dark nebula of the Milky Way. Through this work of studying the structure of the Milky Way, Barnard discovered that certain dark regions of our galaxy are actually clouds of gas and dust that obscured the more distant stars in the background.
Today, we're going to look-back on his life and accomplishments.
We'll also review several of my observations of his dark nebula.







Barnard's Early Years:

A: Childhood, Work, and Stargazing

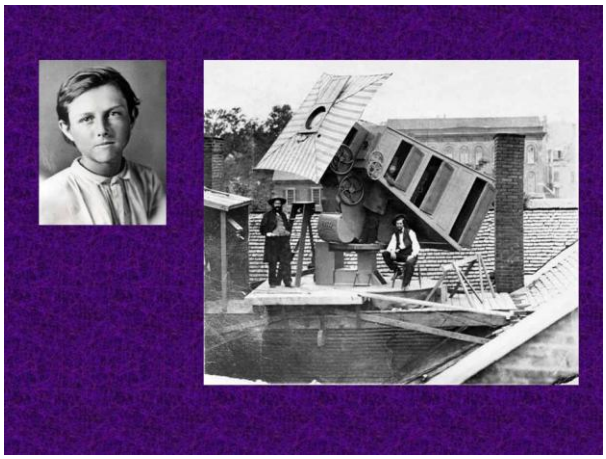
Edward Emerson Barnard was born on December 16th, 1857 in Nashville Tennessee, at the cusp of the Civil War. His mother, Elizabeth, (at the age of 42), had moved the family from Cincinnati to Nashville a few months prior to Edward's birth, when his father, Reuben Barnard had passed away. The family lived in near poverty, with Elizabeth as the sole provider working several small jobs, the most profitable being that of her making wax flowers, which she had a skill at creating.

The family moved multiple times about the city during Edward's early years, with several locations being near the Cumberland River where Edward would swim out into to recover supplies lost in the river by the battling upstream armies. Due to the turbulence from the war, Edward was not able to really attend a formal school setting, only getting in about two months of actual classroom time, but was homeschooled by his mother at an early age to both read and write. Besides the Bible, the family only owned a few other books, including a couple old history and science volumes, but Elizabeth had been well educated and passed on what she knew to Edward.

Once the war had ended and Nashville began to rebound, to help support the family as his mother's health was starting to fail, Edward at the age of nine was able to find a job in a local photography studio. The shop owner was in need of a young assistant whose primary job would be to keep a giant portrait enlarger camera located on the shop's roof pointed at the Sun in order to provide enough natural light for the photo enlargements. (the giant camera was nicknamed the "Jupiter Camera" for its kingly size and needing to follow the Sun). Having gone thru several other boys, who couldn't keep the camera from drifting off of tracking the Sun, when they fell asleep, Edward was given a chance at the job. Not only was Edward able to keep the camera on track throughout the day, but he was also curious in learning how it worked and developed an interest in camera lenses and learning photographic techniques. The patience and endurance skills that he learned in guiding the enlarger, along with the camera and darkroom properties that he learned over the course of 17 years that he spent working at the studio would become extremely useful to Edward in his future career as a professional astronomer.

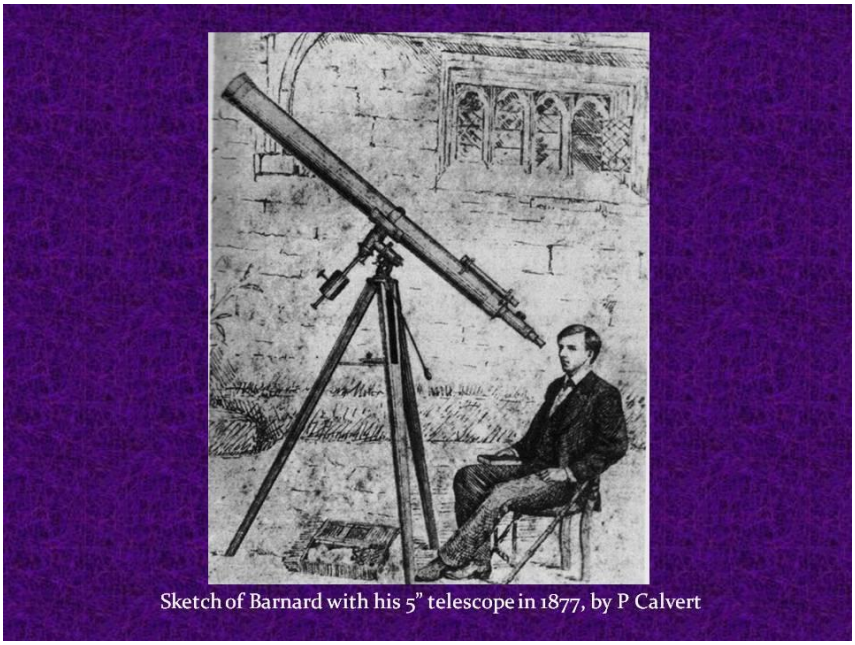
During his tracking duties, Edward soon noticed that the Sun didn't follow the same path at the same rate every day, and 'discovered' that it varied based on the season. This was Edward's first exposure to astronomy. Walking home after dark, his interest in following the Sun's path soon led him to begin

watching the stars. During the summer, once home, he would spend his free time lying in the back of an old wagon gazing at the stars overhead, and from that he became interested in the night sky.
As he would lay there in the wagon, there was one particular bright white star that shone overhead which always held his attention, and he came to think of it as his special star to watch. Due to his sketchy formal education, Edward went for years not knowing that star's name was 'Vega'.



In 1870 when he was 13, Edward, through the help of one of his co-workers, acquired the parts from an old ship's spyglass, (brass tube and several lenses), and built a small altazimuth refractor with a 2" lens which Edward used to study the Moon and the planets Venus and Jupiter.
Then at the age of 17, Edward got the chance to teach himself astronomy when a friend of his borrowed money from Edward and left as collateral a stack of books. One of those books was a text on astronomy and Edward was finally able to learn the names of the stars and constellations that he had been watching since he was a young boy.

