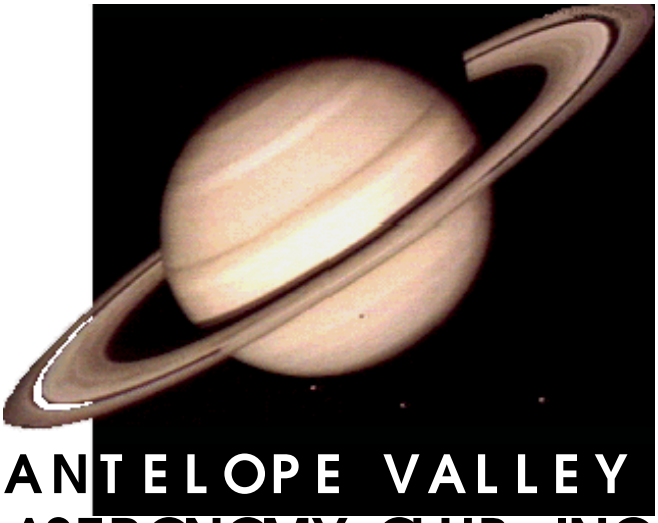
Introduction to the Night Sky – Part I



Antelope Valley Astronomy Club, Inc.

January 2003

Introduction to The Night Sky - Part I (Absolute Beginner)
(1 hour)

Outline:

I. Familiarize the member with the basics of telescope operation
- Words to Know
- How the telescope works
  - Set up
  - Cool down
- Telrad
- Aligning the finder scope
- Eyepieces
  - How to handle them
  - Magnification
  - Using both eyes
- Pack up
- Transportation of the telescope
- Dust on the mirror - Leave it there!

II. The Night Sky
- Use of a planisphere
  - Orientation of horizon
  - Latitude, Zenith
  - Setting the date
- Basic use of a star map
- Star Party Etiquette
- Star Party Comfort Tips
- Question and Answer session

H E L P !

If you have an equipment problem, call any Club Officer at their phone numbers listed on your monthly newsletter. WE WANT TO HELP YOU with your astronomy problem and give you the right answer that will help you enjoy the night sky, while keep the Club's equipment working well for the next member.

Antelope Valley Astronomy Club, Inc.
http//www.avac.av.org

Words Ya Gotta Know

By Alan M. MacRobert
http://skyandtelescope.com/howto/basics/article_510_1.asp

Like anything else, astronomy has its own jargon. Newcomers quickly run into terms like "arcsecond," "4th magnitude," and "right ascension." But they're easy to learn. Here's a quick rundown of the most important astronomy terms you need to know.

Sky Measures

Beginners often have trouble describing distances on the sky. You might get into a conversation that sounds like this:

> "Do you see those two stars? The ones that look about eight inches apart?"
> "Yeah, but they look more like six feet apart to me..."

The problem here is that distances on the sky can't be expressed in linear measures like feet or inches. The way to do it is by angular measure. Astronomers might say the two stars are ten degrees (10°) apart. That means if lines were drawn from your eye to each star, the two lines would form a 10° angle at your eye.

Hold your fist at arm's length and sight past it with one eye. Your fist from side to side covers about 10° of sky. A fingertip at arm's length covers about 1°. The Sun and Moon are each ½° wide. The Big Dipper is 25° long. From the horizon to the point overhead (the zenith) is 90°.

There are finer divisions of angular measure. A degree is made up of 60 arcminutes, and each arcminute is divided into 60 arcseconds.

Sky Coordinates

Seen from Earth, the night sky looks like a huge dome with stars stuck on its inside surface. If the Earth beneath us vanished, we'd see stars all around us — and we'd have the breathtaking sensation of hanging at the center of an immense, star-speckled sphere. Astronomers designate the positions of stars by where they are on this celestial sphere.

