REFLECTIONS

of the University Lowbrow Astronomers

May 2000

The University Lowbrow Astronomers is a club of Astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, Room 130 or 807). Meetings begin at 7:30 pm and are open to the public. Public star parties are held twice a month at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; further directions at the end of the newsletter) on Saturdays before and after the new Moon. The party is canceled if it's cloudy or very cold at sunset. For further information call (734)480-4514.

Photo: Planetary conjunction of April 6th - From left to right is the Moon, Saturn, Jupiter, and Mars. Taken next to The University of Michigan's 26 meter radio telescope on Peach mountain by Chris Sarnecki with a tripod 35 mm camera, 50 mm lens set at f1.8, 4 second exposure using Kodak Royal Gold 1000 color film.

NOTE: This month's REFLECTIONS is completely devoted to observing the Cosmos with only your keen eyesight. Naked eye observing is too often overlooked by amateur astronomers. Leslie Peltier, in his famous book Starlight Nights, wrote "No one, as yet, has ever nearly exhausted all the possibilities of observing with the naked eye alone". Well Dave Snyder will attempt to do this, on paper at least, in his fine article on *University Lowbrow Astronomers Naked Eye Observer's Guide*. Thanks Dave - Ed

This Month:

May 19 - Meeting at 130 Dennison - It's time for our annual Club Elections! Consider throwing your hat into the ring and lend a hand for your club.

May 27 - Public Star Party at Peach Mountain Observatory - See Mercury in late May and early June as it puts on its best apparition this year.

Next Month and Beyond:

June 3 - Public Star Party at Peach Mountain Observatory - Mercury, at mag 0.0, is nicely placed over a 1 1/2 day old Moon! This presents a fine observing challenge for all you planetalogist !

June 9 - Public Star Party at Leslie Science Center in Ann Arbor. Contact Bernard Friberg for details.

June 16 - Meeting at 130 Dennison - Full Moon and werewolves are our tonight.

June 24 - Public Star Party at Peach Mountain Observatory - Latest evening twilight this year.

July 21 and 22 - "Astronomy at the Beach, Kensington Metropark.

University Lowbrow Astronomers Naked Eye Observer's Guide

http://www-personal.umich.edu/~dgs/lowbrows/observers/eye.html
by Dave Snyder
Written: February 2000

This page has a variety of suggestions for beginning amateur astronomers who wish to observe the sky with only the unaided eye. It is a common misconception that you need to have a telescope to do astronomy. This simply is not true. A wide variety of objects can be seen with the naked eye, from planets and stars, to nebulae and galaxies. While you can usually see more detail if you use a telescope or binoculars, you can usually see more objects of a given type if you use a telescope or binoculars. The same types of objects that can be seen with a telescope can be seen without a telescope. If you've decided you want to observe the night sky without a telescope, you will need some idea of what to look for. Even if you have a telescope or have made a firm decision to purchase a telescope, it is a good idea to look at the sky without optical aid. The time you spend will give you ideas on where to look and what to look for in a telescope. It will also enhance your observing skills.

Magnitudes

Some things are brighter than others. Astronomers use an extension of a system invented in the second century B. C. to describe brightness of objects. Most objects are assigned positive numbers. The larger the number the dimmer the object (magnitude 3 is dimmer than magnitude 2). Very bright objects are assigned negative numbers; this is true of the Sun, the Moon, bright planets and the brightest stars. Again the larger the number, the dimmer the object (magnitude -2 is dimmer than magnitude -3).

Here are a few examples (Note these are typical values, values may be larger or smaller under some conditions):

Magnitude -27	The Sun
Magnitude -12	The full Moon
Magnitude -5	Venus (the brightest planet) at its brightest
Magnitude -1	Sirius and Canopus (the two brightest stars)
Magnitude 6	The dimmest objects visible with the naked eye
Magnitude 10	The dimmest objects visible with binoculars
Magnitude 25	The dimmest objects on a Photographic plate produced with a large telescope

As mentioned above, the dimmest object visible with the naked eye is typically magnitude 6.5. However this magnitude (called the magnitude limit) can vary. Many factors affect the magnitude limit:

