June, 2014 Volume 55, Issue #6

The Prairie Astronomer

The Official Newsletter of the Prairie Astronomy Club

IN THIS ISSUE:

June Program

Instead of a program we will have our annual Near Star Party. Dave Churilla will have his new Lunt 60mm Solar filter there and he will set up Hyde's new Coronado scope. Bill Lohrberg will also have his Dob set up with his white light filter.

The Near Star Party will begin at 6pm and we invite all with scopes and solar filters to set up with us. There won't be a formal presentation but Dave will answer any questions you have about solar viewing and solar filters.

Nearest Star Party - May 31, 2011 at Hyde Observatory.

Night Sky Network

The Prairie Astronomer is published monthly by the Prairie Astronomy Club, Inc. Membership expiration date is listed on the mailing label. Membership dues are: **Regular $30/yr, Family $35/yr**. Address all new memberships and renewals to: **The Prairie Astronomy Club, Inc., PO Box 5585, Lincoln, NE 68505-0585**. For other club information, please contact one of the club officers listed to the right. Newsletter comments and articles should be submitted to: **Mark Dahmke, P. O. Box 5585, Lincoln, NE 68505 or** mark@dahmke.com, no less than ten days prior to the club meeting. The Prairie Astronomy Club meets the last Tuesday of each month at Hyde Memorial Observatory in Lincoln, NE.

Meeting Minutes

Monthly PAC Meeting Minutes for May 27, 2014

Jack Dunn (President) called meeting to order at 7:31 PM. Welcomed members and new visitors. Introduced the program to follow the meeting "Laboratory in the Sky" by Michael Sibbernsen from Strategic Air and Space Museum on high altitude ballooning.

Next month program on June 24, 2014 will be solar observing led by Dave Churilla.

There will be an Omaha Astronomical Society/Prairie Astronomy Club joint dinner in Ashland at Parker's on July 12. More details will follow through Night Sky Network.

Jack detailed the benefits of PAC membership and dues.

Entertained a motion to pay 200.00 for annual land rental of star party location, and 300.00 to Jim Kvasnicka for star party land maintenance (mowing). Bob Kacvinsky provided further details and that this had historically been how we handled. Bob Kacvinsky motioned and Lee Thomas seconded. There was no further discussion. Motion was carried unanimously.

Treasurer's report was provided by Bob Kacvinsky. June 15 is the deadline for paying dues to the Astronomical League. All memberships must be paid up by that time in order to make it in time and receive the Reflector magazine. Bob will provide a memo through Night Sky Network.

Other business included notification of MSRAL conference June 6-8 in St Louis.

June observing report was provided by Jim Kvasnicka.

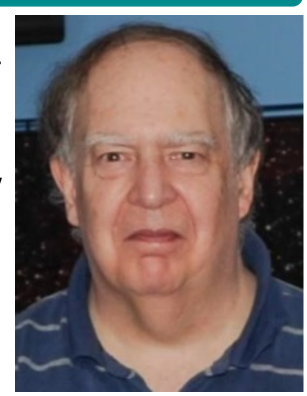
Meeting adjourned at 7:48.

Wrapping Things Up For My Summer

Over 40 years in Lincoln. It doesn't seem like that long. But it is. I have sent out the message to the PAC list that I will be retiring from UNL in August and will be leaving Lincoln. That means leaving PAC, Hyde and Mueller Planetarium. I will have more to say in next month's (July) issue. But this way, if you didn't hear it elsewhere, you'll now know that June will be my last PAC meeting for the foreseeable future.

There is no meeting in July. Like many PAC members, I will be at NSP. Also I wanted to put in a plug for the PAC/OAS dinner. It will be held July 12th at Parker's in Ashland. We'll have tickets at the club meeting The dinner is $20 for a big BBQ dinner.

I'm going to be the speaker and try to sum up 40 years of Astronomy and outreach. I remember when I joined the club Earl Moser was president. I hear from his daughter that his health is not good and we should keep listening for more news. Of course, at the time we were meeting at Nebraska Wesleyan thanks to Carroll Moore. I have many great memories of Carroll and his contributions. I'll try and give a perspective to all this in my talk. But I know you'll be there for the food.



At the same time, I do want to remind everyone the 2017 Total Solar Eclipse is only a little over three years away. We should be preparing now for the large influx of people we'll see in the Lincoln area. I'm sure Hyde will be a busy place and PAC will get great publicity. That brings me to NSP as our featured speaker will be "Mr. Eclipse" Fred Espanek. Fred is retired from NASA but still very active as he lives in the Arizona Sky Village at Portal, Arizona. He's giving two talks at NSP, one about his observatory (on the web at http://www.astropixels.com) and second one on eclipses and in particular the 2017 one. BTW - the Astronomical League has already asked him to speak at their national convention in the future. But we'll have him first.

Hope to see you at the meeting for one more time.