Picture the Earth hanging at the center of the celestial sphere. Imagine the Earth's latitude and longitude lines expanding outward and printing themselves on the celestial sphere's inside. They now provide a coordinate grid on the sky that tells the position of any star, just as latitude and longitude tell the position of any point on Earth. In the sky, "latitude" is called declination and "longitude" is called right ascension.

Declination is expressed in degrees, arcminutes, and arcseconds north (+) or south (–) of the celestial equator.

Right ascension is expressed not in degrees but in hours (h), minutes (m), and seconds (s) of time, from 0 to 24 hours. Astronomers set up this arrangement long ago because the Earth completes one turn in about 24 hours, so the celestial sphere appears to take about 24 hours to complete one turn around Earth.

Brightness

The brightness of a star (or anything else in the sky) is called its magnitude. You'll encounter this term often.

The magnitude system began about 2,100 years ago when the Greek astronomer Ptolemy divided stars into brightness classes. He called the brightest ones "1st magnitude," meaning "biggest." Those a little fainter he called "2nd magnitude," and so on down to the faintest ones he could see ("6th magnitude").

Distances

The Earth orbits (circles around) the Sun once a year at a distance from the Sun averaging 150 million kilometers, or 93 million miles. That distance is called one astronomical unit (a.u.).

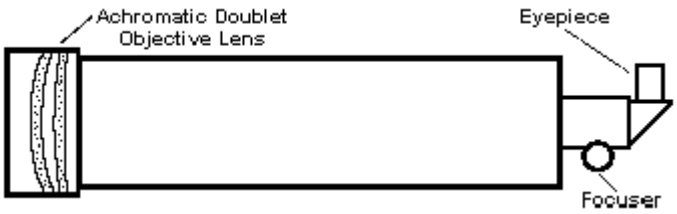
The distance that light travels in a year — 9.5 trillion km, or 63,000 a.u. — is called a light-year. Note that the light-year is a measure of distance, not time. . . . just like kilometers or miles.

Most of the brightest stars in the sky are a few dozen to a couple thousand light-years away. The Andromeda Galaxy, the nearest large galaxy beyond our own Milky Way, is about 2.2 million light-years distant.

Types of Telescopes

There are two basic types of telescopes: refractors and reflectors. Both have their advantages. Properly outfitted, either will show you distant galaxies, the rings of Saturn, or the craters of the Moon.

Refracting Telescopes



Refractor

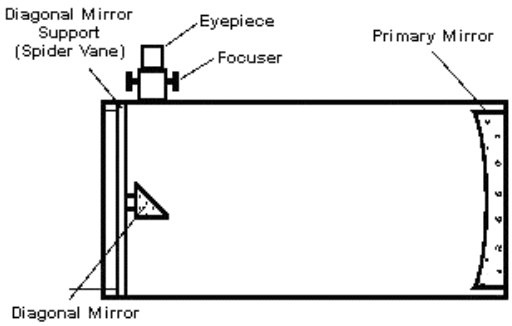
Refracting telescopes gather light with a lens, directing it to the eyepiece. Small starter scopes are often of this type, as they are simple to operate and maintain. Larger refractors, however, become very expensive and are typically bought by avid enthusiasts.

Reflecting Telescopes

Reflecting telescopes gather light with a mirror, reflecting it before directing it to the eyepiece. Reflectors typically give you a wider aperture for the dollar. They require more care and maintenance, however.

The simplest type of reflecting telescope is called a "Newtonian," after Sir Isaac Newton who invented them. When a Newtonian telescope in it's simplest and most user-friendly form, it's called a Dobsonian telescope after John Dobson who showed the world that you don't have to be rich to make your own telescope.

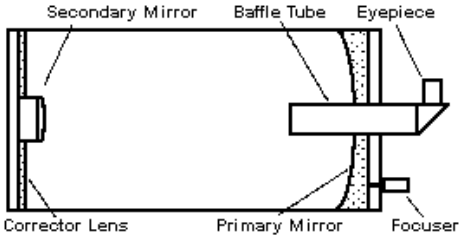
See http://www.astro-tom.com/building_a_dobson.htm for more information.