- Pupil dilation - When you first go outside at night from a brightly light room, you probably not be able to see anything except the brightest objects, but if you wait a few seconds or so, your ability to see improves dramatically.
- Dark adaptation - When you are in the dark, your retina gradually adapts to the light level; most of this adaptation occurs in the first half-hour. Dark adaptation will not be complete if there are bright lights; once established dark adaptation can be lost very quickly if you subsequently encounter bright lights. If you need a flashlight, it is best to use a dim red light. Such lights are less likely to interfere with dark adaptation.
- Light Pollution - Even if you find a site away from city lights, the site still may not be that dark. You may see a glow near the horizon. Large cities can be seen as such a glow as far as a hundred miles away. Smaller cities can be seen from tens of miles away. When there is a glow on the horizon, there is often stray light all over the sky and this stray light will reduce what you can see.
- Snow - Significant snow cover can have the same effect as light pollution and can reduce your limiting magnitude.
- Clouds - Complete cloud cover can prevent you from seeing anything. Partial cloud cover often reduces the limiting magnitude.
- The Moon - The light from the moon reduces your ability to dark adapt. The limiting magnitude is larger (dimmer) when the Moon is not visible.
- Altitude - Objects close to the horizon often are obscured in haze. Thus the limiting magnitude is smaller near the horizon than it is near the overhead point.
- Experience - Someone who has observed for many years typically can see objects one magnitude dimmer than an inexperienced

observer.

- Age - As we get older, our retinas become slightly less responsive. However this will only be a few tenths of a magnitude. The effect of experience is more important than the effect of age.
- Alcohol - Alcohol depresses the dark adaptation response.
- Nicotine - Cigarettes and other sources of nicotine also depress the dark adaptation response.
- Object Size - Extended objects (like galaxies or nebulae) are often harder to see than objects that appear to be points of light (like stars) if both objects have the same magnitude.
- Object Color - The limiting magnitude for red objects is lower than the limiting magnitude for objects of other colors.

Observing Sites

The first step in astronomical observing is selecting an observing location. If you planning to observe bright objects, such as planets, it may be best to pick a site that is convenient, such as a place close to home. If you are planning to observe dim objects you should pick an observing site that maximizes your limiting magnitude. It often helps to observe near the time of the new Moon, so the Moon doesn't drown out the light from dim objects. In many cases it is helpful if there is a good horizon; such a location will have few obstructions such as hills, mountains, trees or buildings. It is also a very good idea to abstain from alcohol and nicotine before and during an observing session.

The limiting magnitude at suburban locations is typically 3.5, and the limiting magnitude at dark sites is typically 6.5. Experienced observers at very dark sites have reported limiting magnitudes as high as 8.5.

Constellations

If you want to find your way around the sky, you need to learn the constellations. Constellations are groupings of stars created by astronomers. Many of the modern constellations were borrowed from constellations invented by ancient peoples. The existing constellations are not always the best groupings possible. There are many groupings of stars that seem like they *should* be constellations, but are not. Such groupings are called *asterisms*.

Which constellations are visible vary depending on your latitude, the time of day and the time of year. In general, at a given location, some constellations will always be visible (they are called circumpolar), some are visible part of the time, and some are never visible.

One way to learn constellations is to first learn a few landmarks. The best landmarks vary depending on time of night and the season, in the Northern Hemisphere the following are good choices:

Each landmark can be used to locate other stars and/or constellations. Orion is a constellation; however the Big Dipper, the Summer Triangle and the Great Square of Pegasus are asterisms. The indicated times are not the only times these landmarks are visible; for example the Big Dipper is circumpolar from most Northern Hemisphere locations, it is visible at all times. However spring evenings and winter mornings are the best time to use the Big Dipper as a landmark. As you learn the constellations, watch out for asterisms that look similar to constellations. If you are not careful you will find the sky filled with "big dippers" or "great squares." Try not to go by shape alone.

Season	Season	Landmark
Winter Evening	Autumn Morning	Orion
Spring Evening	Winter Morning	Big Dipper
Summer Evening	Spring Morning	Summer Triangle
Autumn Evening	Summer Morning	Great Square of Pegasus

Finding Your Way Around

To find your way around the night sky, you probably will find a star chart helpful. You have several choices:

- A simple device called a planisphere shows the bright stars and constellations and can be adjusted for different seasons. Planispheres generally show stars down to magnitude 4.5. This can be helpful if you are starting to learn the constellations, but you generally need more detail if you are looking for specific deep sky objects.
- Astronomy magazines often have star charts that are valid for the current month, again showing stars down to about 4.5.
- Abrams planetarium (at Michigan State University) sells monthly star charts for a nominal fee.
- Star charts are available as books and come in a variety of magnitude limits. If you are just starting we recommend a book with charts with magnitude limit 5. As you gain experience you may want to get more detailed charts with magnitude limit 6 or higher.
- If you own a computer, you can purchase programs that will produce star charts for any time and any location. In most cases the magnitude limit can be adjusted to suit spe-

cific needs.
Star charts may be somewhat confusing at first. They never look exactly like the night sky. However, this confusion will disappear once you get used to them.