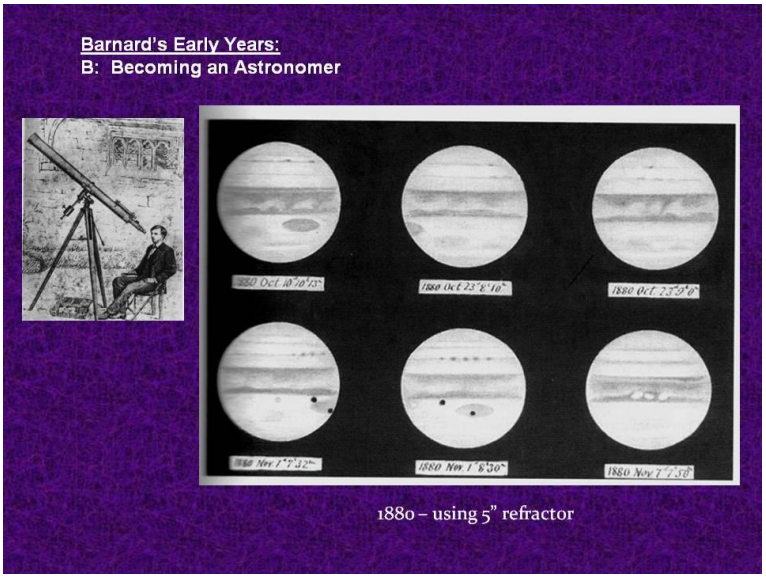
Within two years in 1876, at the age of 19, Edward had saved over a half-year worth of his salary, and used that to buy an equatorially mounted 5" refractor made in New York for $380.
He used this telescope to continue observing the Moon, planets and double-stars and clusters.
But he most enjoyed sweeping along the Milky-Way with it.


Sketch of Barnard with his 5" telescope in 1877, by P Calvert

The following year, in 1877, the American Association for the Advance of Science held its annual convention in Nashville at the new Vanderbilt University. Through his local connections with the photography studio, Barnard was able to meet with the association's president, prominent professional astronomer Simon Newcomb. There, Edward asked Newcomb how to go about becoming a professional astronomer, hoping that he was already on the right track. Newcomb, after learning Barnard's background and lack of education didn't hold out much hope for Edward, as he didn't have the required mathematic knowledge. But Newcomb did suggest to Edward that he should take up comet searching as a way to perhaps become a professional observer and spent a few minutes explaining the methods of comet sweeping to him. Edward came away from that meeting feeling a little crushed, but he resolved to take Newcomb's advice and begin searching for comets.

B: Becoming an Astronomer

After the depressing meeting with Simon Newcomb, Barnard hired a math tutor. Edward would spend nights that were cloudy indoors studying and clear nights out observing. He also began to make more practical detailed observations, sketching Jupiter's bands, Great Red Spot, and the Galilean Moon's shadow transits whenever he could and even participating in recording observations of the 1878 Mercury Transit. Through these efforts, Barnard became a skilled record keeper and planetary sketcher.

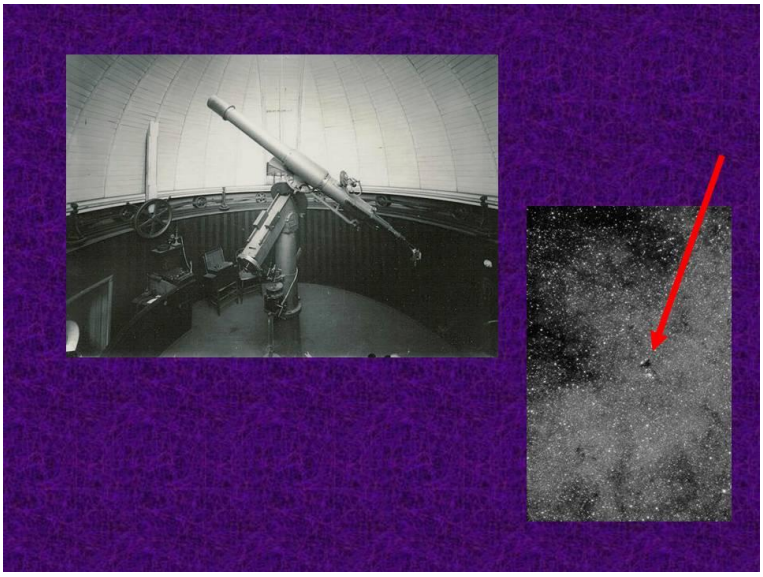


Three years later, on May 21st of 1881, Barnard's sweeping paid-off and he discovered his first comet. Unfortunately, he didn't know the proper technique to measure its position or even how to report it correctly to the professionals. Barnard realized that he needed help in learning how to make the mathematical calculations and reporting techniques, so he reached out to contacts he had made at Vanderbilt University. The university had just recently completed building a new observatory with a 6" Cooke refractor, but had no astronomer on staff to run it. The university's head of the School of Engineering, Olin Landreth, offered Edward a job as the Vanderbilt Observatory Assistant Astronomer, and enrolled Barnard as a student to acquire the necessary education in math and physics.
Barnard was put in charge of the observatory which beside the 6" refractor, included a meridian circle, clocks, and several spectroscopes.

This was the break Barnard was hoping for. He would spend the day studying mathematics and then spend the night observing the sky. Edward considered sleep a waste of time, and he soon became known as "The Man Who Never Slept"! Before long, Edward's diligence paid off again, as he discovered another comet that fall on September 17th, 1881, which became his first official find, and then a year later another new comet discovery on September 14th 1882. Edward even found time to court and marry Rhoda Calvert, the English sister of one his photography studio co-workers.

From his comet discoveries, Barnard became a sort of local Nashville celebrity. His discoveries also proved to be financially rewarding, as at the time, a wealthy American manufacturer of medicinal products, Hulbert Warner, was offering a $200 reward to any American who discovered a new comet. Barnard used his first findings to buy land and build a house for him and his new wife, and it seem that every time a mortgage payment was due, Barnard would discover another new comet and once again collect the reward in time to pay it off. His house was known locally as “The Comet House”. By 1887 Edward had went on to discover a total of 9 new comets!

In addition to comet sweeping, Barnard also spent time using the observatories 6” refractor observing the planets and other deep-sky objects such as star clusters and the various nebula scattered about the night sky. On July 17th, 1883, while observing near M20 in Sagittarius, Barnard discovered a small triangular-shaped ‘dark-hole’ near a small starcluster (NGC6520). This was Edward’s first telescopic discovery of what would become known decades later as Dark Nebula.
It was also Edward’s favorite example.



In 1884, he discovered a previously undetected faint nebulous smudge in Sagittarius known today as NGC6822 or commonly as “Barnard’s Galaxy”, which turned out to be a small irregular dwarf galaxy of the Milky-Way. By the time Barnard left Vanderbilt, he had discovered 20 new nebula, including NGC2237 – a bright knot of the Rosette Nebula, in Monoceros, and NGC1499 – the California Nebula in Perseus.

Barnard never did officially graduate from Vanderbilt University, as in 1887, Edward was offered a job as one of the initial staff astronomers at the new Lick Observatory on Mt Hamilton. Barnard jumped at the chance to use the new soon to be commissioned 36” refractor at Lick, then the world’s largest telescope, and promptly quit his job at Vanderbilt, sold his home to his brother-in-law, and moved Rhoda and himself to Northern California.