Reflector

Hybrid Telescopes

Probably the most common type of serious amateur astronomical telescope is the Schmidt-Cassegrain telescope. It is a reflector telescope that also uses a corrector plate to eliminate chromatic aberration.



Schmidt-Cassegrain

If you're looking for the best value in a telescope, you should read the articles on "Buying a Telescope" and some lessons learned when getting started in astronomy under "Beginner's Advice". The articles can be found at:

http://astro-tom.com/telescopes/buying_telescopes.htm
http://astro-tom.com/telescopes/beginner's_advice.htm

For more information about how telescopes work, there is a good, detailed article at:

http://www.meade.com/support/telewrk.html

Setting Up The Telescope

At least an hour before sunset, choose your location. Make sure the telescope will not be in a line of sight path to streetlights, car headlights, and that the lawn sprinklers are off. Each of these can be an annoyance later in the evening. Choose a spot out of the wind if possible, but a location where you will not be looking directly over a roof (that will cause blurry images from the heat rising off of the roof).

With a telescope like a Dobsonian, you need to find a flat, dry spot to put the base of the telescope down. If you have an old blanket or tarp to put down first, it's suggested to do so. The tube assembly will lower right down onto the base. You can tip the telescope tube up and down to see if you need to flip the tube assembly over. The eyepiece, focuser and Telrad should be easily

accessible on the side and top of the tube if you've placed the telescope on the base correctly.

Place a low power eyepiece in the focuser and gently tighten the setscrew to hold the eyepiece in place. Take the Telrad unit and place it on its mounting base. Adjust the Telrad so that it's aligned and centered on a bright object that you can see through your eyepiece.

Uncover the telescope to let the optics cool down, then do a preliminary collimation if necessary. Wait for the stars to come out!

Cooling Down

The mirror in your telescope is an amazing thing. It is an extremely sensitive tool that is exact enough to focus starlight to a single point, while being sturdy enough to resist flexing even a small fraction of a single wavelength of light. To accomplish this, most mirrors are made of thick Pyrex glass, 2" thick is not uncommon! This precision hunk of glass is the reason that your telescope is so heavy, and it also takes a while for it to cool down to lower nighttime temperatures. It's important that your mirror be at the same temperature as the evening sky. If it's not, you'll have difficulty focusing the image because the mirror will be minutely flexed due to thermal differences. If the mirror is colder than the ambient air temperature, you may get dewing on the mirror like steam on the bathroom mirror after a shower. Either one of these will result in bad images through the eyepiece.

About an hour before you plan on using the telescope, get it set up and remove any caps to allow airflow down and around the mirror. Point the telescope away from the Sun so it doesn't heat up, and let the optics reach 'Thermal Equilibrium'… the same temperature as the surrounding air. If the mirror is a big one 10" or larger, you may consider blowing a fan on the back of the mirror to help speed up the process.

Some evenings the temperature can change rapidly around midnight. You may find yourself letting your optics cool down again, catching up with the night's lowering temperature, while you get some Hot Cocoa so that you DON'T.

The Telrad

The Telrad as a "1X Finder scope." This means it doesn't magnify at all, but it is very easy to use and many different types are available. Amateurs and professional astronomers all find these the finder scopes to have!