Clear DARK Skies, Jack Dunn - PAC President

ANNUAL MEMBERSHIP

REGULAR MEMBER - $30.00 per year. Includes club newsletter, and 1 vote at club meetings, plus all other standard club privileges.

FAMILY MEMBER - $35.00 per year. Same as regular member except gets 2 votes at club meetings.

STUDENT MEMBER - $10.00 per year with volunteer requirement.

If you renew your membership prior to your annual renewal date, you will receive a 10% discount.

Club members are also eligible for special subscription discounts on Sky & Telescope Magazine.

Club Telescopes

To check out one of the club telescopes, contact Cassie Spale. If you keep a scope for more than a week, please check in once a week, to verify the location of the telescope and how long you plan to use it. The checkout time limit will be two weeks, but can be extended if no one else has requested use of a club scope.

100mm Orion refractor: Available

10 inch Meade Dobsonian: Available

13 inch Truss Dobsonian: Available

PAC Star Party Dates

Dates in bold are closest to the new moon

2014 Star Party Dates
January 24, **31**
February 21, **28**
March 21, **28,** April 25
May 2, 23, **30,** June 20, **27**
July 18, **25**
NSP: July 27-Aug 1
August **22**, 29, Sept 19, **26**
Oct 17, **24,** Nov 14, **21**
Dec 12, **19**

Lunar Party Dates
May 9, June 6, Sept 5, Oct 3
* Lunar party dates are tentative, sites to be determined.

PAC E-Mail:

info@prairieastronomyclub.org

PAC-LIST:

To subscribe send a request to PAC. To post messages to the list, send to the address:

pac-list@ prairieastronomyclub.org

Events

PAC Meeting
Tuesday June 24th, 2014
@Hyde Observatory

OAS/PAC Dinner, July 12, Ashland

PAC Dinner, July 15 (tentative)

Nebraska Star Party
July 27-August 1.

THERE WILL NOT BE A JULY PAC MEETING

PAC Meeting
Tuesday August 26th, 2014
@Hyde Observatory

PAC Meeting
Tuesday September 30th, 2014 @Hyde Observatory

Newsletter submission deadline June 14, 2013

Links

PAC: www.prairieastronomyclub.org
Night Sky Network: https://nightsky.jpl.nasa.gov/
CafePress (club apparel) www.cafepress.com

www.hydeobservatory.info
www.nebraskastarparty.org
www.OmahaAstro.com
Panhandleastronomyclub.com
www.universetoday.com/
www.planetary.org/home/
http://www.darksky.org/

NGC4603 Credit: NASA

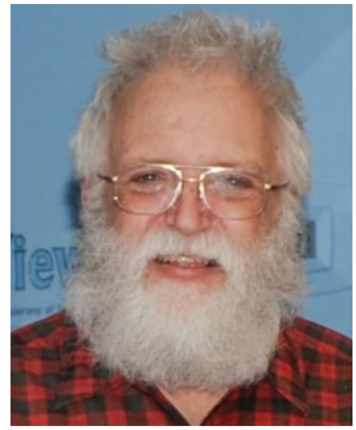
Designing My Remote Observatory Part IV—Rick Johnson

The Scope and Camera Issue Resolved

While I now had a working observatory with the 6” f/4 it was far from what I wanted. The low resolution of 3” per pixel covered a multitude of sins that I couldn’t survive at 0.6”. Focusing was one issue. To focus remotely you need an electric focuser. And not just any one. I had co-opted the one from my visual scope that I used for solar imaging with a video camera and put it on the 6”. The video camera was very light compared to the CCD which was light compared to the larger ones I was considering. While it cost over $100 it did slip under the weight of the CCD. It may have under the video camera but since that was focused manually it didn’t matter. Nor did it matter that it was powered only by a DC motor that moved about the same each time it was activated. But to focus remotely the focuser needs to be consistent and never slip. A much better way of focusing would be needed.

At the time most imagers used (and still do) use a free program called Focus Max. It works by making many calibration runs taking an image as it moves the focuser in known steps from out of focus through focus and beyond noting how the out of focus disk changed in size with each step. From many such runs it could calculate where the exact focus was but only if the motor driving the focuser always moved focus exactly the same each time. Any variation and it would fail. Since the cameras I was looking at were among the heaviest made I’d need a heavy duty focuser system.

Oddly one option was rather "cheap". If the mirror in an SCT is left unlocked another company made a unit that would use the focuser of the SCT along with a stepper motor that always approached focus from the same direction so backlash was eliminated. It with Focus Max could calculate the correct focus position from a couple trial images of a fraction of a second then move to that exact position. While Focus Max was free the control and stepper motor for the unit wasn’t. That was $500, more money into the black hole this was turning into but when I looked up the cost of an external focuser that met the requirements (the one that came with the LX200R didn’t) the cost was well over $1000. I figured this less than half the cost option best (Yep, I was wrong). Not yet having a scope I filed this information away and went about looking for which brand of camera, Apogee, FLI or SBIG.