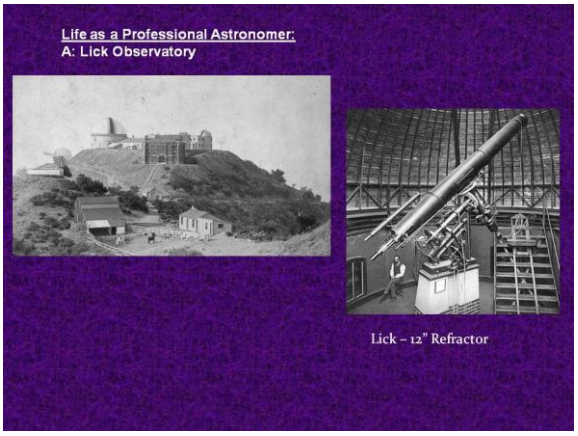
Life as a Professional Astronomer:

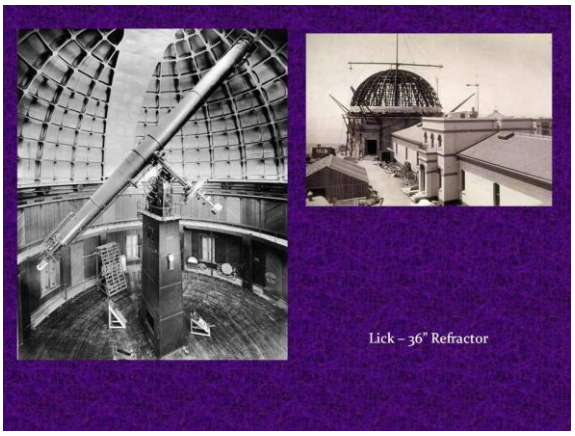
A: Lick Observatory

During the mid 1880’s work on the new Lick Observatory and its 36” refractor was a hot topic of the day among the astronomical world. Edward had been following it in the news and once it was announced that Edward S Holden was named as the director of the observatory, Barnard began a letter writing campaign to him in hopes of getting a job at the new observatory, the first ever to be built on a

mountain top. Thru Barnard's comet discoveries and the good reviews from other astronomers that knew of Barnard's work, Holden decided that even though Barnard didn't have a top educational background that Holden would have preferred for his staff, that Barnard's keen observing abilities was what he needed for the new observatory. So the director offered Edward a job as a junior member of the astronomy staff and was assigned time on the lesser telescopes at the observatory, such as a 12" Clark refractor and a small 6.5" equatorial refractor. Barnard was shutout of any observing time on the big 36" refractor, which eventually led to a long running feud between Barnard and Holden.

Unfortunately, for Barnard, he moved a little too soon from Tennessee, as unknown to him there were delays in building both the observatory dome and support buildings for the 36" telescope, so when the Barnard's arrived in San Francisco, the observatory hadn't yet been turned over for use. Edward had to take a job at a law office as a document copier and sale his beloved 5" refractor for enough money for them to live off of until the new observatory officially opened. Finally, in May of 1888, the observatory was completed and Edward was able to officially start work as a Lick Observatory Astronomer. Barnard wasted no time in sweeping up a new comet in September, and another in October.



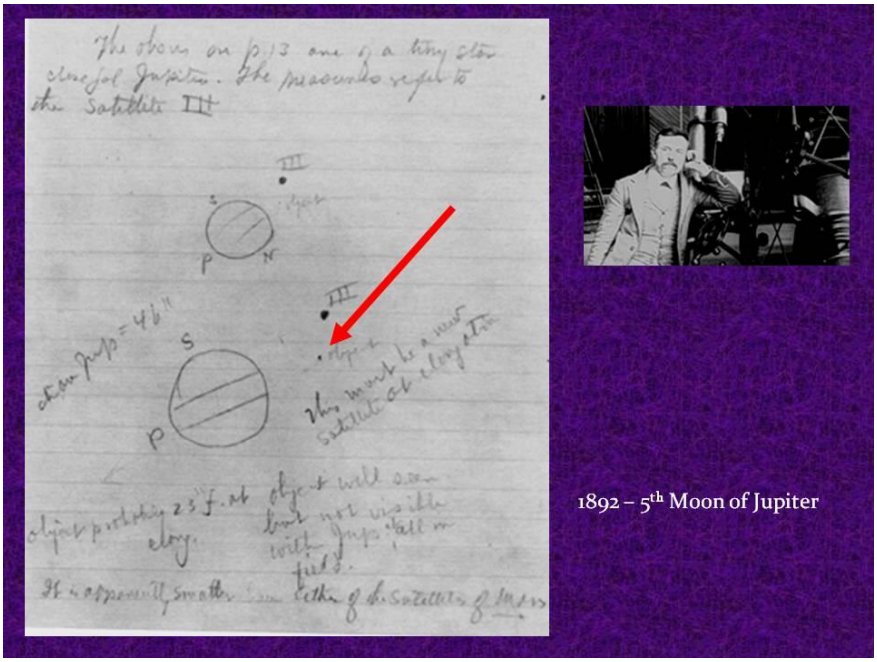


One of Barnard's early assignments was to utilize his studio photography expertise and began to systematically photograph the Milky-Way. So Barnard took a used 6" studio-portrait lens (a Petzval doublet named the Willard lens) that the observatory had acquired and mounted it in a wooden box camera back that he built by hand. Edward then piggybacked this home-made box photographic camera on the small 6.5" observatory refractor and began experimenting with guided exposures. His wide-field time exposures revealed details in the large-scale structures of bright starclouds obscured by what looked to be dark holes/voids, lanes, or spots. His photographs soon became a popular item to be passed around the observatory staff, as they showed the richness of the Milky-Way starclouds as they had never before seen. This was the start of what became Barnard's life-work, gathering evidence as to the nature of these dark features – were they really actual voids of matter in space, or were they something else.

During this period, Barnard also made some other interesting observations, such as an occultation of Saturn's moon Iapetus by Saturn's rings on November 1st 1889, in which he observed shadow bands passing over the moon. Barnard also successfully photographed the total solar eclipse of January 1st, 1889, producing at that time, the best images ever made of the solar corona.
Barnard also accelerated his comet discoveries while at Lick, finding another 8 comets over the next six years. One of which, "1892 T1" was the first comet to be discovered photography.

