South East Queensland Astronomical Society Inc.

Recommendations for Beginning Amateur Astronomers

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Occasionally, amateur astronomers ask for recommendations about telescope buying, learning the sky, and so on. Here are some thoughts taken from a regular posting to the sci.astro.amateur newsgroup by Jay Freeman (point your web browser to http://www.weatherman.com/beginner.htm email: freeman@netcom.com)

If you require any further information, do not hesitate to contact the relevant section director of SEQAS. The material in this document is further explained in the beginners seminars regularly conducted by SEQAS.

What to do first:

Written words do not substitute for experience. Join an astronomy club, go to observing sessions, and try other peoples' telescopes (with their permission, of course). You will learn a lot, and will find people who like to discuss equipment and observing.

To find clubs refer to the club directory published in "Sky&Space" magazine, available at most newsagents. Most of you, being members of SEQAS, have already got this far.

Now you must:

1. Use your eyes.

Get into the habit of glancing skywards whenever and wherever you have a chance, be it day or night, dusk or dawn. (Don't walk into a car or drive off the road though - according to legend, Thales made this mistake and fell into a well).

Learn the compass directions. Watch where on the horizon (and when) the sun rises and sets at a given time of year. Know where the moon is at the moment, and what phase it is; understand where it will be tomorrow or next week. Find out where the naked eye planets are in the sky.

2. Learn your ways across the sky.

Learn all the constellations and asterisms. Know which of them will be overhead at which time of year and night. Get to know where the ecliptic passes on the celestial sphere. The sky maps available in "Sky&Space" and "Astronomy" magazines are recommended. These magazines can be ordered through most newsagents. Charts of the sky are also available in the annual "Astronomy XXXX" guidebook (where XXXX=current year), published by Quaser and available through SEQAS.

Purchase of a planisphere is recommended. A planisphere is a horizon mask overlayed on a all sky star map, which can be used to show the bright stars and constellations visible at any given time and date at a specific latitude.

Astronomy 2002, Planisphere, and magazines.

Most professional astronomers who get observing time on big telescopes find objects by using celestial coordinates, and under the night sky outside would be unlikely to identify bright stars and major constellations. You have the time and interest to do better than that.

3. First hardware purchase.

Your first hardware purchase should be a pair of binoculars, either 8x40, 7x50 or l0x50. The first number refers to the magnification, the second to the diameter of the front lens. The larger the front lens, the more light gathering power the binoculars have, and

What to do first continued ...

7x50 binoculars.

the fainter you can see.

Telescopes, and binoculars useful for astronomy, are not magnification devices. They are light gathering devices. This is because most celestial objects are not so much small, as very faint and distant.

Hundreds of deep-sky objects are big and bright enough to show well through apertures of two inches or so, at low magnifications. Thus, medium sized binoculars - 7x50 or l0x50 ("7x50" means "7 power, 50-mm aperture") make inexpensive, highly portable, easily operated beginner instruments. Perhaps you have one already. To use them well, you must be willing to learn the sky enough to find things with a hand-held instrument. And don't get one that is too heavy to bold steady, or hold for a longer period. Light and portable is best.

Your binoculars will never go out of fashion. Even when you buy a telescope, you will find it refreshing to use just a pair of binoculars and sky map to get re-acquainted with the sky, and to identify deep sky objects for closer inspection with your telescope.

4. Second hardware purchase.

Once you have learned your way around the sky, and can identify all the planets and some deep sky objects courtesy of your binoculars, your second hardware purchase will be a telescope. The choice here is to either make your own, buy a new one, or buy second hand. Before making this choice, the advise of other members of SEQAS should be sought.

Do not be in a hurry to buy a telescope, as other members of the club are usually willing to allow you to view through theirs during field nights. This will allow you to compare different telescopes with each other, so that you first telescope choice will be a suitable one.

In acquiring a telescope, you face bewildering, expensive choices. So before investing in your second hardware choice, you should ask yourself some basic questions.

(a) How much effort are you willing to put into learning the sky? If you know the constellations, and have practiced using sky charts, you will be able to use a telescope cheaper, smaller, lighter, and easier to set up than one using precise alignment or computer control to locate objects.

(b) What are your interests? If you are only interested in backyard observing of the Moon and Planets, a long focal length telescope may be appropriate. If you are interested in deep sky objects, a more portable, faster focal ratio telescope would be better, to allow you to transport it to dark sky locations. Your requirements are best discussed with other members of SEQAS.