SBIG seemed to have a neat idea. It was the only one the included a guiding system built in. It had a second chip that looked just over the top of the imaging chip that could guide the scope while the other chip was taking the image and do so with one power cord and one USB cord rather than two sets of USB and power cords needed for the other cameras. Some, less sensitive guide cameras were self powered over the USB saving one cord. The in camera guider had another advantage. With the two in the same unit any possibility of flexing between the two systems was eliminated. A separate guide system has to be super rigid or the guiding at 0.6” would fail. This system assured rigidity. Sounds great but...

There’s always that dang but butting in. The guide chip was very red sensitive and rather blind to blue light. It worked through the color filters when doing filtered frames needed for color. Those blocked one third the light. Since it was highly red sensitive that wasn’t bad for the red filter but horrible for the blue filter. In fact, talking to users of the cameras all mentioned that since the majority of stars are red dwarfs finding a sufficiently bright star to use for guiding when taking the blue frames could be extremely difficult. Since the chip was mounted rigidly you could only use the stars it saw. To find a good guide star the entire camera would need to be rotated and often the target placed well off center. Rotation meant the object wouldn’t necessarily be framed well and then being off center would just add to the problem. Like OSC this system was starting to look less than it first appeared. After talking with many users of all three cameras I decided most FLI users were highly satisfied with Apogee users not all that far behind but many SBIG users who paid extra for that internal guider had found they needed the same off axis guider and guide camera used by the other two cameras. In fact, today, SBIG has abandoned this approach and no longer sells cameras with the guide chip in them but for one model. While I hadn't decided between the low QE STL-11000 which didn't bloom and the STF-6303 that did I was going to go with FLI. That meant I needed to shop for a good off axis guider and guide camera. More research was needed. But before I got very far a couple unforeseen events changed my plans entirely.

About this time Meade announced that their 14" and 16" LX200Rs were now available in OTA versions (no mount) but it would be another year before the 12" would be available. Wait a year or go with the 14"? A few calculations said it would give a 0.5" pixel rather than 0.62" but that difference wasn't all that great so I placed an order with the only company that had one without a two month or longer backlog. It came in a week. But no camera. The small chip of the ST-7 just didn't work at that focal length so I continued to work with the 6" f/4 learning more about image processing and how to use the abilities of the software which was very complicated to this old guy's brain. This was a good thing as I'd have been in over my head with the 14" and my state of ignorance.

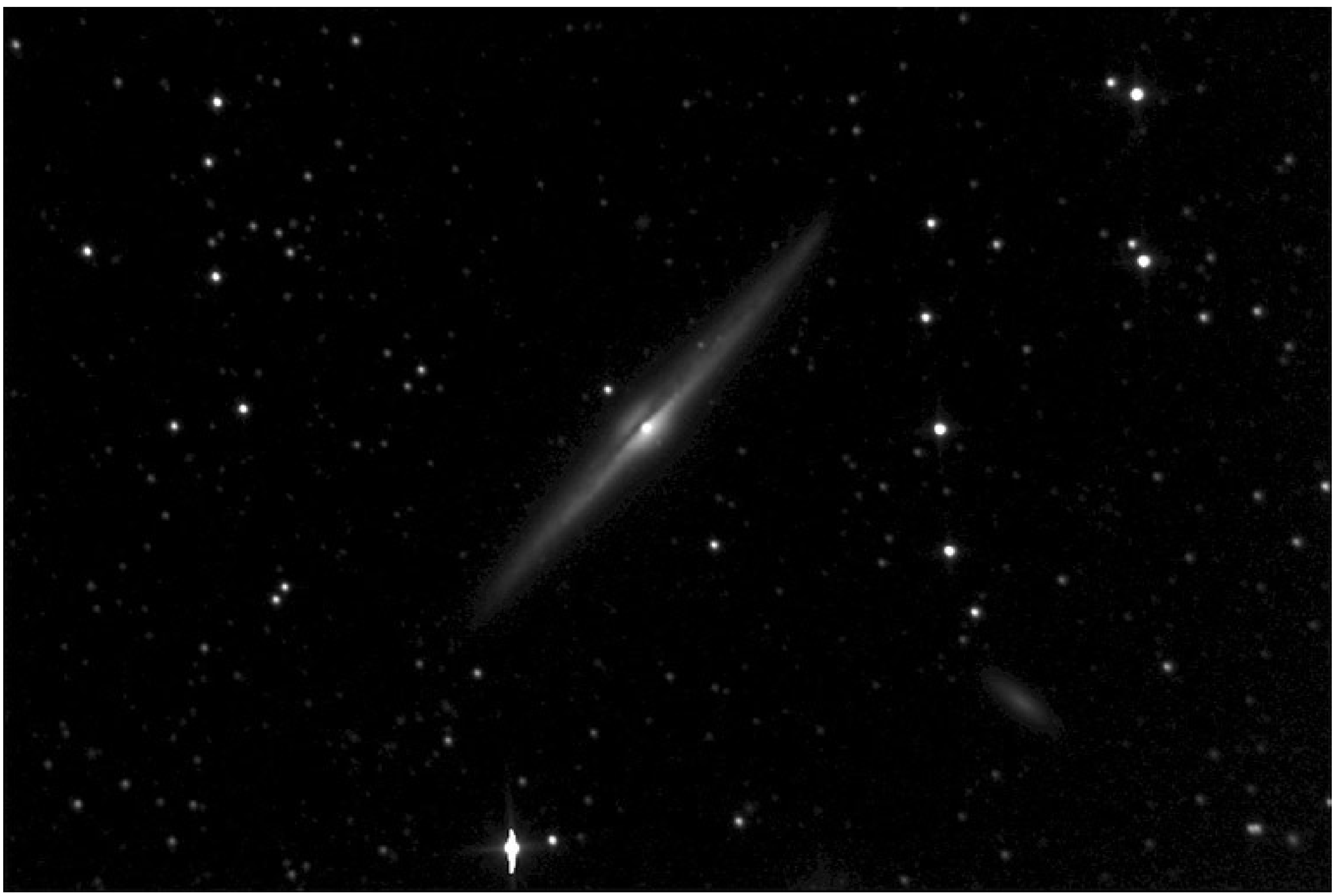
Now which camera, the far more efficient 6303 or the non blooming but slow 11000? That was quickly answered when another imager I knew offered me his 11000 with top filters (for that time) at a price I couldn't refuse. I figured while the camera was slower I was learning how to automate the imaging so time wasn't as critical as I'd originally thought. I could be doing other things while the image was taken. Dealing with blooms of the ST-7 was a pain (software is better today). Why was this fellow selling? He didn't like the lower QE and was moving to the 6303! He was going to do mostly narrow band imaging so didn't need the LRGB filters and was getting a narrower H alpha filter to better work during a full moon. And yes it was an FLI he was getting. Now I had all the pieces, I thought. The 14" came with an electric focuser I could control from the house when the mirror was "locked". This sounded great. As I've already discussed it didn't turn out that way. The 6" came off and the 14" went on. The ST-7 came off and went back to its owner (temporarily) and the STL-11000XM went on. A check from the house showed all was working great. I was in business. Or so I thought. I didn't know some things I've already told you. But I was going to discover them the hard way and quickly.