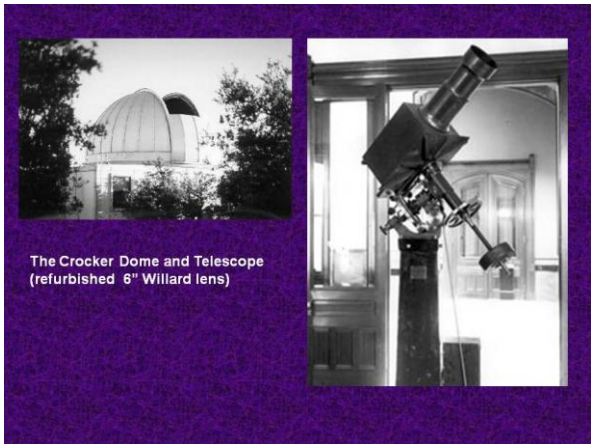
Finally in July 1892, after taking his case directly to the Cal-Tech Lick Observatory board of directors; Barnard was awarded observing time on the 36" refractor. Shortly thereafter in August of 1892, using his newly won time on the 36" refractor, Barnard was the first to visually observe gaseous emissions coming from a recent nova in Auriga, (T-Aurigae or Nova Aurigae of 1891), and correctly deduced that the outflow was the result of a stellar explosion and the birth of a planetary nebula.. One month later, Barnard was to use the 36" to make a discovery that rocked the world and brought international fame to both Lick Observatory and Edward Emerson Barnard.

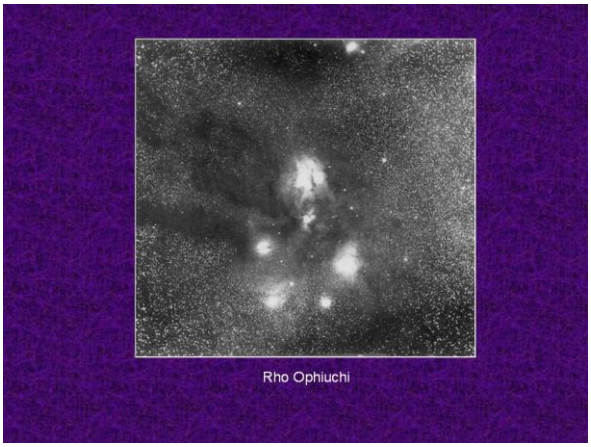
On the night of Friday September 9th, 1892, during Barnard's observing session with the 36" refractor, he pointed the great telescope to Jupiter. While observing Ganymede approaching the planets disk for a transit, he spied a faint spark of light between the two that was also moving. It was a new 5th moon! The first new satellite of Jupiter to be discovered since Galileo in 1610! After a couple more nights of confirmation observations and orbital calculations, the observatory broke the news to the world.



While it was Barnard's right to name the new moon, he never could settle on what to call it. Eventually, upon the suggestion of French astronomer Camille Flammarion, the new 5th moon of Jupiter was named Amalthea. Jupiter's new 5th moon also became the last solar-system satellite to be discovered visually, as all future discoveries have been since made only by photography.

Now, with more time allotted on the 36" refractor, Barnard tried using the old 6" Willard lens studio camera on the great telescope, but the lens had deteriorated and needed re-polished. It was sent off to John Brashear's optical shop in Pittsburgh to be refigured. A local benefactor of the observatory, Colonel C.F. Crocker donated funds to build a dedicated small dome with a dark room and equatorial mount for the new Willard lens, which was now called the Crocker Telescope.
(Telescope lens and mount are still there at Lick Observatory but disassembled in storage)





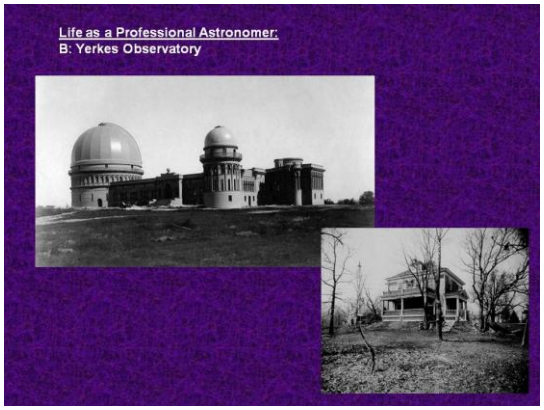
Using this Barnard went back to spending his non-36" evenings to photographing dramatic wide-field pictures of the Milky-Way, particularly the striking dark-holes in the Sagittarius region and around Rho Ophiuchi. Barnard gave fanciful names to some of these objects, such as the 'Snake', (B72), the 'Pipe' (B78), and the 'Parrots Head' (B86). Barnard still continued to view these objects as actual voids in space, but the data was beginning to point in another direction.

Edward also took time out to use the Crocker Telescope to photograph comets. In 1893, he was the first to photographically record a tail disconnection event that occurred with Comet Brooks of that year.

During this period, Edward, on his own purchased a small cheap projecting lens of 1.5" and he made an even wider-field 'lantern' camera with it and piggybacked it on the Crocker Telescope. With this new camera he was able to photograph entire constellations, and was the first to image an enormous nebula in Orion in its entirety, now called "Barnard's Loop". This inexpensive little camera of his was also very successful in imaging the vast starclouds of the Milky-Way.

Finally by 1895, the feud between Barnard and Lick Observatory Director Edward Holden peaked, with Holden refusing to publish Barnard's wide-field and comet images.
In an opportune moment, George Hale made an offer to Edward Barnard to come work at the new Yerkes Observatory with a title of 'Professor of Practical Astronomy', where he would have full access as a staff astronomer to the new 40" Refractor being built. Barnard accepted, and was soon on his way to Williams Bay Wisconsin with his lantern camera and unpublished wide-field Milky-Way photos.

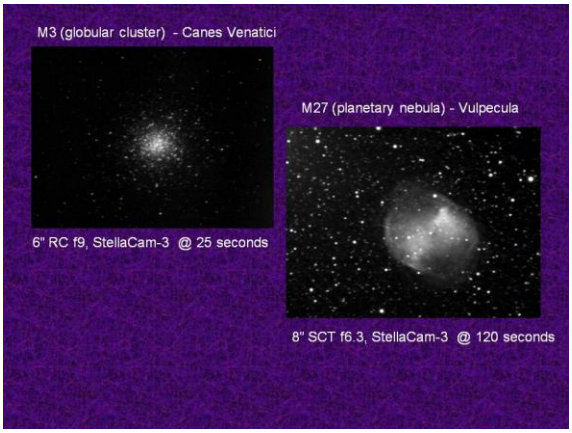
B: Yerkes Observatory
With the October 1895 offer from Hale, Barnard and Rhoda once again sold off most of their belongings and moved to the small town of Williams Bay, along the shore of Lake Geneva, Wisconsin.
There they purchased land next to the new observatory and had a two-story wood-frame house built.