(c) How much effort are you willing to spend on your observing skills? Seeing fine detail in celestial objects, or just seeing faint ones at all, requires practice and patience. Yet the rewards are enormous: An experienced observer may see things with a small telescope that a beginner will miss with one five times larger, even with objects and sky conditions that favour both telescopes equally.

(d) How far will you have to lug your telescope to get it from where you keep it to where you use it, by what means, and how much effort will you put up with to do so? Differences in size and optical design create vast differences in telescope portability, and any telescope that you take out and use will be far better than one that sits in the closet because it is too heavy or too cumbersome.

(e) Some people are into technology for its own sake, without regard to whether it is useful or cost effective. Are you willing to pay extra for sophisticated features, even if you don't need them? If so, fine -- lots of us like neat equipment. But if not, take care that technology enthusiasts don't persuade you to buy things you don't need.

(f) Do you want to take photographs or CCD images of celestial objects? Astrophotography can be an expensive word. It typically takes several telescopes and several years before you will be satisfied with your results, and you will spend lots more money than purely visual observers do. This should not dissuade you from experimenting with sky photography using a 50mm SLR camera, possibly on a barn door mount or piggybacked onto a telescope.

Whilst the purchase or construction of a first telescope may appear a difficult choice, the reality is that almost any telescope will do, providing it is used frequently. For frequent use, it must be convenient and portable to set up.

5. What else to do.

Read everything you can acquire on astronomy, astrophysics, cosmology, planetary science and stargazing. The SEQAS library has many items, including videos. The Brisbane City Council Library and the Pine Rivers Shire Council Library has many useful books to bor-

What to do first continued ...

row. Of particular recommendation is the magazine "Astronomy" and "Sky & Telescope", available for purchase at many newsagents.

The more you understand about what you are seeing, the more meaningful it will be for you. Amateur astronomy, even at a casual level, requires appreciation, patience and study.

Of the extensive collection held by The Brisbane City Council Library, the following is recommended:

- Man and the Stars by Robert Hanbury Brown
- Amateur Astronomers Handbook by J. B. Sidgwick
- Astronomical Objects for Southern Telescopes by E. J. Hartung
- Astronomy through the Telescope by Richard Learner

Don't forget the Brisbane City Council's Sir Thomas Brisbane Planetarium (or "Skydome") at the Mt Cootha gardens, who run regular programs. The State Library also has an excellent collection of astronomy books.

6. Other resources.

If you own a computer, there are many astronomical software programs available. Feel free to attend the club's computer workshops, or seek the advice of other club members. There are many shareware programs available over the Internet. Sky Globe, Sky Map and the Earth Centred Universe are good planetarium programs available at modest cost, but there are also many others.

The Internet has a cornucopia of information available, much of which was previously only available to professionals. There are also many hundreds of web sites available on astronomy. Start with Sky and Telescope's site (http://www.skypub.com/s_t/s_t.html). They have great articles for beginners, which can be printed out, bound, and keep for reference.

About Telescopes:

Telescopes come in a number of optical designs. These designs determine the cost, portability and usefulness of the telescope. The most common design in amateur hands is the Newtonian telescope, which has a long tube with a mirror at the bottom end and the eyepiece at the other. The eyepiece magnifies the image collected by the mirror. This type of telescope is relatively easy to fabricate, and is therefore inexpensive to buy and make. This alone accounts for its popularity amongst amateurs.

Also relatively common, especially in smaller sizes, is the refractor. This telescope uses lenses at the front of the tube to collect light which is magnified by the eyepiece at the bottom end of the tube. For refractors larger than 80mm, the tube becomes long and requires a very heavy mounting. The cost of producing large lenses is far higher than the cost of fabricating large mirrors, so refractors over l00mm are rare and expensive.

The third most popular type of telescope is the Schmidt-Cassegrain Telescope (SCT). This uses a plate of glass (called the front corrector plate) over the front of a very short tube. At the bottom of the tube is the primary mirror, which collects light and sends the image to a secondary mirror located on the front corrector plate, which then sends it to the bottom of the tube where the eyepiece is located. These telescopes are mass manufactured and are widely available. Their advantage is their compactness and portability.

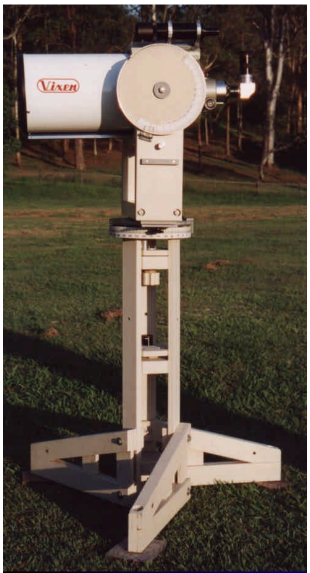
There are a number of other telescope designs in the cassegrain family, but they are not usually found in amateur hands. Other telescope designs, of which there are many, are even rarer.