- Most star charts have north up, east to the left and west to the right; a mirror image of most terrestrial maps. To align the chart to the night sky, you need to find north. In the northern hemisphere you can use the Big Dipper to locate Polaris, which is very close to due north.
- To estimate angles in the sky, the distance from the horizon to the overhead point is 90 degrees and your fist held at arm's length is approximately 10 degrees. Using these estimates, if you know that it is 5 degrees from one star to another star, you should be able to "hop" between the two stars easily.
- The sky appears to be a curved dome, but charts are generally flat. This can be confusing if you attempt to star hop from a star on one side of the sky to star on the other side of the sky. This is less of a problem if you star hop short distances.
- Unless you have an up to date chart from a magazine or a computer program, there are likely to be bright "stars" that appear in the sky, but do not show up on the chart - they could be planets or transient objects such as comets. There are several ways to tell the difference between stars and planets. Stars tend to "twinkle" and planets generally do not twinkle. This often (but not always) allows you to distinguish stars and planets. Planets are always found along an imaginary line called the ecliptic. Mercury, Venus, Mars, Jupiter and Saturn are all brighter than any of the stars along the ecliptic.
- It is unlikely the limiting magnitude of the chart will match the limiting magnitude of the night sky, so the chart may show stars that are not visible in the sky, or more likely, the sky may have stars that do not appear on the chart.
- You may be tempted to bring a flashlight so you can read star charts in the dark. However to preserve your dark adaptation, it is best to use a light that is designed for astronomy: the best ones emit a dim red light.

For more information:

- How to make a Planisphere (by Peter Alway). - http://www-personal.umich.edu/~dgs/alway/planisphere.htm
- For suggested books and magazines go to the Lowbrow Astronomers Astronomy Bibliography; Introductory Texts. - http://www-personal.umich.edu/~dgs/lowbrows/biblio/intro.html
- To obtain the Abrams Planetarium Sky Calendar, go to Abrams Planetarium (Michigan State University). - http://www.pa.msu.edu/abrams/

The Planets
Venus, Mars, Jupiter and Saturn are easy to observe with the unaided eye. Each planet is visible within a fixed schedule. For a given evening, each planet may be visible the entire evening, just part of the evening, or not be visible at all. This schedule doesn't change by much over the course of an evening or two, but will change over a period of weeks or months. Over the course of the year, each of these planets will be visible at least part of the time. It is not possible to see any detail on these planets without a telescope.
Whenever Venus is visible, it is much brighter than anything in the sky with the exception of the Sun and Moon. Mercury, Mars, Jupiter and Saturn are brighter than anything other than Venus, each other, the Sun or Moon, Sirius and Canopus.
There are several things you can notice if you observe planets over an extended period of time. Some planets display noticeable changes in brightness over the course of time. This is particularly true of Mars, but changes can be observed in other planets. All planets move relative to the background stars, but Mars, Jupiter and Saturn will occasionally appear to go into "retrograde" motion. They normally move in a preferred direction, but occasionally they reverse direction, move in that direction for a time, reverse direction again and move in their preferred direction.
While Mars, Jupiter and Saturn all have satellites (moons), only the four brightest satellites of Jupiter are bright enough to be seen with the unaided eye. However even these satellites are very difficult to observe in practice (without binoculars or a telescope) since they almost always get lost in Jupiter's glare.
To observe Mercury, you must plan ahead. The best opportunity to observe Mercury is when it is close to maximum elongation (that is, the planet appears at its highest point in the sky). It also helps to observe from a location without obstructions (such as buildings, trees, hills or mountains) in the direction of the Sun. Given the right conditions Mercury will be very bright and can be seen with the naked eye.
When Mercury is visible, you have only a short period of time to observe it. Sometimes Mercury is visible in the evening in which case you have at most 30 minutes after sunset to observe the planet before it sets. At other times Mercury is visible in the morning. You will be able to see Mercury 20-30 minutes before sunrise.

