The Prairie Astronomer

The Official Newsletter Of The Prairie Astronomy Club, Inc.

March 2000 **Volume 41 Issue #3**

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MEETINGS & EVENTS

PAC MEETING
TUESDAY, MARCH 28, 2000, 7:30 PM
at Hyde Memorial Observatory

CLUB STAR PARTY
FRIDAY, APRIL 7, 2000
OAS Observing Site
(see map on back page)

UNL STUDENT OBSERVATORY OPEN HOUSE
FRIDAY, APRIL 7, 2000, 8:30 P.M. TO 11:00 P.M.
UNL Student Observatory

HYDE VOLUNTEER MEETING
SUNDAY, APRIL 9, 2000, 7:00 - 10:00 P.M.
At Hyde Memorial Observatory

PAC YOUTH GROUP MEETING
SUNDAY, APRIL 9, 2000, 7:00 - 8:30 P.M.
At Hyde Memorial Observatory

COMMITTEE PLANNING MEETING FOR 2000 NSP
THURSDAY, APRIL 13, 2000, 7:30 P.M.
Mahoney State Park Lodge

PAC MEETING
TUESDAY, APRIL 25, 2000, 7:30 PM
at Hyde Memorial Observatory

MARCH'S PROGRAM:

Not Yet Announced

Please check the club website for the latest information.

PAC-LIST: Mark Dahmke maintains an e-mail list server for PAC. If you have an e-mail address and are not on the PAC List, you may subscribe by submitting an e-mail to list@4w.com. Write "Subscribe PAC-List" in the body of the e-mail.

IRIDUIM FLARES: A federal bankruptcy judge has given permission to de-orbit the iridium satellites beginning in two weeks. So if you haven't caught one you don't have much longer. (Thanks to Rick Johnson for the info) http://ap.tbo.com/ap/breaking/MGI7EIJMY5C.html

BEHLEN OPEN HOUSE: The Behlen Observatory Public Night for the Spring of 2000 will be held on March 31st. It will run from 7 pm to 10 pm.

PAC OFFICER PROFILE: Liz Bergstrom, our club treasurer, is the last officer profile to be published. However, due to time restraints, it will have to wait until the April issue.

CONTENTS:

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 $20/yr, Family $22/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 on the last page of this newsletter. Newsletter comments and articles should be submitted to: **Jeff King, 4018 South 83rd Street, Lincoln, NE 68506-5973 or jeffrey892@aol.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.

Secretary's Report

By: Willa Penney

President Dave Knisely opened the meeting; we had 2 guests.

Dave Scherping, Hyde Observatory Chairman, presented the Volunteer of the Year award from Hyde Observatory and the Lincoln Parks & Recreation Department. This award, given to the outstanding volunteer, was presented to Lee Taylor, who volunteered 37 nights this past year. Congratulations, Lee!

The next NSP Planning Meeting is scheduled for March 9th; it will be at the Mahoney State Park Lodge at 7:30 p.m. Doug Bell announced that the speakers have all been lined up for NSP; Doug has information packets available.

Mark Fairchild, Hyde Volunteer Chairman, announced that the next meeting for volunteers will be Sunday, March 12. An appreciation night, with pizza, will be held Tuesday, March 7, for those who volunteered within the past year.

There will not be observing at UNL this month because of spring break.

A new Platte Valley Astronomical Observers Club has been formed. Their meetings will be held at Crane Meadows Nature Center on the third Thursdays of each month.

The Annual Convention of the Mid-State Regions Astronomical League will be June 9 – 11 at Kansas City.

Bill Wells, Club Observing Chairman, reminded everyone of the club star party this Friday at the OAS site. A map is on the back page of the monthly newsletter.

Astronomy Day is scheduled for May 13 at Morrill Hall; there will also be events at the SAC Museum. At least one astronaut is scheduled to attend as well as representatives from the Johnson Space Center and from Lockheed/Martin. Jack Dunn is predicting that we may very well have space “week” in coming years, or at least the event will span several days. Lee Taylor, Chairman of Astronomy Day, will be lining up volunteers and equipment for display.