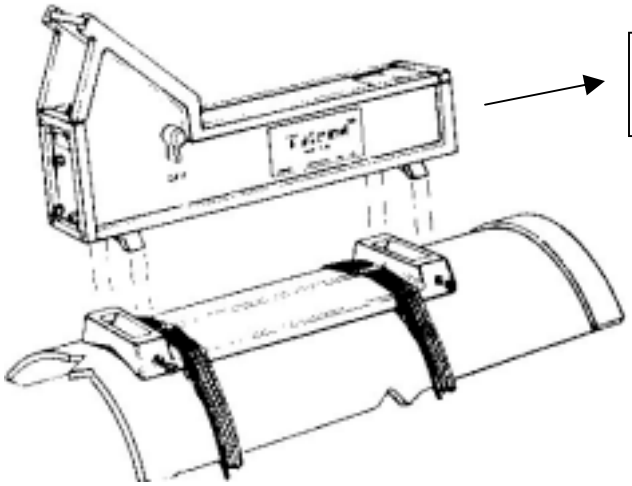
It "projects" three red circles onto the sky with diameters of 1/2, 2 and 4 degrees. You look through the Telrad while moving your scope to where you want to look.

The beauty of the Telrad is that it's totally intuitive to use - you just look through it and aim. All you have to do is align the bull's-eye with the star you want to look at, and look through the eyepiece.

How to Align A Telrad Finder Scope

If you take a couple of minutes to align the finder scope with your telescope before you start observing, it will be easy to find objects for the rest of the evening!

Slip the Telrad unit into the mounting base and finger tighten the screws until they hold the unit snugly. Do not over tighten the screws or they will strip out. The unit has a clear piece of glass at a 45-degree angle at one end and a long battery compartment at the other. When mounted correctly, you should be able to sight through the glass along the battery compartment in the direction that your telescope is pointing.



Placing the Telrad Unit In The Mounting Base

Turn the Telrad on and turn up the intensity on the reticule all the way. Put a low power eyepiece in the telescope and focus on something really bright like Venus, Jupiter or Sirius (or even a distant streetlight). Put the object right in the middle of the field of view, then look through the Telrad and see how the reticule is centered on the object. There are three little adjustment knobs on the back of the Telrad, just below the glass on the back of the unit. As you look through the Telrad, turn each of these slowly back and forth and watch the effect on the reticule circles. Adjust the knobs until the object is dead center in both the eyepiece and the Telrad circles. You're ready to go!

Eyepieces

Eyepieces come in several diameters: 0.96 inches, 1.25 inches, and 2 inches. The 0.96-inch eyepieces are generally found on cheap department store telescopes, I would not recommend buying a telescope only capable of using them, as they can be very difficult to find. The more common sizes are 1.25" and 2.0".

Eyepieces not only vary in size, and focal length but also in design. The simple designs give acceptable performance and in some cases even excellent performance.

The cost of an eyepiece is generally determined by its complexity. The market is literally flooded with eyepieces, all of which are geared to achieving the best field of view, magnification without sacrificing image quality.

Huygens, Ramsden, Kellner, orthoscopic, Erfle, and Plossl eyepieces are all pretty good at what they were intended to do. But a Plossl eyepiece is considered an excellent multipurpose eyepiece.

Plossl

An optician named G. S. Plossl, living in Vienna, Austria, developed this excellent eyepiece in 1860. After a hundred years of relative obscurity, the design finally caught on and has resulted in one of the most highly regarded eyepiece designs around. Excellent on all criteria, it features twin close-set pairs of doublets for the eye lens and the field lens.

Plossl's incorporate at least 4 optical elements. The plossl design is a very well designed eyepiece, I would highly recommend them if you are using a Newtonian telescope with a very short local length. Plossls generally have a wide field of view and generous eye relief. If there is such a thing as a good all around eye piece for observing then these are it: planet viewing, lunar observing or for deep sky objects.

Some are better than others and it's fair to say that you get what you pay for. Things to look for when purchasing Plossls include, fully multi-coated optics, blackened lens edges, and anti-reflection threads for filters.

Zoom

I include this type, because the beginning amateur astronomer is often tempted to buy one of these eyepieces thinking that it will replace several individual eyepieces. But the truth is, it's too good to be true unless you pay for the premium quality parfocal (equal focus) designs. These are EXPENSIVE. Resist all urges to purchase cheaper versions.