One I haven't mentioned is depth of focus. At f/4 the math says to have good focus I must position the CCD within 48 microns of the right position (less than half the width of a human hair. At f/10 which the new scope ran I had plenty of leeway as the zone was 287 microns or 6 times greater. That should be easy compared to the 6" scope. But the 6" scope was working at one sixth the resolution! That was hiding my focus errors. Now they were out in view and hitting focus was nearly impossible. While the software would send a short pulse to the DC focus motor it would move various distances each pulse so hitting focus was a hit or miss affair. Also it meant the CCD frame which is far larger than the one I had been using had to sit square to the optical axis to within 143.5 microns or a bit more than a human hair. The Meade focuser fell down here as well. It wasn't strong enough for the weight of the camera and would sag. How much it sagged depended on where the scope was pointed but there was no way to hold the camera at right angles to the optical axis and move the scope. This issue was made worse because there was no rigid connection between the focuser and camera. You just slid in the 2" draw tube from the camera and hoped it stayed square but under the weight that didn't happen either. Also the now 1.7" clear aperture vignetted the image. The focuser might work with small cameras but it was worthless for the STL-11000XM I had.

Also at the time I'd not heard of Focus Max I mentioned earlier. I was trying to use the focus routine in CCDSoft and a couple others but all suffered from finding good focus unless seeing was perfect. Then, with 10 minutes work, I could find a good focus. But the scope was very temperature sensitive. I was finding even if I did stabilize the focuser for a bit a temperature change of even 1°C would take the image out of focus so it was again 10 minutes of struggle to refocus. Change filters and you had to refocus as well. Focusing was turning into a nightmare.

Consulting the imager that loaned me the ST-7 I was told about RoboFocus and Focus Max. That worked well with the SCT's internal moving mirror focuser I was told. But that still left me with a camera that sagged as the scope moved around the sky. I needed a better connection system. More research and more money. For only about $50 there was a coupling that did rigidly mount the camera to the scope that was 2" internal diameter but I'd already found I was getting vignetting in the corners that was rather severe. Other users of the camera all told me I needed at least 3" couplings to assure all the light the scope could provide was hitting the chip. Those weren't $50! In fact, at the time I only found one provider and they wanted about $300.