Uranus is bright enough to be seen with the unaided eye, but appears as a dot of light that can be very difficult to distinguish from nearby stars. Neptune and Pluto are too dim to be seen with the naked eye.
On occasion a planet passes in front of a star, such an event is called an occultation. Occultations can be predicted in advance and are easy to observe if you plan ahead.
It is often possible to see planets during the daytime. The trick is to know exactly when and where to look. Venus is the easiest to locate, other planets are harder.
For more information:

- General information about currently visible planets and other naked eye events can be found at Star Hustler (Jack Horkheimer: Director of the Miami Planetarium) - http://www.starhustler.com/
- and at Abrams Planetarium (Michigan State University). - http://www.pa.msu.edu/abrams/
- Information about occultations can be found at the International Occultation Timing Association. - http://www.lunar-occultations.com/iota/iotandx.htm

The Sun
Several solar phenomena are visible with the naked eye, **but it can be dangerous to observe them. If you do not have proper eye protection you may suffer permanent eye damage. It is even more dangerous to observe these phenomena with binoculars or telescopes unless a proper solar filter is used.** These phenomena include sunspots, solar eclipses, Mercury transits and Venus transits (a transit is where a planet passes between the sun and the earth, the planet can be seen as a black dot on the sun's disk).
Observing sunspots is relatively easy. During solar maximum, which occurs once every 11 years, sunspots are usually quite numerous. At such times, if you have proper eye protection, it is easy to see sunspots (no magnification is needed). At other times, there are generally very few sunspots visible.
Observing eclipses and transits require planning ahead. Eclipses and transits occur infrequently, and a given eclipse or transit will only visible from some parts of the earth. In a given year there may be as few as two solar eclipses or as many as five, however they are not necessarily total (they may be partial) and they are not necessarily visible from a convenient location (for example, some eclipses are only visible from Antarctica). Transits of Venus occur approximately twice a century. Transits of Mercury occur about 13 times a century.
A number of phenomena are created by light from the Sun interacting with the atmosphere. These phenomena include rainbows, haloes, solar pillars, crepuscular rays, coronas, sundogs, glories and the green flash (observing these phenomena is safe).
For more information:

- The article "Three Rising Suns," by Christopher Sarnecki, February, 1999 - http://www-personal.umich.edu/~dgs/lowbrows/reflections/csarnecki.4.html contains more information on daytime solar phenomena.
- NASA: Solar Eclipse Home Page. - http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html

The Moon

The first thing you will notice about the Moon is that it changes phase over the course of its 29 1/2 day cycle. The phases are listed below (this shows the number of days into the cycle and the period of time during which the Moon is visible. These times are approximate and do not take into account daylight savings time or variations due to longitude).

1 day	New Moon	not visible
4 days	Waxing Crescent	8 AM to 10 PM
7 days	First Quarter	11 AM to 1 AM
10 days	Waxing Gibbous	2 PM to 4 AM
14 days	Full Moon	5 PM to 7 AM
18 days	Waning Gibbous	8 PM to 10 AM
22 days	Last Quarter	11 PM to 1 PM
26 days	Waning Crescent	2 AM to 4 PM

You will note the Moon is visible during daytime hours a significant fraction of the time.
The crescent Moon points to the position of the sun (except during the new Moon, when the Moon is not visible, and during the full Moon, when there is no crescent). The Moon often appears to point slightly above or below the Sun, but this is an optical illusion. It really does point to the Sun.
You may have heard that the same part of the Moon always point to the Earth and half the Moon can never be seen. This is only partly true; due to a phenomenon called libration you can see 59 of the moon provided you observe over a period of time. The Moon wobbles very slowly when it orbits the Earth, and this wobble is noticeable if you compare the edge of the Moon day after day for a month or so.
With even a causal look at the Moon, you can see maria (which are lowlands and dark colored), terrae (which are highlands and light colored) and the terminator (the line between the dark part and the lit part of the Moon). Features that are harder to see include craters and mountain ranges. Despite what

you might think, the full Moon is not the best time to look for lunar features. Maria and terrae are easiest to see during the full Moon, but craters and other features are easier to see when the Sun is low in the lunar sky as seen by that feature. In other words it is best to observe the Moon at several different phases; particularly first quarter and last quarter. Lunar craters are generally too small to be seen without optical aid, however there is one mountain range which can be seen with the naked eye. If you look just after first quarter, the mountain range *Apennines* can be seen as irregular section of the terminator (which is normally a smooth arc).

Lunar eclipses occur when the Earth passes between the Sun and the Moon. In a given year there may be as few as two lunar eclipses or as many as five. Some of these are partial eclipses and some are total. On occasion the moon passes in front of a planet or a star, such an event is called an occultation. Occultations can be predicted in advance and are easy to observe if you plan ahead.