Barlow Lens

A Barlow lens isn't actually an eyepiece, it simply multiplies the amount of magnification of the eyepiece. Barlows come in 1.5X, 2.0X, 2.5X and 3.0X. Barlows are mostly used for planetary and binary star observation. Barlows must be of high quality though or the resulting image will be badly distorted.

Eyepieces – How to Handle Them

Most permanent damage happens to an eyepiece when it falls (it is either dropped or is left unsecured in the focuser then slips out onto the ground) or when someone unknowingly puts their greasy finger on the glass elements. Both types of accidents may be avoided.

You should hold an eyepiece securely between thumb and forefinger when carrying it from its case to the telescope. Place your freehand under it to catch it if it falls. Once fully inserted into the focuser, tighten up the retainer

screw until it is 'finger tight.' Too tight will strip the threads of the retainer screw and mar the finish on your eyepieces.

Placing an old blanket or quilt under your telescope before setting up is a good backup plan for dropped eyepieces. A light thud is a nicer sound than the sharp, tinkling sound of an eyepiece's glass shattering.

Cleaning Eyepieces

People who may not be as familiar with your telescope as you are have a natural tendency to grab the eyepiece with their hands as they move their eye up to it. This can easily lead to greasy fingerprints on the top glass element.

The eyepieces are coated with special anti-reflective coatings, so don't use glass cleaner or lens cleaners to remove the smudge. Ask someone knowledgeable at your astronomy club meeting how to clean it the right way.

You'll be tempted to use tissues – don't! Kleenex and other tissues contain fibers that will scratch the glass on eyepieces. There is a detailed explanation on cleaning optics located on the astro-tom.com website.

Using Both Eyes

Beginners often try to use just one eye when observing and squint the other eye closed. You don't have to do this – if you keep both eyes open, your brain will learn how to shut off the eye that you're not using to observe. If this bothers you, you can still keep both eyes open and cover your other eye with your hand, or use an eye patch. Keeping one eye closed for a long time with your face muscles begins to hurt, and can give you a headache.

Under this same category, you should also alternate which eye you're using for observing. One eye will get tired after an hour or so and by switching eyes, the views you'll get will still be fresh and clear.

Packing Up

When it's late, you're tired and it's time to pack up the telescope and go inside or drive back home, you're most likely to drop an eyepiece, lose a cap, your keys, or do something else that you really wouldn't like to do normally. Fatigue can make all of us do stupid things that are expensive to fix later. It's a good idea to pack up before you get to your tolerance points for fatigue or cold. Experience will tell you where these points are. If you're driving home late, remember you'll need to be sharp behind the wheel. At that time of night, there are mostly drunks, cops and tired astronomers on the road.

The first thing you should do when packing up the telescope is put the cap or cover over the end of the telescope to protect the mirror and keep anything from dropping down the tube.

Next, remove the eyepiece that you were using, replacing the caps over the focuser and on both ends of the eyepiece. Remember to unscrew any filter that you might have been using on an eyepiece before putting it back in the case.

In the case of a Dobsonian telescope, lift the tube assembly off of the rocker base and place the cover over the telescope. Carefully load the telescope and base into your vehicle if transporting the telescope.

Transporting Telescopes

When Transporting a Dobsonian Telescope…

The tube and the base/rocker assembly should be moved separately. Secure the base well so that if it shifts during transport, it will not hit the mirror tube.

Depending on the Dobsonian, you may be required to remove the mirror from the mirror cell and wrap it up carefully. If the mirror must be removed, place it in its container and place the container on the floor of the vehicle. The base/rocker assembly doesn't need to be protected from vibration, but wrapping a blanket around it will keep it from getting chips in the paint.

The open end of a Dobsonian telescope should face the rear of your vehicle. In a sudden stop, the mirror will be pressed against the mirror cell and not torn from its mounting and breaking the secondary mirror and hitting other passengers in the vehicle! If pointing the tube in this direction is not possible, the next best is to have the telescope crossways in the vehicle and seat belted in at both ends.