The meeting was adjourned to our program: Bill Wells demonstrated “home-made” astronomical equipment.

DS030400 DEEP-SKY OBSERVATIONS
by David Knisely

DATE: March 4th, 2000 *and* March 5th 2000, 0630 to 0945 hrs UTC.
LOCATION: Rockford Lake, Nebraska 40.227N, 96.581W, 1400 ft. elevation.
INSTRUMENT: 10 inch f/5.6 Newtonian, 59x, 101x, 141x, 220x, 253x, 353x
CONDITIONS: Clear, Temp. 40 deg. F. Wind Calm.
UNAIDED EYE LIMITING MAGNITUDE: 6.7 (on March 4th), and 6.8 (on March 5th).
SEEING: 0.8" arc (variable).

OBSERVATIONS: I finally got two back-to-back nights which were nice and clear,with temperatures I could easily deal with. In addition to some much needed sight-seeing, I managed to log another 16 Herschel II objects with only 26 more to go to complete my list. I began with an extended look at "Leo's Triplet", M65, M66, and NGC 3628. I could easily see M65 and 66 in my 8x50 finder, and all three fit nicely in my 24mm Koenig (59x), but I found higher powers to be much better at showing the wealth of detail visible. M65 was a nice elongated almost cigar-shaped fuzzy patch with a small brighter center. I found 141x to be ideal for showing the galaxy's star-like nucleus, but also faintly noted the dark lane along the east side of the galaxy, as well as faint patches in the north and south portions of the object. The galaxy held up well even at powers as high as 253x in my 14mm Meade Ultrawide with the 2.5x Televue Powermate. M66 showed even more detail, with several faint patches outlining portions of the rather distorted spiral structure in the main body of the galaxy. The broad faint fan of the western spiral arm was also seen clearly extending well to the southwest of the main body of the galaxy. NGC 3628 is a very nice edge-on spiral which showed a dark lane running down the entire length of the galaxy. 141x made the ends of this object look a bit "bushy" or flared. I also spent a little time on M81 and M82 before getting more "serious". M81's spiral arms were very faint and a long way out from the bright inner core. The southern arm showed as a dim patch as it arced around the south side of the galaxy, but it was also vaguely visible as a very dim narrow feature well to the east of the bright core. The northern arm complex was visible as a diffuse patch as well, but its extension to the west was a bit vague at best. M82 showed its usual wealth of dark detail at 220x, with the main central dark band being visible even at 59x.

After this side trip, I went after the large faint planetary nebula PK164+31.1 in Lynx, also known as JnEr-1. I like to call this one "the Headphone Nebula", as in photographs, that is a bit what it looks like. It was not difficult to find the correct field, but the object itself was a bit elusive without filters. I finally sighted it as a large but *very* faint double blob-like glow without a filter, approximatly the size of M27. With the UHC, the object became somewhat easier, as it now appeared as two very faint oval fuzzy patches on a northwest-southeast line with a hint of a ring-like feature linking the two patches to form a rough annulus. With the OIII filter, the patches became much better defined, but the ring-like feature linking them became somewhat more difficult to see. The H-beta filter killed the nebula completely, while the Deep-sky filter provided only a slight gain in contrast over non-filter use. This object is one of the more difficult of the "big" planetaries, but was worth the hunt, as I had not seen it in several years.

I took a short break to let a local Sheriff's deputy who regularly patrols the park have a look at M13 and M51 before he was once again called away to more pressing duties. He was blown away by M13 using the 24mm Koenig and my 2.5x Powermate (148x), and had little difficulty in noticing the dim spiral structure of M51 at that same power. I think about 14x to 15x per inch seems to yield a good compromise between object size and brightness, as I usually employ such powers to do my "post-finding" descriptive observations of the Herschel II objects. It brings out a great deal more features such as star-like nucleii, dark lanes, and hints of weak spiral structure more than lower magnifications tend to do.