For more information: - See Peter Alway's Lunar Eclipse Page - http://www-personal.umich.edu/~dgs/alway/lunareclipse.htm. For more information about lunar eclipses.

- The International Occultation Timing Association - http://www.lunar-occultations.com/iota/iotandx.htm gives information about lunar occultations.

Asteroids

Asteroids are small bodies, most of which are in orbits between Mars and Jupiter. All are faint.

The best time to observe asteroids is at opposition, when they are the brightest. If it is visible at all, an asteroid will be visible only as a dot of light that is difficult to distinguish from nearby stars. Of the hundreds of known asteroids, Vesta is the easiest to observe and will sometimes be visible to the naked eye. Experienced observers at very dark sites may be able to see asteroids in addition to Vesta.

For more information see the IAU: Minor Planet Center. - http://www-personal.umich.edu/~dgs/alway/lunareclipse.htm. This site describes many asteroids that are not naked eye visible, pay attention to the magnitudes listed on this site.

Comets

Some comets are short-period comets, that is they return after a set period, which can be as short as three years or as long as 200 years. Any comet with a period longer than 200 years is not considered to be short period. The best known of these comets is Comet Haley, which returns every 76 years. Many short-period comets are known, but not all comets are short period. New comets are continually being discovered. Most newly discovered comets are not short period; they will not return for hundreds or thousands of years.

Comets generally spend most of their time far away from the Sun. They are close to the Sun for a relatively short time, but this is the only time they are easy to observe. New comets are often detected far from the Sun when they are quite dim. Usually such comets are getting closer to the Sun, if so they can be expected to get brighter over time. Astronomers often make predictions about how much brighter these comets will get, but such predictions are frequently wrong. Comet Kohoutek in 1973 was much dimmer than predicted, Comet West in 1975 was much brighter than predicted.

At any point in time, over a dozen comets can be seen through telescopes; however most are not naked eye visible. Comets that have bright easily visible tails occur roughly once every 10 years, comets that are naked eye visible with small fuzzy tails are somewhat more common. Comets have at least two tails, a dust tail and an ion tail. The dust tail is the easiest to see, the ion tail is visible only in some very bright comets. When it is visible, the ion tail is oriented at a slight angle to the dust tail and is blue in color.

For a list of comets that are currently visible, see the Jet Propulsion Laboratory's Comet Page. - http://encke.jpl.nasa.gov/. Note: most of the comets listed on this page are too dim to be seen without optical aid; pay attention to the magnitudes of the listed comets.

Interplanetary Dust

Dust within the solar system can reflect light from the Sun, and this reflected light can be seen from a dark site. *Zodiacal light* is a soft glow that is usually triangular in shape. There are two areas of zodiacal light, one in the east and one in the west. They are easier to see in winter. The *zodiacal band* is a band of light that joins the two areas of zodiacal light, but it is very difficult to see. An oval shaped section of the zodiacal band, the *Gegenshein* often is bright enough to be seen even when the zodiacal band itself cannot be seen.

Aurorae

Aurorae are bright lights visible at night caused by electrons entering the earth's upper atmosphere. Aurorae in the Northern Hemisphere are called Aurorae Borealis or Northern Lights. Aurorae in the Southern Hemisphere are called Aurorae Australis or Southern Lights. Aurorae are more frequent the nearer you are to either the North Magnetic Pole or the

South Magnetic Pole and are more frequent near the time of the solar maximum. Scientists have been somewhat successful (but not perfect) at predicting when aurorae will occur.
For more information, see the University of Alaska: Aurora Information and Images. - http://encke.jpl.nasa.gov/

Meteors

On any clear night you can expect to see a number of meteors. Meteors are sometimes incorrectly called "shooting stars". The number you will see is affected by several factors.