I had more homework to do! In the meantime I started to learn mono imaging at 0.5" per pixel. That was a whole new ballgame from imaging at 3" per pixel. If I thought it was hard at 3" it seems the difficulty goes up by the square of the difference so was now about 36 times more difficult. In fact the 6" on the Paramount ME hardly needed guiding corrections as my errors were hidden by its low resolution. I could take 5 minute images without guiding in fact. Not so with the new scope! I was going to need some time to master this. Also, while only the centers



Typical image with the 6" f/4 and the ST-7 processed with insufficient software by an inexperienced user. Note the bloom from a bright star that's typical of such high quantum efficient cameras. Software can deal with this but I didn't have it at the time.

of the image I was taking were usable due to the focuser sag issue processing these higher resolution images was also a whole new ballgame. So I had plenty to work on while I solved the issue of how to focus and hold the camera rigid at the same time. I had an oddball idea in mind but needed time to figure out if it would work and then implement it.

14" system as first configured with the inadequate Meade focuser.

In the meantime I'd started to email out some of the "better" 6" f/4 images with the ST-7 and had a lot that hadn't been even processed. So while I worked out issues with the 14" I continued sending those out. I find them very embarrassing today but at the time they seemed a lot better than they really were. Also while I covered some of the issues I was fighting many I never mentioned so those who got those early emails will be hearing (and have heard) some things I never talked about before, at least in any detail.

Next month I'll cover the oddball way I ended up solving the guiding, camera rigidity and focus issues. Yes it was a major black hole for my bank account but has worked out very well even though as best as I can determine I was the only person in the world using this solution routinely at the time. It is starting to catch on with top mounts and software today.

Friday the 13th Full Moon - and the dome of the Nebraska State Capitol Building, by Mark Dahmke. This photo was taken with a Nikon D600 and Celestron Onyx refractor (about 600mm). 1/100 sec at ISO 800.

July Observing—Jim Kvasnicka

This is a partial list of objects visible for the upcoming month.

Planets

Venus: Low in the ENE at dawn shinning at -3.8.
Neptune: In Aquarius.
Uranus: In Pisces.
Mercury: To the lower left of Venus.
Jupiter: Lost from view early in July. It reaches conjunction on July 24th.
Mars: Dims from 0.0 to 0.4 magnitude in July.
Saturn: In Libra, the rings are at 21° from edge on.

Messier List – The Virgo Galaxy Cluster

M3: Class VI globular cluster in Canes Venatici.
M4: Class IX globular cluster in Scorpius.
M5: Class V globular cluster in Serpens Caput.
M53: Class V globular cluster in Coma Berenices.
M68: Class X globular cluster in Hydra.
M80: Class II globular cluster in Scorpius.
M83: Galaxy in Hydra.
Last Month: M58, M59, M60, M84, M86, M87, M88, M89, M90, M91, M98, M99, M100
Next Month: M6, M7, M8, M9, M10, M12, M19, M20, M21, M23, M62, M107

NGC and other Deep Sky Objects

NGC 6781: Planetary nebula in Aquila.
NGC 6818: Little Gem Nebula in Sagittarius.
NGC 6826: The Blinking Planetary in Cygnus.
NGC 6894: Planetary nebula in Cygnus.
NGC 6905: Blue Flash Nebula in Delphinus.
NGC 6934: Class VIII globular cluster in Delphinus.

Double Star Program List

Nu Draconis: Equal white stars.
Psi Draconis: Light yellow pair.
40/41 Draconis: Equal pair of light yellow stars.
Xi Scorpii: Yellow primary with a light blue secondary.
Struve 1999: Two yellow-orange stars.
Beta Scorpii: Blue-white primary with a light blue secondary.
Nu Scorpii: Yellow and light blue pair.
Delta Serpentis: Pale yellow pair.
Theta Serpentis: Two blue-white stars.

Challenge Object

Palomar Globular Clusters: Palomar 5 – Class XII in Serpens Caput.
Palomar 9 – Class VIII in Sagittarius.
Palomar 10 – Class VII in Sagitta.
Palomar 12 – Class XII in Capricornus.

NGC Objects—Jim Kvasnicka

NGC 6781 is a planetary nebula located in the constellation Aquila. It is 2,500 light years distant and has a magnitude of 11.4. It has an apparent size of 1.8'.

NGC 6781 is an almost perfect circular bubble of gas cast off by a Sun like star that died. The bubble continues to expand and it measures 2 light years across. Through a 16 inch telescope you are able to see the central star which glows weakly at magnitude 16.2.

Compared to the Ring Nebula NGC 6781 is larger and dimmer, but not so dim to be seen in a small telescope. In a 6 inch telescope NGC 6781 stands out well against a rich star filled background. The disk appears to have a slightly darker center and if the seeing is good at your observing sight look for dark blotches on the face of the planetary nebula.

NGC 6781 is part of the Herschel 400 list.

The piece, shown below, is an antique table-top telescope that is now in the possession of the Wildwood Historic Center (http://www.wildwoodhistoriccenter.org/) in Nebraska City.

The most reliable indicator of the telescope age is the date 1854 carved into the telescope storage box. Interesting enough, that date is also the year that Nebraska became a territory of the U.S., the year a solar eclipse occurred, and just shortly after Neptune was discovered in 1846. The back end of the main telescope tube is clearly marked "Yeates & Son, Grafton St., Dublin", and that form of inscription corroborates the box date.