I then resumed my Herschel II hunt, bagging 11 more galaxies before I ended the first night's observations. Many of these did show star-like nucleii, but not a lot of additional detail, other than vague hints. One exception to this was the moderate-sized faint galaxy NGC 5068 in Virgo. Low power just showed a good-sized very dim oval glow which was rather diffuse, but switching to 141x changed it into a large area of haze with extensive mottling. The core was noticably elongated with a very faint star-like pip near its center, while numerous other very faint patches

surrounded it. Although spiral stucture was not well-shown, it was fairly clear that thegalaxy was a barred spiral. Another highlight of the first night was the nearly edge-on spiral NGC 5084. This one had a brighter oval core and a star-like nucleus with spike-like extensions outward into the east and west parts of the galaxy.

The next night, I did a little more sight seeing before once again plunging into the Herschel II's. Several of these were in tight groupings with other galaxies, which made exact identification more difficult. The scale of Uranometria was sometimes too small to be certain of which object was which, so I just dictated a description of the field into my tape recorderand sorted things out later with Megastar. I did take a few side-stops to more familiar objects, such as the "Ring-Tail" galaxy NGC 4038-9 in Corvus.

This was one object which really revealed itself to high powers. At 59x, I could see a somewhat oval patch with a "hook' on one side, but at 220x, the object showed a great deal of faint patchy detail in both the main oval part of NGC 4038, as well as its interacting companion NGC 4039. The whole thing ended up looking a bit like a shrimp! While in the area, I paid brief visits to M104 and M83 before resuming my Herschel hunt. M104 was glorious at both 141x and 220x, showing a bright star-like nucleus in an oval inner core. The long dark lane was easy to see, showing a hint of curvature towards each end.

M83 also showed an even brighter central core and star-like nucleus, as well as the dim curved central bar of the galaxy. The spiral structure was faint and somewhat diffuse but was dimly visible, with numerous faint mottled patches throughout the field at 220x. Overall however, it seemed to look best at 141x.

Once I had enough of my faint fuzzy Herschel II's, I picked up one last "old favorite", the bright planetary nebula NGC 6210 in Hercules. We had been discussing it on the amastro mailing list, so I thought I would get another look at it for posting purposes. Low power showed a tiny fairly bright bluish-green disk, and the use of the UHC or OIII filters showed hints of a possible faint outer shell, especially just to the north and south of the planetary's main disk. Seeing was quite good, so I bumped things up to 353x using the Powermate, and was surprised to see a little more detail.
The disk was somewhat oval and diffuse, and had a slightly smaller and a bit brighter broad ring-like feature superimposed on the disk. At the center was a small brighter puff which, when seeing got very good, showed a tiny faint central star, probably 12th magnitude or so. All in all, it was a pretty goodnight.

Clear skies to you.

David Knisely

Objects in Coma Berenices

The stars that form the constellation really aren't that remarkable to look at, only a handful of fourth-magnitude stars, including three Bayer stars. Yet there are several fine binaries, eight Messier objects and the Coma Star cluster, not included in Messier's list.

From *Denebola (beta Leonis)* draw a line to the bright star to the southeast, *Arcturus (alpha Bootis)*. Alpha Comae is found on this line at about the midpoint.

Now proceed north from *alpha Comae* to *beta Comae* and then west about the same distance to *gamma Comae*. These three stars form half of a nearly perfect square. They aren't very prominent, and you will have to have a nice dark night in order to study them.

Alpha Comae, sometimes called *Diadem*, has the same diameter as our Sun, and is 62 light years away with a luminosity of nearly three. It's a rapid motion binary (see below) and in the same field is the globular cluster M53 (see below).
Beta Comae is actually the brightest star in the constellation, and certainly the closest at 27 light years. It too has a diameter equal to the Sun.
Gamma Comae is an orange star about 260 light years away. It is in the same region as the well-known Coma Star Cluster, but isn't a member of that group.