When transporting a telescope, it's a bad idea to go 4-wheeling :-). For that matter, speed bumps, curbs, and uneven roadwork can cause optics to shift dramatically too. Keep your speed reasonable on paved roads, and drive like you were transporting a crate of eggs anytime the road gets worse. Think ahead about the road coming up. Packing old pillows or several blankets under and around the telescope help dampen out the significant vibrations.

How To Clean Telescope Mirrors and Lenses

The best advice on cleaning mirrors and lenses is … you guessed it… DON'T. But if things are so bad that you must, ask an experience person to show you how to do this delicate task.

Using a Planisphere

Adapted from an article by Alan M. MacRobert

In principle nothing could be simpler. You turn a wheel to put your time next to your date, and presto, there's a custom-made map of the stars that are above your horizon for that moment. The edge of the oval star map represents the horizon all around you, as you would see if you were standing in an open field and turned around in a complete circle. The part of the map at the oval's center represents the sky overhead — much like the all-sky map in Sky & Telescope or Astronomy Magazines each month.

In practice, several complications can throw beginners off. The worst is that a planisphere's map is necessarily small and distorted. It compresses the entire celestial hemisphere above and around you into a little thing you hold in your hand. So star patterns appear much bigger in real life than on the map.

Moving your eyes just a little way across the map corresponds to swinging your gaze across a huge sweep of sky. The east and west horizons may look close together on a planisphere, but of course when east is in front of you west is behind your back. Glancing from the map's edge to center corresponds to craning your gaze from horizontal to straight up.

There's only one way to get to know a map like this. Hold it out in front of you as you face the horizon. Twist it around so the map edge labeled with the direction you're facing is down. The correct horizon on the map will now appear horizontal and match the horizon in front of you. Now you can compare stars above the horizon on the map with those you're facing in the sky. Then there's the distortion issue. On a planisphere designed for use in the Northern Hemisphere, constellations in the southern part of the sky are stretched sideways, taffy-like, making it hard to compare them with real star patterns. This problem does not exist on a well-designed map for fixed dates and times,

such as the one in the center of each month's Sky & Telescope or the interactive star chart on this site. Some planisphere designers have come up with a partial solution. David Chandler's planisphere The Night Sky presents two maps, one on each side. One minimizes distortion north of the celestial equator, the other south of it. Just flip it over for the best view.

Latitude Range

A further complication is that a planisphere works correctly for only one narrow range of latitudes on Earth. Fortunately, many models (notably Chandler's) are made in several editions, each for a particular latitude range. In Lancaster and Palmdale, we are roughly at 35 degrees North Latitude.

Using a Map at the Telescope

Adapted from an article by Alan M. MacRobert

By the time you set out into the night with a telescope, you should know the constellations well enough to find your way around the sky.

An all-sky constellation map (such as the one in or near the center of Sky & Telescope magazine every month will get you started. So will a planisphere. Think of your all-sky map as like a map of the world, or a globe; if you don't know the location of Japan or England, you need to learn.

Keeping Track of North

The biggest pitfall in going from map to sky is keeping directions straight. Remember that in the sky, celestial north is not up but toward Polaris, no matter how cockeyed this direction may be in the eyepiece. To find north as seen in the eyepiece, just nudge the telescope a bit toward Polaris. New stars will enter from the field's north side, showing you where this is. Turn the map around accordingly, so north on the map is oriented in this direction. This north-nudging trick will become such a habit at the telescope that you'll forget you're even doing it.

Star Party Etiquette

These rules are intended to help maintain access and use of the Astronomy Club observing sites for as many members and their guests as possible, while preserving the conditions that have brought us out to enjoy the sky. Following these rules will permit everyone to pursue the study and enjoyment of astronomy to the fullest satisfaction.

If you are new to the Club, or it has been a while since you have been to a Star Party, please take a few minutes to review these basic rules. Please don't hesitate to ask questions if anything is unclear.