- The limiting magnitude. If the limiting magnitude is reduced by 1, this will reduce the number of meteors visible by a factor between 2 and 3. If the limiting magnitude is reduced by 2, this will reduce the number of meteors by a factor between 4 and 9.
- Time of day - Meteors go through a diurnal cycle with a minimum at 6 PM and increasing to a maximum at 6 AM. Of course you can't see meteors in daylight, but this cycle is one factor in the number of meteors you will see when it is dark.
- Time of year - There is an annual cycle of meteors. There tend to be fewer meteors in March than there are in September.
- Meteor showers - On certain days in the year, the background rate of meteors increases, sometimes dramatically. For example between August 10-16, the Perseid meteor shower produces an elevated number of meteors. The Perseid shower is rather reliable. Every year they produce similar numbers of meteors. Other showers such as the Leonid Shower, on November 17, can produce huge numbers of meteors some years and only moderate numbers other years.
- Each meteor shower has a *radiant*. Meteors from the shower appear to 'radiate' from this point. During a meteor shower, the number of meteors seen is highest if the radiant is high, preferably near the overhead point.
- A few meteor showers, such as the Leonids, are only active for a period of a few hours each year. In such cases, observers in some parts of the world might see a lot of activity, but observers in other parts of the world will not. While some aspects of Leonid activity are known' it tends to follow a 33 year cycle, attempts to predict the exact time of maximum Leonid activity have been wrong in the past. However, some scientists believe that Leonid predictions are more accurate now. In 1999 one scientist gave a prediction that was within a few minutes. We will see over the next few years if Leonid predictions are more accurate.

If you plan to observe meteors, your best bet is to wait for a major shower, such as the Perseids. You can attempt to observe any night of the year, but you may observe for a long time and not see anything. It is best to bring a chair, anything else you need to be comfortable, perhaps warm clothing, sit back, relax, and watch. Typical non-shower observation rates at midnight at a dark sight during March are zero to 3 per hour. Typical observation rates during September, midnight at a dark sight, are 8 to 10 per hour.
With a simple radio (in the United States use an FM radio) it is possible to detect the presence of meteors. This can be done during the daytime or nighttime, when it is clear or when it is cloudy. You may want to consider trying this if it is overcast during a meteor shower.
For more information

- Look at Astronomy Reference http://astronomer.net/meteor.html, by fellow Lowbrow Reid Travis for a list of meteor showers. The International Meteor Organization. - http://astronomer.net/meteor.html

Artificial Satellites

There are thousands of man-made satellites in orbit around the Earth. Some are too dim to be seen with the unaided eye. However others can easily be seen if you know when and where to look. In a given evening, you can expect to see several satellites. They appear as dots of light that slowly move across the sky.
For more information see "What Satellite is That?" by Christopher Sarnecki, June, 1999. - http://www-personal.umich.edu/~dgs/lowbrows/reflections/csarnecki.5.html

Galaxies

The universe is composed of billions of galaxies. If you go outside at night, almost all the objects you can see with the unaided eye are within our own Milky Way galaxy. There are four exceptions:

- M31, The Andromeda Galaxy - Easy to see from a relatively dark site.
- The Large Magellanic Cloud - Easy to see, but only from the Southern Hemisphere.
- The Small Magellanic Cloud - Easy to see, but only from the Southern Hemisphere.
- M33, The Pinwheel Galaxy - Few naked eye observations have been reported, most from experienced observers at very dark sites. M33 is very difficult to see without optical aid.

Our Galaxy, the Milky Way, can be seen from any reasonably dark site as a band of light that extends across the sky.

Stars

In general all stars vary slightly in brightness over time. Most of these changes are insignificant, however some stars vary noticeably in brightness. The majority of these so-called variable stars change in brightness over a period somewhere between a few hours and a year. A few such stars can be seen with the naked eye. If one is careful, persistent, and patient, it is possible to track the variations of these stars. In some cases the star is visible during part of its range and not visible during the rest of its range.

Two types of variable stars, novae and supernovae, change brightness dramatically and unpredictably. Novae will increase in brightness from 7 to 16 magnitudes over a day or two and then decrease in brightness slowly over the next several months. Novae bright enough to be seen with the naked eye occur once every few years. Supernovae increase in brightness over 20 magnitudes in the span of a few days and then decline slowly over the next few years. Bright supernovae are rare. Over the past 400 years, there have been only three naked eye supernovae, one in the year 1604, one in 1885 and one in 1987. Both novae and supernovae are unpredictable. It is possible to locate a previously undiscovered novae or supernovae with persistence and luck.

The color of stars is easily observed. Color is directly related to the star's temperature. The coldest stars are red; the hottest stars are blue-white. Stars with intermediate temperatures can be orange, yellow or white. It is easy to tell the color of bright stars, but difficult to tell the color of the dimmer stars. Dim stars often appear white even though they may be red or blue or some other color.

Many of the points of light that appear to be stars are in fact double stars or even triple or quadruple stars. In a few cases, it is possible to "split" these stars (that is observe the different components) with the naked eye.