Double stars in Coma Berenices:

Alpha Comae is a rapid binary of two equal stars (5.05, 5.08). The companion orbits every 25.87 years and is presently decreasing; in 2000 the separation will be less than 0.05". The orbit is an unusual one, seen perfectly edge-on.
Zeta Comae is a fixed binary: (6.0, 7.5; PA 237º, separation 3.6").
17 Comae and *24 Comae* are two binaries with contrasting companions.

17 Comae is one of the members of the Coma Star Cluster. The primary is white, the companion a soft blue: 5.4, 6.7; PA 251º, separation 145". From *gamma Comae* follow the slight arc of stars south that bend to the east. First comes 14 Comae, then 15, and finally 17.

24 Comae is even more spectacular: a fixed binary with an orange primary and emerald component. (5.5, 7.0; PA 271º, separation 20.3").

This binary is located eight degrees west of alpha Comae and one degree north.

35 Comae is a slow double with an orbit of over 600 years. However, unlike most long period binaries, this one is presently quite close. While the companion is beginning to emerge from its close pass with the primary, and gradually lengthening its separation, it won't achieve one arc second of separation until past the year 2000. Presently the values are: 5.1, 7.2; PA 207º and separation 0.79".

35 Comae is in a fairly barren part of the sky, found five degrees northwest of alpha Comae.

Struve 1633 is a very pleasant fixed binary: 7.0, 7.1; PA 245, separation 9.0". To find it start from *gamma Comae*, then drop down exactly one degree south where you'll find 14 Comae. Struve 1633 is one degree to the west.
Struve 1639 is a closer binary: 6.8, 7.8; PA 323º, 1.7". This is a slow moving binary with an orbit of 678 years.

This double star makes a small triangle with 12 Comae and 13 Comae. Start at 14 Comae and look south. The bright star to the east is 15 Comae, while below this and to the west is 13 Comae. Nearby, immediately southwest, is 12 Comae. Now look between these two stars to the southeast, where you'll find the third point in the triangle. This is Struve 1639.

Variable stars in Coma Berenices:

The constellation doesn't have a wealth of variable stars. We list the two variables that might be of some interest.

13 Comae is an alpha-CV type variable with very small range (5.15-5.18).

R Comae is a long-period variable with period of 362.82 days, and range of 7.1 to 14.6. Thus the maximums are nearly a year apart. In the year 2000 the maximum should occur in the first week of December.

Deep Sky Objects in Coma Berenices:

There are eight Messier objects (M53, M64, M85, M88, M91, M98, M99, and M100), as well as a number of other fine galaxies, with NGC 4565 being the best of the bunch.
However the best object is the unrivalled open cluster known as ‘The Coma Star Cluster’.

The Coma Star Cluster

Best seen in binoculars, the cluster fills the entire field of view: about 40 stars spread out over a five degree area.

The cluster was once known as the tuft of hair at the end of Leo's tail. It now constitutes Berenice's golden tresses.

The cluster extends south from *gamma Com* (which is not, however, a member). At about 270 light years away, the cluster is one of the closest to our solar system.

The brightest member of the cluster is 12 Comae. Other fourth-magnitude members are 13 and 14 Comae, and another thirty or so fainter stars go to make this one of the loveliest sight in the heavens.

The Messier Objects in Coma Berenices

M53 is a globular star cluster one degree northeast of *alpha Comae*. The brightest Messier in the constellation (7.7), it tends to be most impressive with larger telescopes, which are needed to resolve the individual stars. The cluster is thought to be 65,000 light years away.

M64, the *Black Eye Galaxy*, is a bright (8.5) compact spiral one degree east-northeast of 35 Comae. The "black eye" can only be seen under ideal conditions with large telescopes. The galaxy is over 20 million light years away.

M85 is a bright spiral galaxy and member of the Virgo Galaxy Cluster, most of which is found about five degrees further south. All the remaining deep sky objects discussed also belong to this cluster.