The best estimate of the original purchase cost is about $2,000 and the craftsmanship in the telescope is impressive. The first person to possess the telescope was believed to be Mr. Cornelius Shannon of Dublin, and it stayed in that family until it was donated to the Wildwood Historic Center in 1969. Current work has only found one other similar telescope by the manufacturer Yeates & Son, currently at the NUI museum in Maynooth, Ireland, so the restored telescope is quite rare.

The telescope was not useful for viewing in early 2014, as issues blocked the light within the telescope and some parts were missing. The work on the telescope included, but was not limited to, removal of all lenses and cleaning them with a mixture if isopropyl alcohol and distilled water, removal of all debris from the interior of the telescope, replacing missing screws, and checking optical alignment. The exterior of the brass telescope was not cleaned, as directed by the Wildwood staff, so as to preserve the patina appearance as an antique. Work on the storage box included making new wood parts for those that were missing, repair of a major crack in the lid due to warping of the wood, forming a new tray to house the storage box so as to preserve the 1854 date scratched into the bottom of the box, and restoring the capability to store the telescope in the storage box with the lid closed.

In tandem with the restoration work, an extensive effort to determine the main characteristics of the telescope was accomplished to aid any future restoration efforts. All of the optics are "original glass" from the mid-1800's. Work including focal length testing and the simple lens formula to determine the infinite focal length, using polarized plates to examine the objective for residual stresses (to assess if the lens was at risk for cracking), disassembly of the eyepieces to determine their type and focal length of each element (again with the simple lens formula), researching formulas to determine the focal length of each eyepiece (they were not marked), learning to use OpticalRayTracer 3.3, and performing a final laser collimation on the optics.

Test for determining the AFOV of eyepieces

The primary characteristics are:

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Objective Lens</td><td>2.09” / 53mm (clear aperture), simple, double-convex</td></tr>
<tr><td>Objective Focal Length</td><td>30.3”/770 mm (Sample Std. Dev. (s)=0.345”/8.9mm => 1.1%, N=6). Overall metric: f/ 14.5</td></tr>
<tr><td>Eyepieces</td><td>Christian Huygens design
<table>
<tr><th>Eyepiece Physical Length, inches</th><th>AFOV, degrees [Kinsey’s methods]</th></tr>
<tr><td>3-1/8</td><td>21.1 (s=0.4, N=10)</td></tr>
<tr><td>2-3/8</td><td>25.8 (s=0.2, N=10)</td></tr>
<tr><td>7/8</td><td>Received damaged</td></tr>
</table>
From star drift measurements:
<table>
<tr><th>Eyepiece Physical Length, inches</th><th>TFOV, degrees</th><th>Eyepiece focal length, in/mm</th><th>Eyepiece sample std dev. error</th><th>Eyepiece Magnification</th></tr>
<tr><td>3-1/8</td><td>1.63 (s=0.03 N=8)</td><td>2.3 / 59.6</td><td>2.8%</td><td>13x (s=0.4x)</td></tr>
<tr><td>2-3/8</td><td>1.59 (s=0.02, N=10)</td><td>1.9 / 47.4</td><td>1.9%</td><td>16x (s=0.3x)</td></tr>
<tr><td>7/8</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>
Those are “respectable” magnifications for the mid 1800s.</td></tr>
<tr><td>Erector Tube</td><td>The telescope came with a tube that could be inserted between the eyepiece and the telescope housing, much like a “Barlow” lens would be, but had radically different lenses in it. Investigations revealed it was an old design that has the dual function of being an image erector as well as increasing the magnification of the telescope by a factor of 2.2</td></tr>
</table>

Telescope Inscription

Test of focal length of primary

In summary, restoring a high quality, and rare, antique telescope was an adventure in tracing the genealogy of the previous owners as they traveled from Ireland, to England, to Ontario Canada, into the Nebraska Territory long ago, and finally to residing in Nebraska City. The adventure also included finding like wood to repair the wooden storage case and developing a means to preserve the storage box from further damage! Last, but not the least, of the adventures was the privilege of restoring the optics of the telescope and characterizing the optics, together with finally locating the great-great-great-grandson (may be short a great- or so) of the telescope maker (George Yeates) in Australia and corresponding with him via e-mail with him. Looking at stars, the moon, and some planets with such a rare antique telescope and just imaging all that have do so in the past was inspiring. It was a privilege to go on such a restoration adventure while contributing in a meaningful way to the Wildwood Historic Center museum in Nebraska City.

Eugene is open to questions from readers, please put "Yeates" in the subject line.