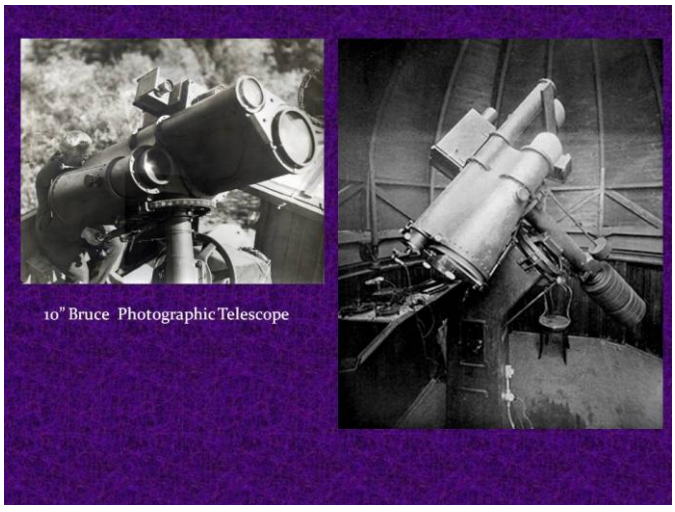
While waiting for the 40” refractor to be completed, Edward put to use George Hale’s personal 12” refractor that Hale had installed in a smaller dome at Yerkes and was able to continue with visual observations. During this time in 1896, the prestigious English Royal Astronomical Society awarded its Gold Medal to Barnard for his work, and Edward spent a month over in England lecturing at Oxford and Cambridge.

Finally in May of 1897, the 40” lens by Alvan Clark was finished, taken to Yerkes and installed in the great telescope tube. The telescope performed flawlessly, but unfortunately, less than a week later, the support system on one side of the moveable observatory floor failed, causing that side to crash down 45 feet, wrecking it. The 40” was out of commission until the middle of August.

With the observatory officially opened, Barnard was one of the principle observers on the 40” refractor, and would never miss a clear night at the observatory. Edward used the telescope visually by taking micrometer measurements of the planets and moons, globular clusters, and planetary nebula. Barnard tracked the globulars M3, M5 and M13 in hopes of determining their distances by parallax, and planetary nebulas M27, M57, and M97 in hope of determining whether they were physically changing.



In 1897, Barnard made a successful sales pitch to the wealthy Yerkes Observatory benefactor Catherine Bruce, to fund a new wide-field 10” photographic refractor telescope for Barnard’s exclusive use. This instrument became known as the “Bruce Telescope” and its 10” doublet lens was made by John Brashear of Pittsburgh. The 10” was also coupled with a 6.25” German Voigtlander portrait lens. Once completed in September of 1900, Barnard used it to eventually take over 4000 images, and made a number of photographic nebula discoveries, and he also re-imaged the large-scale Milky-Way structures he had earlier photographed using the small lantern camera at Lick.



In January of 1905, Barnard convinced Yerkes Observatory director Edwin Frost to allow him to temporarily take the Bruce Telescope to the Mount Wilson Observatory. While there, a staff astronomer noted that Barnard still lived-up to his "Man who never Slept" nickname as Barnard would "observe till midnight, then drink a large quantity of coffee, work the rest of the night developing his photographs, and then join the solar astronomers for breakfast". (Sometime after WWII, the Bruce Telescope fell into disuse and in the early 1960's was donated to the Athens Observatory in Greece).

Using the new Bruce Telescope, it was the richness of the starclouds and outstanding Milky-Way features, showing much more fine detail in the dark regions than ever before, which became the center of Barnard's work. During this period, Barnard began to reconsider his view that these objects were actual star-less voids in space. He started to believe that what he was seeing was actual dark obscuring material, parts of what Barnard called "Dead Nebula", where he thought the nebula could no longer form stars, had burned-out, no longer emitted light and had gone dark. In March of 1907, Barnard published a research paper based on the new Bruce photos in the 'Astrophysical Journal' where he studied both the bright and dark nebula of Rho Oph in Ophiuchus (B42 & B43), and around LBN782 in Perseus (B10), and speculated that a large nebula existed in both regions, but its major portions had gone dead and was non-luminous and cutting out the light from stars behind it.
Barnard stated "*I have been slow in accepting the idea of an obscuring body to account for these vacancies (voids); yet this particular case almost forces the idea upon one as fact,,, There is no question that this is real, and not a subjective effect".*

This was the evidence, from his own photographs, that convinced Barnard to finally come around to the thought that these dark voids were actually obscuring dark matter in front of and blocking the view of the more distant Milky-Way. This was considered a huge discovery among the astronomical world, as now all the various galaxy formation models would have to take into account these dark clouds of dust and gas.

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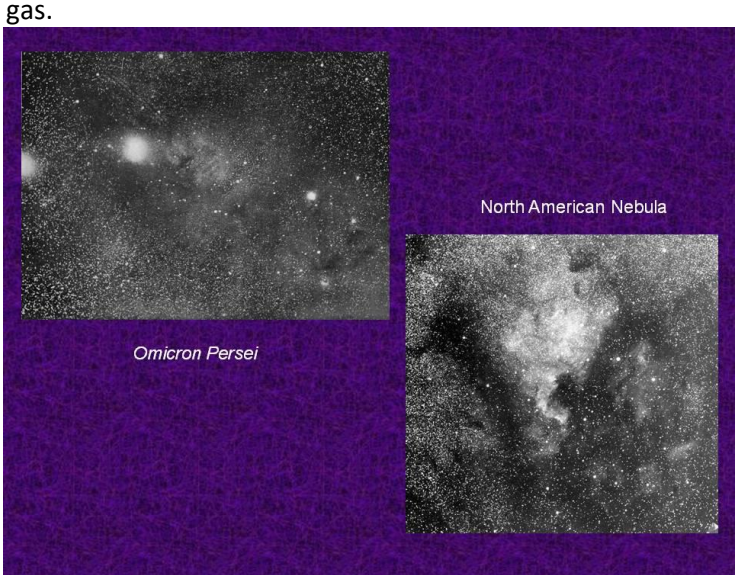


On May 28th, 1900 another total solar eclipse of about 1 minute in duration was to cross over the Eastern Seaboard, and Yerkes sent a group to Wadesboro, North Carolina to setup an observing station. Once again, Edward, tasked with photographing the solar corona, was successful. A year later, Yerkes Observatory sent Barnard and several astronomers overseas as part of a US Naval Observatory expedition to Sumatra for the 6-1/2 minute total eclipse that was to occur there on May 18th, 1901. Barnard thought the most interesting part of the trip was when they sailed past the remnants of the island of Krakatoa, which had blown its volcanic top just 8 years earlier.
Once arriving at their observing site, Barnard setup his equipment, but it was all for naught, as on the day of the eclipse, the sky was heavily clouded and the expedition was not able to observe any of it.