M88 is a many-armed spiral galaxy some forty million light years away. Quite bright (9.5), it's a favourite with many Messier observers.

M91 (NGC 4548) is another spiral galaxy, but is a rather confusing object, sometimes being labelled M58. It is a rather faint galaxy (10.2) and one wonders why, with so many galaxies in the region, spreading down through Virgo, that this one was chosen by Messier.

M98 is a faint (10.1) spiral seen practically edge-on, lying just half a degree west of 6 Comae.

M99 is roughly one and a half degrees east-southeast of M98. An open spiral seen face on, its several arms are visible in large scopes. It has a brightness of 9.8.

M100 is the largest of these spiral galaxies, although difficult to appreciate in small telescopes. It's seen face-on, and has a brightness of 9.4.

NGC 4565 is a well-known edge-on spiral with highly visible dust lane from end to end. It's the largest galaxy of its type and has a visual magnitude of 9.6. The galaxy is found one degree due east of 17 Comae.

Coma Berenices has many more deep sky objects, particularly the southern regions, where it borders Virgo. This is a fertile part of the sky to investigate, as the evenings grow a little warmer and more inviting.

Behlen Open House

The Behlen Observatory Public Night for the Spring 2000 will be held on March 31. It will run from 7 pm to 10 pm. The evening will start by viewing the Orion Nebula (M42). It is a giant cloud of gas where it is thought that stars are still forming today. Four hot stars known as the trapezium heat up the surrounding gas and give the Orion Nebula its eerie glow.

A special treat of recent public nights at Behlen Observatory has been the presence of amateur astronomers from the Lincoln and Omaha astronomy clubs, who bring their telescopes to share astronomical viewing with the public. Look for them outside near the south end of the observatory. You will be impressed by how much an amateur's telescope can show you and also learn about the fascinating hobby of amateur astronomy.

CENTRAL OBSTRUCTIONS AND THEIR EFFECTS

by David Knisely

In most reflecting or catadioptric telescope designs, a secondary mirror is required in the optical path to send the light from the main mirror to the correct position for viewing. This mirror and its holder obstructs some of the light entering the telescope, and for larger secondaries, this has the potential to cause some problems.

A central obstruction affects the image in two ways:

1. Causes a light loss due to the blocking of light entering the telescope.

2. Introduces diffraction effects which can cause a slight loss of both light and contrast for high power images *if the secondary is too large*.

As far as light loss is concerned, the best human eye can just detect a difference of 0.1 magnitudes, so with obstructions less than 30 percent of the aperture diameter (9 percent of the area), the actual light loss caused by just the blockage is essentially undetectable visually. Indeed, many people have trouble seeing a magnitude difference of 0.2 magnitudes, so for obstructions of less than 41 percent of the aperture (16.8 percent of the area), the light loss due to the obstruction is not all that noticeable.
Of these two effects, the second (diffraction) is more significant. The obstruction from the secondary and its cell slightly alters the disk and ring diffraction pattern of stars, taking a little light out of the central Airy
disk and putting it into the rings (mostly the first ring out from the Airy disk for common-sized obstructions). If the secondary is large enough, this energy redistribution can result in a slight reduction in the contrast of fine detail for high power images of the moon and planets. How much of a problem this is for the observer depends on how big the obstruction caused by the secondary is. In practice, if the secondary obstruction is less than 20 percent of the main mirror's diameter (1/5th of the mirror is obstructed), the effect on the image is negligible. For example, a six inch f/10 Newtonian with a 1 inch secondary mirror (16.7% obstruction) would perform about as well as if the obstruction wasn't there at all. Indeed, the secondary's obstruction can be somewhat larger without hurting high power images all that
much.