The most important thing in determining the optical performance of a telescope is the diameter of the beam of light that goes into it, its so called "clear aperture". This determines the light grasp. Obviously, the more light, the fainter the things you can see. Less obviously, image detail is limited by clear aperture, via physical optics. Bigger telescopes produce sharper images, just because they are bigger.

There are important qualifiers. Bad craftsmanship can make any telescope perform poorly. Fortunately, it is not too hard to make optics of the sizes and types common in amateur telescopes. Most manufacturers routinely turn out units that are acceptable. Bad ones turn up, but major manufacturers will often fix or replace a real lemon, if you have wit to recognise that you have

Newtonian telescope on Dobsonian mount.

About Telescopes continued ...



Cassegrain telescope on alt-azimuth mount.

one, and will to complain. (Many have neither; that's how some manufacturers make money!)

Also, different optical designs perform differently. Schmidt-Cassegrains (SCT's), Newtonian reflectors, and refractors all have good and bad points. People who love telescopes, or sell them, will be eager to debate the matter. However, variations are relatively minor. It is usually adequate to assume all telescopes of given clear aperture and given quality of optical craftsmanship have the same optical performance. Real differences in telescope performance (viz. light grasp) will correspond to changes in aperture of usually no more than 10 to 20 percent.

Finally, atmospheric turbulence (called "seeing") limits the ability of a telescope to show detail, and sky brightness limits its ability to show faint objects. Poor seeing usually hits large telescopes harder than small ones. When seeing is poor, there may be no reason to take out and set up a big telescope. If you always observe from such conditions, you may have no reason to buy a big telescope. Yet, even in a bright sky, a large-aperture telescope will show fainter stuff than a small one. And many have found dark-sky stable-seeing sites within a reasonable drive of home.

Notwithstanding these caveats about seeing and dark skies, aperture wins, and wins big. If you buy the finest 90 mm fluorite refractor in the world, do not be chagrined if someone shows up with a home-made 6-inch Newtonian that outperforms it. There is no contest.

Some generalisations about the various types of telescopes:

1. The most optical performance per unit of clear aperture comes from modern, high-quality refractors. However, they are outrageously expensive compared to other designs of the same aperture. Also, in sizes much above 80mm aperture, the tubes are generally long enough to make the whole instrument cumbersome and heavy.

2. The most optical performance per unit of portability comes from Schmidt-Cassegrain and Maksutov designs, but they are still pretty expensive. There's a qualifier here: What makes them portable are short, stubby tubes, but for small apertures of four inches or less, the portability advantage is dominated by clumsiness of the tripod. So the portability advantage of Schmidt-Cassegrains and Maksutovs diminishes at these smaller apertures.

Cassegrain telescope on equatorial mount.

3. The most optical performance per unit of cost comes from Newtonians, especially those with Dobsonian mountings. Compared to other telescopes of the same aperture, they are less portable than Schmidt-Cassegrains and Maksutovs, but not nearly as immovable as refractors. Equatorial mountings make Newtonians difficult to move, Dobsonian mountings make them far more portable. When you buy a Newtonian you are buying a project, as there is always something extra you can do to them to fine tune their performance, or make operation easier. They require a lot more maintenance than other designs.

For all their cost, small refractors and Schmidt-Cassegrains are durable and difficult to get out of collimation. Good ones make respectable beginner instru-

Newtonian telescope on equatorial mount.

About Telescopes continued ...

ments, particularly for beginners without the inclination or ability to construct and maintain a Newtonian. But beware of mass-marketed junk refractors, advertised as high-power and sold in department stores. Often these have good primary lenses, but the mountings and eyepieces are of poor quality. Do not despair, if you already own one of these, it can be upgraded. Contact the SEQAS ATM Director for details.

Of equal importance to the optical configuration and quality, if not more so, is the quality of the mounting. A shaky, difficult to use mounting will only result in frustration. Telescope mountings must be solid with ease of movement.

Equatorial mountings are designed to easily follow objects as they move across the sky by movement in one axis only. To do this successfully, they need to be heavy and robust. Except for small telescopes (l00mm reflectors and 80mm refractors), this also makes them awkward, heavy and difficult to move. The most common equatorial mounting for the Newtonian reflector is the German Equatorial Mounting (GEM), the most popular mounting for the Schmidt-Cassegrain (SCT) is the fork mounting. There are several other designs for equatorial mountings.