From the start of his time at Yerkes, first using his little 1.5" lantern camera and then once completed, the Bruce 10" photographic telescope, Barnard photographed nearly every new comet that came around, once again capturing a number of images showing comet tail structures, disconnects, and disturbances that were important in analyzing the physics of comet behavior. Using this data, in 1909 Barnard came up with the theory that these comet tail changes were caused by the effects of solar disturbances, the same that caused geomagnetic storms and auroras on Earth.

Barnard went on in May of 1916 to discover a star, located in the constellation of Ophiuchus, that has the fastest proper motion of any in the sky at 10 arc seconds per year. Since named "Barnard's Star", the 9th magnitude star is also the 4th closest nearby star to our solar system at about 5.96 light-years. (click for popup) Barnard's Star is a small red dwarf star, and has a stellar mass of about 16% of the Sun's, a little larger than the planet Jupiter.

Proper motion is the apparent movement of a star across the sky as seen from our line-of-sight on the Earth. Here are two separate observations of Barnard's Star that I made over 10 years apart, showing proper motion.

Recently confirmed exoplanet "Barnard b" orbits close to the star, completing an orbit every 3.15 days. At only about 2.1 million miles away from the star, the planet
orbits inwards of the star's habitable zone, with an estimated surface temperature of 260 °F. Barnard b is a likely rocky world, with a mass of only about a third of the Earth.
There's also evidence for three additional planetary candidates. If confirmed, these would all be low-mass planets in close orbits, similar to Barnard b.

In December of 1916, Barnard using the 40" telescope, was again the first to detect the expanding planetary nebula from a nova in Perseus. Edward had first observed the nova back in 1901 when it erupted, seeing nothing at the time, but kept the star in his observing plans and finally was able to visually see the forming gaseous shell.

In 1918, Barnard at age of 60, once again went on a total solar eclipse expedition, this time to Green River Wyoming for a 98 second eclipse on June 8th. Barnard was successful in recording both the inner corona and limb prominences. Arriving back at their hotel after the eclipse at dusk that evening, Barnard noticed a new naked-eye nova in Aquila, and he along with a group of astronomers rushed back to their equipment to make observations. Edward became one of the many independent observers who discovered the nova that night. Barnard followed the nova all that fall as it slowly faded.

Observations of Barnard's Dark Nebula:

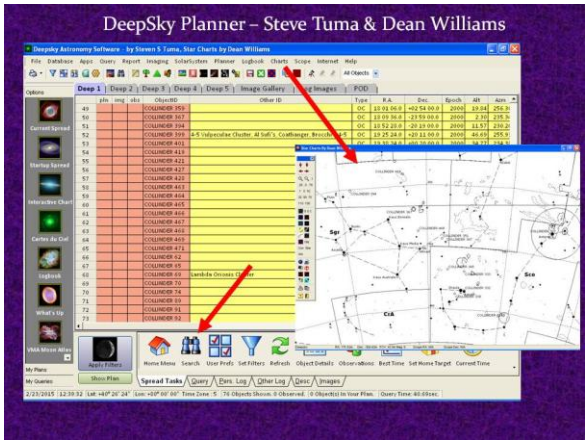
So, where can you find E.E. Barnard's Dark Nebula's?
Dark Nebula can be found all along the glowing band of light that we call the "Milky-Way", our home galaxy. Some large nebula are best suited for the naked-eye, while others are telescopic and require large apertures. Fortunately, there are many objects that display nicely using binoculars or small rich-field telescopes. While a number of dark nebulas are fairly easy to find, most require observing from a dark-sky country location such as Cherry Springs.

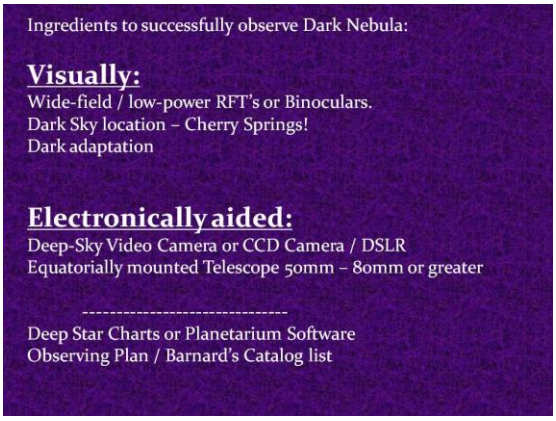
It helps to have a list of the Barnard catalog. One of my favorite book resources is Barnards revised atlas by Gerold Dobeck in 2011 by Cambridge publishing. It contains all of Barnards original photographs, finder charts, and descriptions in an updated format.

Also, "*The Night Sky Observers Guide – Glories of the Milky-Way*", by George Kepple:
This is the 4th in the series of handbooks written by George Kepple and Glen Sanner, each chapter covering a specific constellation, with finder charts, sketches, images, and visual descriptions of various deep sky objects. Volume 4 focuses specifically on constellations that lie along the path of our Milky-Way galaxy. Each 'chapter' lists all Barnard Dark Nebulae visible within its boundaries in a very convenient layout.

You can get a computer software program to help: "Deep Sky Planner" – Steve Tuma & Dean Williams
Do a search for your favorite catalog, and generate a star chart.

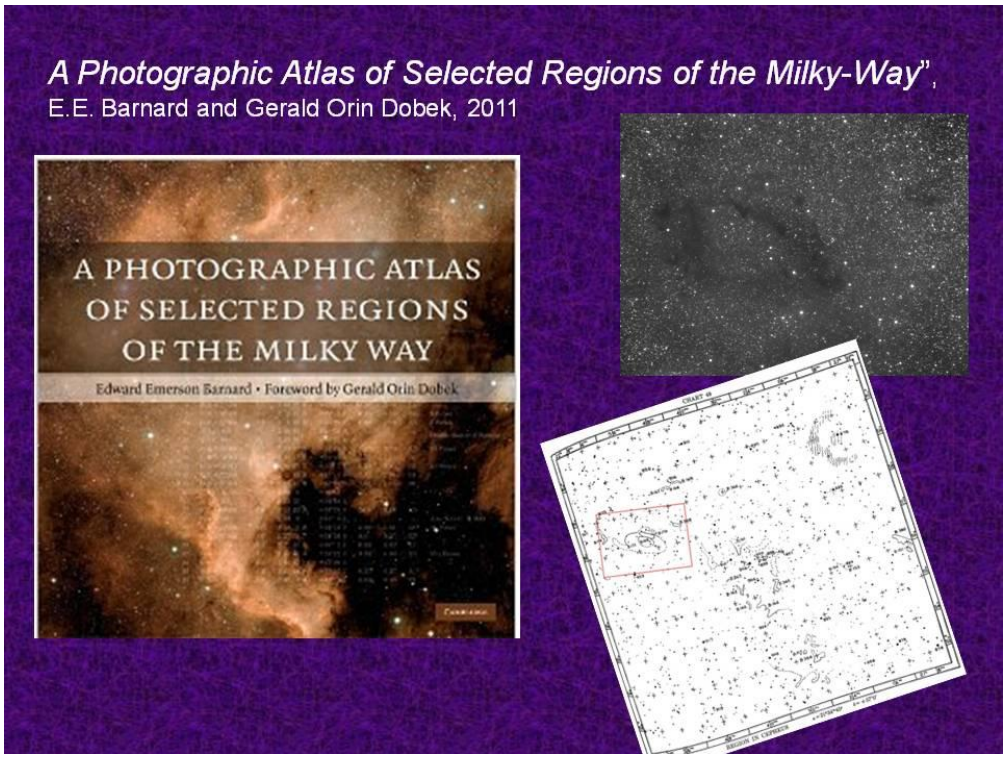
Or, if you're using a planetarium program, you can utilize its settings to show the dark nebula that you are interested in finding. This example is from my favorite program – "Earth Centered Universe"