In some cases, stars can be found in large groups called "clusters." There are two types of clusters, globular and open. There are a few globular clusters and a few open clusters visible with the naked eye.

For more information:

- The American Association of Variable Star Observers - http://www.aavso.org/

posts information about variable stars and lists of newly discovered novae. Stars listed with magnitudes greater than 6.5 will be difficult to see with the naked eye.

- A list of naked eye clusters can be found at The National Deep Sky Observers Society (Observing the Deep Sky with the Naked Eye). - http://www.aavso.org/
- For a list of naked eye double stars, see "Observing Naked (or I got 5.5 arcmins resolution)," by Christopher Sarnecki, October, 1999 (in part) and January 2000 (in part).

Nebulae

Nebulae are areas of gas within the galaxy. Some nebulae (emission, reflection and planetary nebulae) either glow or reflect light from nearby stars; many such nebulae can be seen from the earth. Other nebulae (dark nebulae) do not glow, but can be detected because stars cannot be seen through them (these nebulae are opaque and starlight cannot pass through them). A few nebulae are visible to the unaided eye.

For more information see The National Deep Sky Observers Society (Observing the Deep Sky with the Naked Eye). http://www-personal.umich.edu/~dgs/lowbrows/reflections/csarnecki.6.html

Binoculars and Telescopes

After gaining experience with observing with the naked eye, the next step is to attempt observing the same objects with binoculars. Many objects that are barely visible with the naked eye reveal a lot of detail when observed through binoculars. In addition, binoculars increase the number of objects you can see.

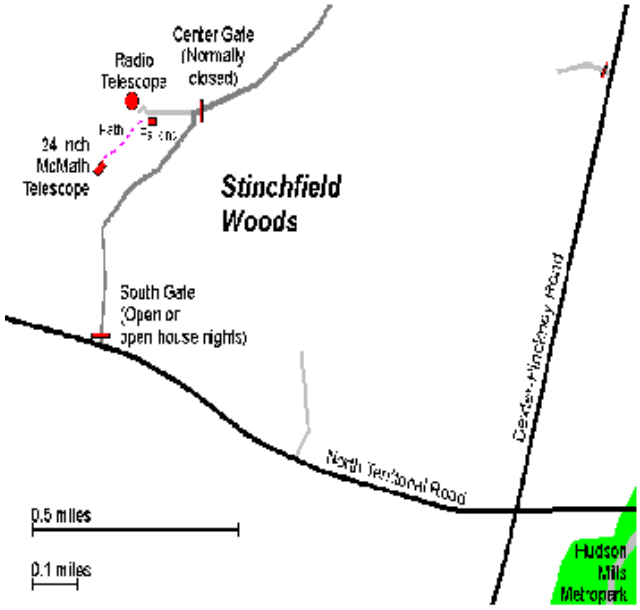
After gaining experience with binoculars, you may feel ready to purchase a telescope. Keep in mind that many people who purchase a telescope on impulse, are subsequently unhappy with their instrument. To avoid this, take your time when deciding to buy a telescope.

References

For a list of the reference materials used to produce this guide, see the University Lowbrow Astronomer's Book List. - http://www.cismall.com/deepsky/eye.html

Places and Times:

Dennison Hall, also known as The University of Michigan's Physics and Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. It is found in Ann Arbor on Church Street about one block north of South University Avenue. The meeting is held in room 807. Monthly meetings of the Lowbrows are held on the 3rd Friday of each month at 7:30 PM. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.



Peach Mountain Observatory is the home of The University of Michigan's 25 meter radio telescope as well as the University's McMath 24 inch telescope which is maintained by the Lowbrows. The observatory is located northwest of Dexter. The entrance is on North Territorial Road, 1.1 miles west of Dexter-Pickney Road. A small maize-and-blue sign marks the gate. Follow the gravel road one mile to a parking area near the radio telescopes. Walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.

Public Star Parties:

Public Open House/Star Parties are held on the Saturday before and after each new Moon at the Peach Mountain Observatory. Star Parties are canceled if the sky is cloudy at sunset or the temperature is below 10 degrees F. Call 480-4514 for a recorded message on the afternoon of a scheduled Star Party to check on the status. Many members bring their telescopes and visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitoes - bring insect repellent, and it does get cold at night so dress warmly!

Amateur Telescope Making Group meets monthly, with the location rotating among member's houses. See the calendar on the front cover page for the time and location of next meeting.