Equatorial mountings allow automatic tracking of objects with a simple drive on one axis, which allows use of higher power for moon and planets (300z to 400z or more with good seeing). Piggyback photography is easy, and photography through the telescope is possible. The disadvantages are that they are usually heavier than Dobsonian or other altazimuth mountings, and take longer to set up, due to the requirement to "polar align" them.

Altazimuth mountings, such as the dobsonian, tend to be cheaper, lighter, less clumsy, and more quickly set up than equatorial ones. This is especially true for larger telescopes, and the larger they are, the more true it is. These mountings have two motions, up and down, and round and round. They generally require manual tracking of celestial objects as these objects arc across the sky. To use one you must be willing to learn the sky well enough to find things without dialling in celestial coordinates. Providing they are well designed and built, they are hassle free to use, and even novices can very easily locate objects due to the intuitive feel of these mountings. These mountings are great for deep sky and planets up to 200x (about the magnification where Dob manual tracking prevents decent observation for most users). Best of all, they are easy to transport and set up. The disadvantage is that they can't be used for much photography. Dobsonian mountings can be fitted with drive mechanisms, or placed on a equatorial table. This allows automatic tracking of objects, the use of higher powers and the possibility of taking CCD images. These drives or tables are an added expense, almost as much as a good equatorial mounting. These devices will never equal a well made equatorial mounting for astro-photography or even CCDing. Even so, they still leave the dobsonian mounting as the most portable, cheapest and easiest to set up mounting available for Newtonian telescopes.

Setting circles are calibrated disks that are used to locate faint objects by setting the telescope to the object's Right Ascension (RA) and Declination by direct reading of the circles. Generally, these are graduated disks located on the RA and Declination axis of the telescope mounting. During the last few years, the price of optical encoders has fallen dramatically, and the use of microprocessors has resulted in the widespread availability of Digital Setting Circles. These devices provide a display of where the telescope is pointing in RA and Dec. Digital Setting Circles are also available for dobsonian mountings, and they allow use of celestial coordinates to find faint objects, and they can look up the coordinates for you from an internal data base and guide you to the object. They are an added expense. Many members of SEQAS use them and regard them as an invaluable accessory.

In summary, the ideal telescope is the largest conveniently portable telescope that suits your lifestyle and is affordable. This telescope will fit easily in your motor vehicle, and is easy to carry and set up. This depends on where you will be using your telescope. Many buy vans to transport the largest telescope they can buy. An eight- to eleven-inch Schmidt-Cassegrain is the right size for many people; that is one reason these telescopes are very popular. In fact, the 8 inch Schmidt-Cassegrain is the best all round telescope for portability, aperture and freedom from maintenance.

About Eyepieces:

Beginners are sometimes confused about what eyepieces to get for a new telescope, or how to expand their eyepiece collection. Here are some simple, practical comments.

1. Magnification.

The magnification given by a particular eyepiece is the ratio of the telescope's focal length to the focal length of the eyepiece in use. A telescope with a 1000 mm focal length, used with an eyepiece of 25 mm focal length, has a magnification of 1000 / 25 = 40x. It makes things look 40 times wider, or if you prefer, 40 times closer. Put in an eyepiece with 4 mm focal length, and the same telescope now has magnification

About Eyepieces continued ...

of 1000 / 4 = 250x.

Magnification is sometimes symbolised by the letter "X" (or "x"). Thus we might speak of 40x, or 250x, and a 7x50 binocular magnifies seven times. (As we saw earlier, the "50" is the diameter of its front lenses, in millimetres.) Focal lengths of commercially available telescope eyepieces range from 2.5 mm to 60 mm or more.

2. Apparent and Actual Fields of View.

When you look into an eyepiece, the width of the apparent field of view is the angle through which you must turn your eyeball to transfer your gaze from one side of the field of view to the other. It varies with eyepiece design, from as little as 30 degrees to more than 80 degrees. The width of the actual field of view is the angular width of the patch of sky you are looking at. It is equal (more or less) to the width of the apparent field of view divided by the magnification. Thus if you are using an eyepiece with an apparent field of view of 50 degrees, in combination with a telescope such that its magnification is l00x, the width of the actual field of view will be about 50 degrees / 100 = 0.5 degree, which is about the width of the full Moon.

3. Eyepiece Design.

Eyepieces come in many different designs, and they all have names, for example Huygens, Ramsden, Kellner, Orthoscopic, Erfle, Plossl, Koenig, Nagler, and many others. Don't worry about what the names mean, just remember that they do mean something. Some cost more than others, some work better than others. The ones that cost more aren't always the ones that work better. All of the designs have pluses and minuses.