Contributors to the restoration effort, in no particular order, were:

Jacobson Woodworking (Nebraska City, NE)	*Mr. David Knisely* (Prairie Astronomy Club)
Mr. Carl Bergman (Nebraska City, NE)	*Mr. Eugene Lanning* (Prairie Astronomy Club)
Mr. Dave Hamilton (Prairie Astronomy Club)	Fastenal Company (Nebraska City, NE)
Mr. Mark Dahmke (Prairie Astronomy Club)	*Mr. Chris Lord* (Antique Telescope Society)
Mr. Phillip Houston (Antique Telescope Society)	*Dr. James Quinn* (optometrist, Nebraska City, NE)
Mrs. Gail Wurtele (Manager, Wildwood Historic Center)	*Natanyal & Atira Lanning (Omaha, NE)*
Mr. Rick Johnson (Prairie Astronomy Club)	

While members of the Prairie Astronomy Club and the Antique Telescope Society contributed to the restoration project, the project was a private effort not endorsed by either group.

Left: Test setup to find focal length of each elements of the eyepieces

Below: Wildwood Historic Center

Mystery Solved? Why There are No Lunar 'Seas' On The Far Side Of The Moon

By Elizabeth Howell, Universe Today.

In these days of daily image releases from Saturn, Mars, the Moon and other spots in the universe, it's hard to remember just how exciting it was back in the 1950s and 1960s when a few images trickled out to the world at the time. Perhaps one of the biggest early surprises was how jagged and cragged the back side of the moon looked. Where were the lunar "seas" that we are familiar with on the Earth-facing side of the moon?

About 55 years after the first Soviet images of the farside were sent to Earth, a team of researchers led by graduate astrophysics student Arpita Roy (at Penn State University) may have an explanation.

They say it's due to the violent way that the Moon formed — likely after a Mars-sized object collided with our Earth, creating a sea of debris that gradually coalesced into the Moon we see today. The huge crash and gathering together heated up both our planet and the Moon, but the Moon got cooler first because it was smaller.

Since the Earth was still hot — radiating at more than 2,500 degrees Celsius (4,500 degrees Fahrenheit) — and the Moon very close to the planet, the heat of the Earth had quite the effect. The far side of the Moon cooled down while the near side remained very hot.

"This gradient was important for crustal formation on the moon. The moon's crust has high concentrations of aluminum and calcium, elements that are very hard to vaporize," Penn State stated.

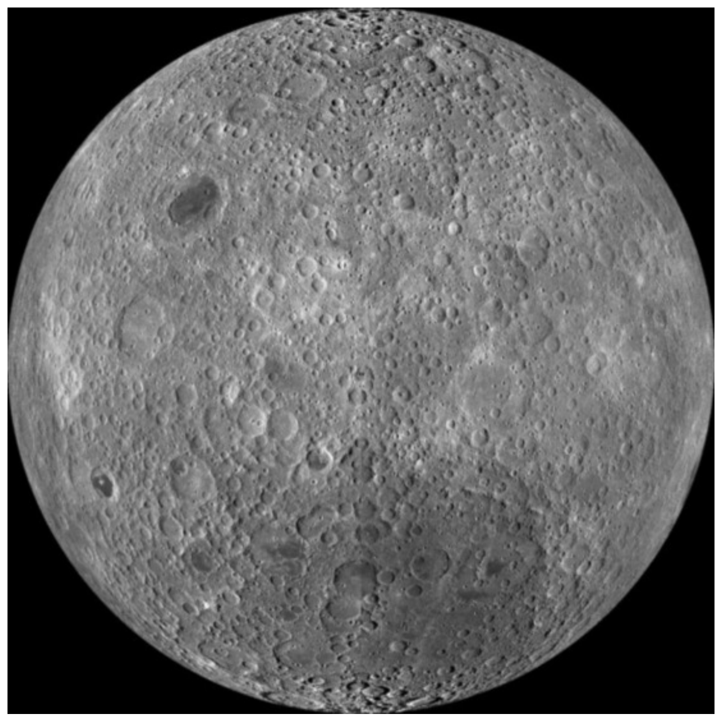
Calcium and aluminum are the first elements that "snow out" as rock vapor cools, and they would have remained in the atmosphere on the Moon's far side. (The near side was too hot.)

"Thousands to millions of years later, these elements combined with silicates in the Moon's mantle to form plagioclase feldspars, which eventually moved to the surface and formed the Moon's crust," Penn State added. "The farside crust had more of these minerals and is thicker."

The seas themselves were formed after huge meteors crashed into the Moon's Earth-facing side, rupturing the crust and letting the basaltic lava beneath burst forth. The crust on the far side was too thick for the meteors to penetrate, in most cases, leaving the rugged surface we are familiar with today.

The research was published yesterday (June 9) in Astrophysical Journal Letters. And by the way, there's been a flurry of news in recent days about the Earth and the Moon's formation: the "signal" in Earth's crust and the oxygen signature on the Moon.