As you use larger and larger secondary sizes, eventually, high power images will tend to gradually acquire a slight "softness" to them, which may make fine low-contrast detail a bit harder to see. A certain limit comes when the secondary obstruction does become somewhat more noticeable, and that point is when the obstruction reaches about 25 percent of the main mirror's diameter. This amounts to a six percent light loss, and becomes significant, especially for daytime use, when the shadow of the secondary mirror may become visible in the eyepiece at low power. Only Rich-field instruments, Cassegrain systems, or those instruments requiring large fully illuminated fields should have secondaries which obstruct more than 25 percent of the aperture.

One frequent claim by some authors is that a larger secondary can help increase the apparent resolving power of a telescope. This is somewhat of an exaggeration. While the diffraction caused by the secondary obstruction does cause a reduction in the diameter of the Airy disk, the actual amount of
reduction for common central obstruction sizes is slight, and would not significantly improve the ability of the telescope to resolve close double stars. Indeed, the diffraction disk of a telescope with a 20 percent central obstruction is only about four percent smaller than that of an unobstructed instrument. Even a 33 percent central obstruction would only yield a 10 percent reduction in the Airy disk size, so for common central obstruction sizes, the "improvement" in effective resolution is negligible. The amount of energy put into the first ring by the obstruction would negate any alleged resolution increase on extended objects, so it is still best to keep the secondary obstruction at 25 percent or less if possible.

As long as you keep the secondary's minor axis size below 1/4 of your primary mirror diameter, the telescope should yield good images. However, even at a 25 percent level, the image degradation is far from fatal, and the telescope will still function. Often in Newtonian design, an

18% to 25% central obstruction range is a good guideline to follow. As for resorting to ultra-small secondaries to improve the telescope's high-power performance, this can backfire. The proper size for Newtonian's secondary mirror will depend on many things, but it is important to make certain that it big enough to catch all the light from the primary mirror which is headed to at least a small area around the center of the field. You don't really get significant image quality improvement by using a secondary size much under 20 percent of the main mirror's diameter, and you may actually lose light with a secondary mirror which is too small to catch all the light from the primary mirror. In addition, low profile focusers used with such small secondaries may allow some external scattered light to get to the eyepiece without being blocked by the diagonal. Small secondaries of high optical quality can also be harder to find or to make. You need to balance the desire for high power contrast with the need for proper overall design.

Overall optical quality is more important in the long run than is how small a secondary mirror your telescope uses. A quarter wave of spherical aberration has about as much effect on the overall energy in the Airy disk of an imaged star as a nearly 33 percent central obstruction does. The effects of a quarter-wave (peak-to-valley wavefront error) mirror, while just meeting the Rayleigh Limit, would basically overshadow the benefits gained by the use of a small secondary mirror. Resorting to a tiny secondary mirror while tolerating a lower-quality mirror makes little sense to those who are trying to get the best planetary images from their scopes. Indeed, many of the often talked about performance differences between various telescope designs are due more to lack of mirror quality than to the problems caused by the presence of a secondary mirror.

The "modified" Schmidt-Cassegrain telescope needs a much larger secondary, often obstructing 33 to 36 percent of the primary mirror's diameter. This does cause a visible loss in contrast for high power images and a slight reduction in limiting magnitudes for the fainter stars, but overall, the telescope still performs adequately. Indeed, many planetary observers and imagers do successfully use SCTs for their work. The tradeoff is in contrast verses telescope compactness. The SCT does offer a very convenient package for people who want portability or ease of use for photography, so the secondary obstruction isn't the only factor to consider. Once again, optical quality is the most important thing to have when it comes to an astronomical telescope.