Ingredients to successfully observe Dark Nebula:
Observing them visually requires maintaining dark-adaptation, having good starcharts, and slow sweeping with a wide-field low-power telescope. A nice 80mm F6 or shorter refractor piggybacked on a larger telescope would work very well. The 80mm acts as a low-power RFT giving you a wide-field in which to find the dark-nebula and the larger telescope it is attached to allows use of higher magnifications, depending on the object. You'll need all your visual observing skills to find and bring out the subtle differences in these objects.

For the Imagers, dark nebula can also be challenging, in that even with an accurate GOTO mount, it may not position the telescope squarely on the object to where it's framed the way you want it. Having a photographic atlas or picture of the dark nebula will help you in both locating and identifying the most interesting sections of the nebula and framing your image. I've found that using short-exposure EAA camera techniques works great in positioning and identifying Dark Nebula.



Now let's run thru a few examples of Barnard's Dark Nebula:

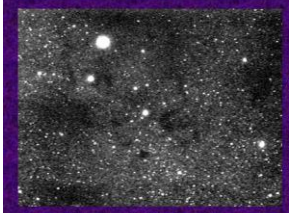
B33 - Horse head
B72 - The Snake
B86 - Ink Spot
B87 - Parrot Head
B78 - Pipe Nebula
"The Galactic Dark Horse" or "Prancing Horse"
B85, 88, 89, & 296 "M20 & M8" - Sagittarius

B33 "Horse Head" - Orion

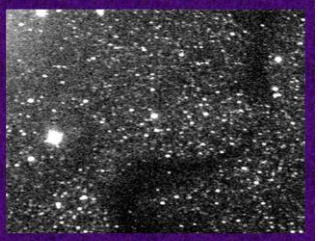
50mm Refractor & SC-II @ 8 seconds

6" RC f5 & Stellacam-3 @ 45 seconds

B72 "The Snake" - Ophiuchus

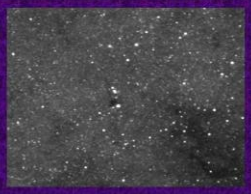


50mm Refractor & SC-II @ 8 seconds

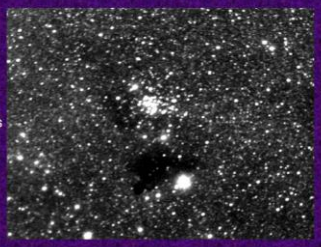


6" RC f5 & Stellacam-3 @ 30 seconds

B86 "Ink Spot" - Sagittarius



50mm Refractor & SC-II @ 8 seconds



6" RC f5 & Stellacam-3 @ 30 seconds

B85 , 88, 89, & 296 "M20 – Trifid, & M8 - Lagoon" - Sagittarius

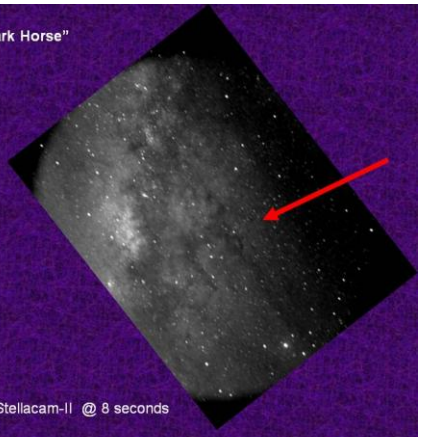
6" RC f5 & Stellacam-3 @ 90 seconds

8" SCT f6.3 & Stellacam-3 @ 30 seconds

B78 "Pipe Nebula" - Ophiuchus

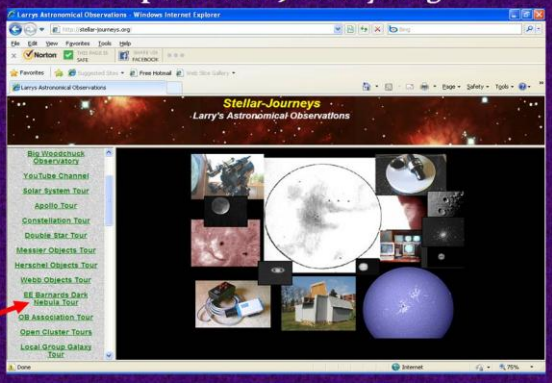
25mm CCTV lens & Stellacam-3 @ 3 seconds

"The Galactic Dark Horse"