Membership:

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students and seniors (age 55/+). This entitles you to the monthly REFLECTIONS newsletter and the use of the 24" McMath telescope (after some training). Dues can be paid to the club treasurer Doug Scobel at the monthly meeting or by mail at this address:

1426 Wedgewood Drive
Saline, MI 48176

Magazines:

Members of the University Lowbrow Astronomers can get a discount on these magazine subscriptions:

Sky and Telescope: $29.95 / year
Astronomy: $29.00 / year

For more information contact the club Treasurer. Members renewing subscriptions are reminded to send your renewal notice along with your check when applying through the club Treasurer. Make the check payable to "University Lowbrow Astronomers".

Newsletter Contributions:

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call or E-mail to Newsletter Editors at:

Bernard Friberg (743)761-1875 Bfriberg@aol.com
Chris Sarnecki (734)426-5772 chrisandi@aol.com

to discuss length and format. Announcements and articles are due by the first Friday of each month.

Telephone Numbers:

President: Mark Deprest (734)662-5719
Vice Presidents: Lorna Simmons (734)525-5731
Dave Snyder (734)747-6537
Paul Walkowski (734)662-0145
Treasurer: Doug Scobel (734)429-4954
Observatory Director: Bernard Friberg (734)761-1875
Newsletter Editors: Chris Sarnecki (734)426-5772
Bernard Friberg (734)761-1875
Keyholders: Fred Schebor (734)426-2363
Mark Deprest (734)662-5719

Lowbrow's Home Page:

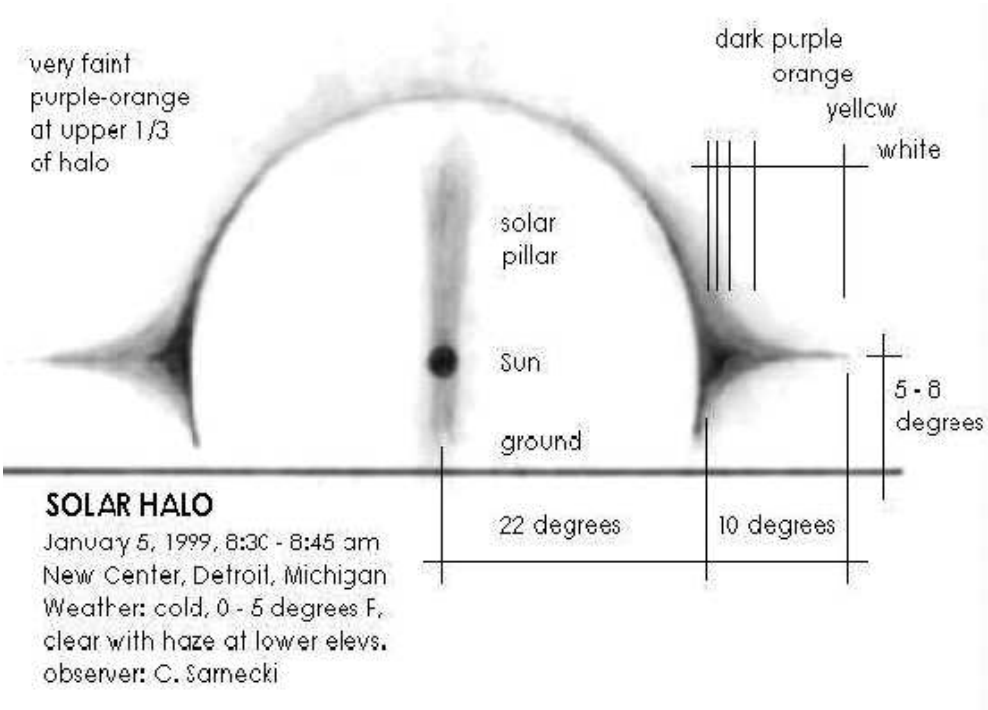
http://www.astro.lsa.umich.edu/lowbrows.html

Dave Snyder, webmaster
http://www-personal.umich.edu/~dgs/lowbrows/

Monthly Meeting
May 19, 2000, 7:30 pm
Room 130 Dennison Hall
Physics & Astronomy Building
The University of Michigan

Club Elections

!It's traditional to elect those members whom choose to be absent to Officer positions.



UNIVERSITY LOWBROW
ASTRONOMERS
3684 Middleton Drive
Ann Arbor, Michigan

Lowbrow's WWW Home Page:
www.astro.lsa.umich.edu/lowbrows.html

Check your membership expiration date on the mailing label !