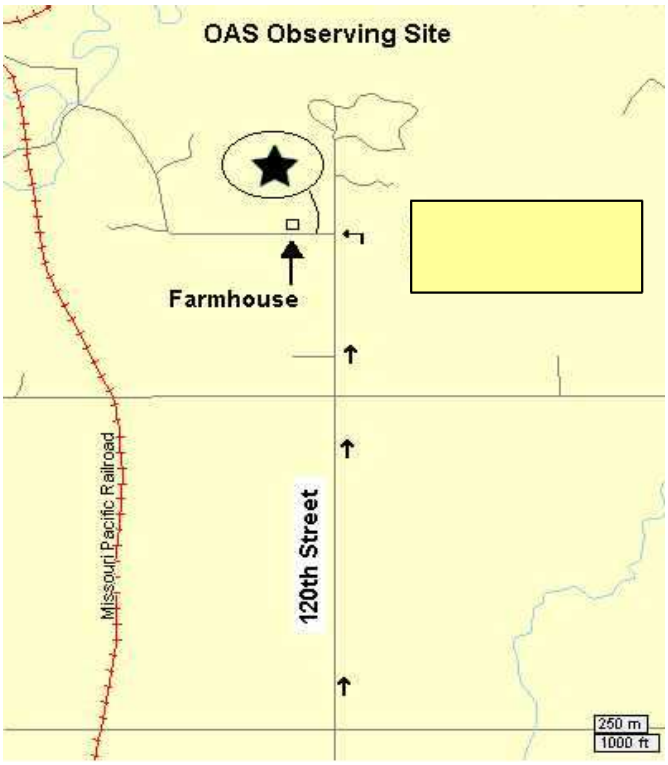
David Knisely,
Prairie Astronomy Club, Inc.

THE PRAIRIE ASTRONOMY CLUB CALENDAR
For APRIL 2000

Sun	*Mon*	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*
The **Lyrids** are visible through most of the night, with the radiant rising around 9 p.m. (local time). It is located high in the morning sky around 4:00 a.m., with an altitude of about 75. To best observe the Lyrids wear appropriate clothing for the weather and lay outside in a reclining lawn chair for best, comfortable viewing. Late in the evening it would be best to lay with your feet pointing towards the east and look straight up. During the morning hours, as the radiant gets higher, you could point your feet towards the north, west, or south and adjust your line of sight to about 50 to 60 degrees above the horizon. *The Lyrids peak around April 21-22.*						**1** **Hyde Observatory open to the public Sunset-11:00 PM**
2	**3**	**4** **NEW MOON** 	**5**	**6**	**7**	**8** **Hyde Observatory open to the public sunset-11:00 PM**
9 **Volunteer Practice Night**; 7 p.m. to 10 p.m. @ Hyde *PAC Youth Group 7-8:30 p.m. @ Hyde*	**10**	**11** **1ST QUARTER** 	**12**	**13** **NSP 7 Planning Meeting, 7:30 @ Mahoney State Park**	**14**	**15** **Hyde Observatory open to the public sunset-11:00 PM**
16	**17**	**18** **FULL MOON** 	**19**	**20**	**21** Lyrids Peak	**22** **Hyde Observatory open to the public sunset-11:00 PM** Lyrids Peak
23	24	**25** **PAC Meeting 7:30 PM Hyde Observatory** **3RD QUARTER** 	**26**	**27**	**28**	**29** **Hyde Observatory open to the public sunset-11:00 PM**
30	Hyde Observatory Schedule for April: 04/01/2000 10 Luke Breinig , Bev Hetzl , Tom Miller , Jerry Williams 04/08/2000 11 Mike Benes , Sid Doher , Mike Kritikos , Travis Miller 04/15/2000 12 Liz Bergstrom , Jeff King , Matthew Lefeber 04/22/2000 13 Margaret Fairchild , Mark Fairchild , Cassie Floyd , Brian Weber 04/29/2000 14 Mark Fairchild , Michael Fairchild , Deepali Gangahar , Bob Leavitt					

Directions to OAS Observing Site

From Lincoln, take Highway 34 East approximately 29 miles to 120th street. Then go North about 2 ½ miles.



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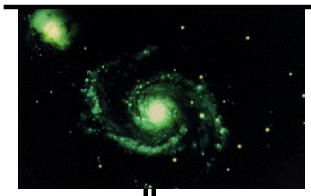

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First Class Mail

Next PAC Meeting
March 28, 2000
7:30 PM
Hyde Observatory