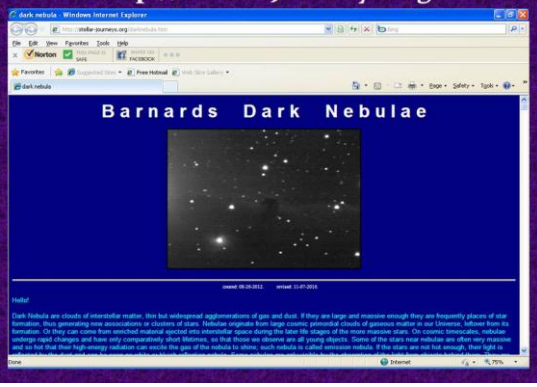


12mm CCTV lens & Stellacam-II @ 8 seconds

http://Stellar-Journeys.org

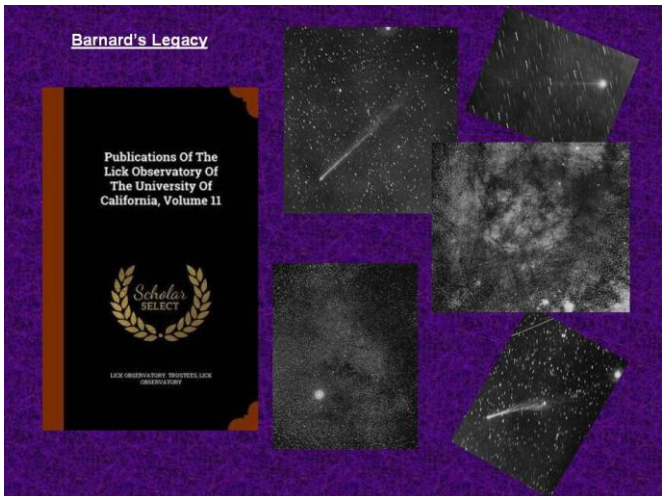


http://Stellar-Journeys.org

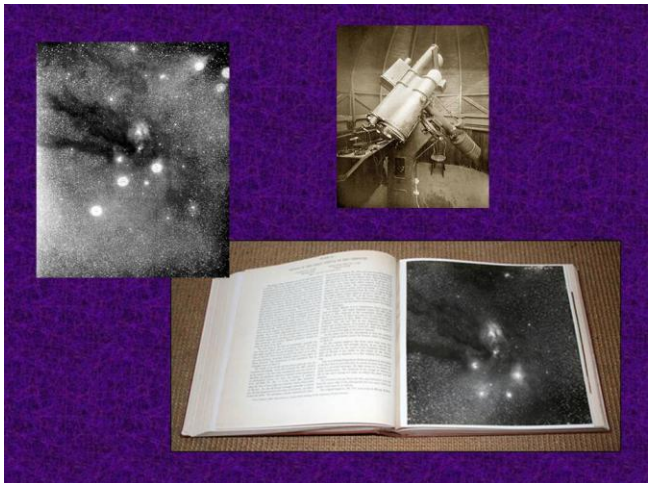


Barnard's Legacy

In 1902, after much prompting from colleagues both at Yerkes and Lick, Barnard took up the task of publishing his earlier Lick Observatory comet and Milky-Way photographs made with the 6" Willard lens/Crocker Telescope. Being the perfectionist that he was, Edward spent years experimenting with various Chicago printers using halftone processes or collotype printing, but was never happy with the quality. Finally, Edward found a printer that he was satisfied with, and his images, along with a write-up were published as volume 11 of the "Publications of the Lick Observatory" in September 1914.
Even though the images were now over twenty years old, the Lick photographs were declared groundbreaking and the publication became a valuable addition to every professional observatory and astronomical institution.



In 1907 Barnard obtained funding from the Carnegie Institution for a publication of his wide-field Milky-Way photographs made with the 10" Bruce Telescope.
Using what he had learned in 1914, in trying to find the best printer for his earlier work, Edward spent the next decade continuing working with various print studios to find one that could reliably replicate his images in the best format. After a number of false starts, Barnard finally came to the realization that none of them would ever be able to meet his high quality standard in the form of paper printed images. He decided that it would be worth the cost to have actual photographic prints made of each negative as a separate photograph that would be pasted into the pages of each individual copy of the atlas.
The printer would then create photographic print batches of each individual image, and Barnard would go thru each one separately, keeping only the best quality prints and rejecting any lesser quality copies, and then sending the rejects back to be reprinted. Edward ended up sorting thru near 35,000 prints to hand-select only the finest ones of consistent uniform quality that he considered worth including.



But before he could finalize his atlas of Dark Nebula, long-standing health issues that Edward had neglected finally caught up to him.
Declining in health, brought on from untreated diabetes and heart issues, Edward Emerson Barnard, at the age of 65, passed away on February 6th, 1923 at Yerkes Observatory in Williams Bay, Wisconsin.
As requested, Barnard was buried in his hometown of Nashville, where he was given a heroes funeral procession fitting to a state official.

But his assistant and niece, Mary Calvert who started working for Edward in 1905, along with the current director of Yerkes Observatory, Edwin Frost, dedicated themselves to finishing Barnard's work.
So in 1927, Edward Emerson Barnard's greatest accomplishment, his photographs of the Milky-Way listing 370 of his "Barnard Objects" was published as a two-volume photographic atlas called:
"A Photographic Atlas of Selected Regions of the Milky-Way". Only about a 1000 copies were printed, and they soon were all taken up by the various professional observatories and universities around the world. Today, the occasional 1st edition copy that comes available are highly sought after.

In addition to the Royal Astronomical Society's Gold Metal, Barnard also received three Gold Metals' from the French Academy of Sciences for his astronomical accomplishments. And he also received the Bruce Metal from the Astronomical Society of the Pacific.
Over the years, Barnard has had a number of solar system objects named in his honor, including an asteroid, a Lunar crater, another crater on Mars, and a region on Ganymede, Jupiter's largest Moon.

Conclusion:

E.E. Barnard is considered by some to be the last great Victorian visual observer, living at the dawn of the age of the "New Astronomy" - astrophysics. But Barnard was also one of the first pioneers of wide-field photography, and his discoveries and studies of these 'dark voids' in space and his realization, starting in 1913, from his observations, both visual and photographic ,that they were in reality foreground 'dark clouds' of interstellar gas and dust ,broke new ground in the science and changed our perception of the Milky-Way galaxy and star formation.
Edward Emerson Barnard straddled the divide between the old and new astronomy, and his work lives on today, both for the professional astrophysicist and amateur astronomer alike.

To E.E.Barnard, a clear night observing with a telescope was almost a sacred rite, to search for the truth in celestial places. So I encourage everyone to get out tonight and try your hand at finding and observing the celestial truth of these elusive deep-sky objects, the *Dark-Nebula* of Edward Emerson Barnard.

Credits:

"*A Photographic Atlas of Selected Regions of the Milky-Way*", E.E. Barnard and Gerald Orin Dobek, 2011
"*The Immortal Fire Within – The Life and Work of Edward Emerson Barnard*", William Sheehan, 1995
"*Deep Sky Magazine – A viewing guide to E.E. Barnard's Dark Nebula*", David Higgins, Summer 1987
"*Mercury Magazine - Edward E Barnard: The 14th Bruce Medalist*", Joseph Tenn, Sep/Oct 1992
"*Sky & Telescope Magazine - The Legacy of E. E. Barnard*", G. Mumford, July 1987
"*Astronomy Magazine* - E.E. Barnard's Magnificent Milky Way", William Sheehan, June 1996
"*Reflections* Magazine - A Man Not Known to Sleep, E.E. Barnard at Mount Wilson", M Morgan, Mount Wilson Institute, Summer Quarterly June 2014
"*Astrophysical Journal* – On Nebulous Groundwork in the Constellation Taurus", E.E. Barnard, March 1907, American Astronomical Society