1. Do Not Litter! Everyone shall be responsible for his or her litter. If you bring it in, take it with you when you leave. Access to the observing site depends upon each member complying with this rule.
2. No Open Fires Permitted.
3. Consumption of Alcoholic Beverages is Prohibited.
4. No White Lights after Dark! Use dim red lights after sundown. Use only the minimum light necessary for safety. If you must use lights, please ask first, to avoid spoiling someone's night vision or astrophoto. Shield or turn off automatic car door or trunk lights (Pull the fuses if necessary.)
5. Park Based on your Observing Plan. Park facing towards the exit, to avoid having to backup using backup lights. If you planning to leave early, park close to the exit. If you do not bring a telescope, park away from observers and walk over. Five MPH is the maximum speed while on observing field to keep dust to a minimum. Also be careful that your vehicle does not block the view of a nearby observer.
6. Remember, your vehicle back-up lights are bright white. A good idea is to back your vehicle in at the start of the evening so that when you leave, you can pull straight out rather than having to back up.
7. Plan Your Departure. Please announce in advance (to save night vision and astro-photographer's tempers), and have someone lead your vehicle out with a flashlight. Use Parking Lights Only – No Headlights, Please!
8. Members are Responsible for their Guests. All non-members are considered "Invited Guests," and must observe the rules.
9. Bring Observers Only. Very small children and pets generally do not enjoy star parties, and can be annoying to others. Please leave them at home if possible.
10. Keep Noise to a Minimum. Please, no loud radios, tape players, CB, CDs, horns, yelling, etc.
11. Never be the Next to the Last to Leave. Don't leave someone alone at the observing site without first checking with him or her. Dead car batteries, vandals...
12. The last two people should sweep the area with white light flashlights to see if anyone accidentally dropped something important. If you find anything left behind, contact the club President the next day and then bring the item with you to the next meeting to be re-united with its owner.

Star Party Comfort Tips

These are intended to be lessons learned. You may assume that these are listed because at one point I didn't know any of this and did something really dumb and learned my lesson. The Boy Scout Motto is "Be Prepared." ...Also sage advice for any amateur astronomer.

- Bring warm clothes, boots and a hat. It gets cold, even in the summer in most places - especially on mountain tops where we like to hang out. (OK it's not exactly cold in the Mojave National Preserve in July :-) It is said that you lose up to 80% of your body heat through your head. "If your feet are cold, put on a hat," the saying goes. I cheat a bit when it comes to dressing warmly. I bring a couple of heat packs can be purchased at most sporting goods shops for about $1 each. These small packets heat up to about 150 degrees F and work by oxidation. They are completely safe and although they are advertised to stay warm for 6 hours, I have often had them last for double and triple that time. Put one in the pocket of your shirt under your jacket and you'll be toasty. They also come in Toe/Finger Warmer size.
- Bring an old large blanket or drop cloth to put under your scope. The first advantage to doing this is that it will keep the dust down around your scope and you'll have a lot less cleaning to do the next day. Another is that you'll be able to find that black lens cap you accidentally dropped much more easily. It's also a lot easier on your knees if your eyepiece is low to the ground and you have to kneel. I always seem to find the weeds with the stickers to kneel on.
- Bring extra batteries. If you have a Telrad, a LED flashlight, map light, or if your scope is a battery powered GOTO scope, it's only a matter of time until you've hauled everything out on a nice dark evening, you're set up and ready to observe only to find out that something's out of juice. If it's not you, you can be the person who saves your observing buddy's evening by giving them a battery or two.
- Consider bringing out a card table to put your charts and eyepieces on. Sturdy is good. I've tried one of those roll-up camping tables and had poor luck with them. I got one from Target for about $20 that is kind of a half card table. It works well, but personally I would like something just a bit bigger.
- Put your car keys in a zippered jacket pocket or attach them to your tripod. Seeing them safely locked in your car is not necessarily a happy feeling...at three a.m.