Source: Penn State University



Composite image of the far side of the moon taken by the Lunar Reconnaissance Orbiter in 2009. Credit: NASA

Mercury Passes in Front of the Sun, as Seen From Mars

This comparison shows five versions of observations that NASA's Curiosity made about one hour apart while Mercury was passing in front of the sun on June 3, 2014. Two sunspots, each about the diameter of Earth, also appear, moving much less than Mercury during the hour. Image credit: NASA/JPL-Caltech/MSSS/Texas A&M

This animated blink comparison shows five different versions of observations that NASA's Curiosity made about one hour apart while Mercury was passing in front of the sun on June 3, 2014. Two sunspots, each about the diameter of Earth, also appear in the images, moving much less during the hour than Mercury's movement.

This is the first observation of any planet's transit of the sun observed from any planet other than Earth. It is also the first observation of Mercury from Mars.

With precise information about when the transit would occur, the rover team planned this observation using the telephoto-lens (right-eye) camera of Curiosity's Mast Camera (Mastcam) instrument. The camera has solar filters for routine observations of the sun used for assessing the dustiness of the atmosphere. Mercury appears as a faint darkening that moves across the face of the sun. It is about one-sixth the size of a right-Mastcam pixel at the interplanetary distance from which these images were taken, so it does it does not appear as a distinct shape, but its position follows Mercury's known path.

Each of the five versions of the image presented here blinks back and forth between two views recorded at different times during the transit. North is up. The version on the left is minimally enhanced, for a natural looking image of the sun with two sunspots barely visible. The second version has limb darkening removed, the edges masked. The third has enhanced contrast. The fourth has a line added to indicate the calculated path of Mercury during the transit. The fifth adds annotation to point out which spot is Mercury (in the cross hairs) and to identify two sunspots.

Transits of the sun by Mercury and Venus, as seen from Earth, have significant history. Observations of Venus transits were used to measure the size of the solar system, and Mercury transits were used to measure the size of the sun.

NASA's Jet Propulsion Laboratory, a division of the California Institute of Technology, Pasadena, manages the Mars Science Laboratory Project for NASA's Science Mission Directorate, Washington. JPL designed and built the project's Curiosity rover. Malin Space Science Systems, San Diego, built and operates the rover's Mastcam.

More information about Curiosity is online at http://www.nasa.gov/msl and http://mars.jpl.nasa.gov/msl/.

A Glorious Gravitational Lens, Dr. Ethan Siegel

As we look at the universe on larger and larger scales, from stars to galaxies to groups to the largest galaxy clusters, we become able to perceive objects that are significantly farther away. But as we consider these larger classes of objects, they don't merely emit increased amounts of light, but they *also* contain increased amounts of **mass**. Under the best of circumstances, these gravitational clumps can open up a window to the distant universe well beyond what any astronomer could hope to see otherwise.

The oldest style of telescope is the refractor, where light from an arbitrarily distant source is passed through a converging lens. The incoming light rays—initially spread over a large area—are brought together at a point on the opposite side of the lens, with light rays from significantly closer sources bent in characteristic ways as well. While the universe doesn't consist of large optical lenses, **mass itself** is capable of bending light in accord with Einstein's theory of General Relativity, and acts as a *gravitational* lens!

The first prediction that real-life galaxy clusters would behave as such lenses came from Fritz Zwicky in 1937. These foreground masses would lead to multiple images and distorted arcs of the same lensed background object, all of which would be magnified as well. It wasn't until 1979, however, that this process was confirmed with the observation of the Twin Quasar: QSO 0957+561. Gravitational lensing requires a serendipitous alignment of a massive foreground galaxy cluster with a background galaxy (or cluster) in the right location to be seen by an observer at our location, but the universe is kind enough to provide us with many such examples of this good fortune, including one accessible to astrophotographers with 11" scopes and larger: Abell 2218.

Located in the Constellation of Draco at position (J2000): R.A. 16h 35m 54s, Dec. +66° 13' 00" (about 2° North of the star 18 Draconis), Abell 2218 is an extremely massive cluster of about 10,000 galaxies located 2 billion light years away, but it's *also* located quite close to the zenith for northern hemisphere observers, making it a great target for deep-sky astrophotography. Multiple images and sweeping arcs abound between magnitudes 17 and 20, and include galaxies at a variety of redshifts ranging from z=0.7 all the way up to z=2.5, with farther ones at even fainter magnitudes unveiled by Hubble. For those looking for an astronomical challenge this summer, take a shot at Abell 2218, a cluster responsible for perhaps the most glorious gravitational lens visible from Earth!

Learn about current efforts to study gravitational lensing using NASA facilities: http://www.nasa.gov/press/2014/january/nasas-fermi-makes-first-gamma-ray-study-of-a-gravitational-lens/

Kids can learn about gravity at NASA's Space Place: http://spaceplace.nasa.gov/what-is-gravity/

Abel 2218. Image credit: NASA, ESA, and Johan Richard (Caltech). Acknowledgement: Davide de Martin & James Long (ESA/Hubble).

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Amateur Astronomy — A Hobby as Big as the Universe

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TUESDAY
June 24, 2013
6:00 PM
Hyde Observatory