4. Eyepiece Diameter

Eyepieces come in different barrel diameters, i.e. the diameter of the cylindrical part of the eyepiece, that fits into the telescope's eyepiece holder. There are three common sizes on the market today, and one less common one. The common barrel diameters are 2.00 inches,1.25 inches, and 24.5 millimeters (0.965 inch). The less common one is 23 mm (0.917 inch). Barrel diameter has nothing to do with magnification. But too small a barrel may restrict the apparent field of view of a long focal-length eyepiece.

5. Barlows.

A device called a Barlow lens (sometimes a telextender) may be used with eyepieces to change their magnification. The best way to think of a Barlow lens is as a device which multiplies the telescope's focal length. Thus if you insert a 3x Barlow lens into the back of a telescope with 1000 mm focal length, the combined focal length of the telescope and Barlow lens becomes 3000 mm, and the magnification of any eyepiece used

Eyepieces, filter, and Barlow.

with the telescope will be tripled when it is used with the Barlow lens, compared to the magnification without. Barlow lenses on the commercial market come in at least the three common barrel diameters, and have focal-length multiplication ratios from 1.75 to 5.00. Some have adjustable multiplication ratios. A good quality barlow lens is useful for higher power viewing. The Televue, Meade or Klee barlows are recommended. These accessories increase the magnification range of your existing set of eyepieces, whilst preserving eye relief.

6. Eye Relief.

Eye relief is the distance between the final glass surface of the eyepiece and the lens of your eye when you are looking through it. It is the space into which your glasses must fit, if you wear them when you observe, and is the clearance which keeps your eyelashes from smearing the outermost lens surface of the eyepiece, and your eyebrow ridges and cheekbones from jiggling the telescope. Sufficient eye relief is a good thing. Too little is vexing, but too much can be vexing, too, as you can have trouble figuring out where to put your eye. In general, for eyepieces of the same design, eye relief increases in proportion to focal length. But at constant focal length, it varies enormously from design to design. Several lines of eyepieces have been designed specifically to provide the same, ample, eye relief over a wide range of focal lengths.

7. Eyepiece Selection.

Some generalisations about Eyepiece Selection:

(a) Hands-on experience is more valuable than the printed word -- join an astronomy club, take your telescope to star parties, and ask to try out other people's eyepieces in it.

(b) A small number of good eyepieces is better than a large number of "bad" eyepieces. Buy the best you

About Eyepieces continued ...

can afford. In that way you will not need to upgrade later on. TeleVue Plossels are highly recommended.

(c) Not all Barlow lenses work well with all telescopes and eyepieces. You have to try the combinations you have in mind, and find out what works.

(d) It is desirable to have eyepieces that provide a nicely-spaced sequence of magnifications along a useful range for your telescope. Yet some magnifications are more useful than others. It makes sense to buy those first. It is best to start with two eyepieces, one with magnification of about one-fifth the aperture of your telescope, expressed in millimetres, and the other with magnification about equal to the aperture in millimetres. For a six-inch telescope of 150mm in aperture start with magnifications of about x30 and about x150. Or possibly x25 and x120, or x40 and x200.

The more powerful eyepiece in the above combination gives a magnification most of us would call "medium". It will be the one you use in decent seeing, to look at the Moon, planets, and double stars. The other one will give brighter images of faint nebulae and galaxies, and so make them easier to see than if their limited light were spread wide, by high magnification.

The low-magnification eyepiece will also do double duty for finding things. Thus it should have a field of view as wide as possible, and that means that its front lens should be as big in diameter as possible, subject to two limits o your budget (wide-field eyepieces are expensive), and the diameter of the focus tube of your telescope (wide lenses won't help if telescope parts get in the way). If you have a telescope with a long focal ratio (big "f' number), with a small- diameter focus tube, then you won't be able to get a wide-field view, but you will still want a low magification for faint fuzzies.

If you have money left after buying these two eyepieces, and if you absolutely cannot wait until you have joined a club and tried things out, then the next two magnifications you will want will probably be one a little less than the half way point between the first two -- say, 65x to 75x ~ and one at not quite twice the magnification of the more powerful of the first two -- say, 250x.

Note what complex, expensive eyepieces can and cannot do. The best, such as the TeleVue Panoptic and Nagler, and the Meade Ultra Wide, give wider fields of view, with fewer eyepiece aberrations near the edges, than older types. The improvement is most noticeable for telescopes with fast focal ratios. Eyepieces are not aperture stretchers. They can neither increase image detail beyond the theoretical limit for the aperture, nor increase the number of photons that make it to the focal plane. The best an eyepiece can do is not make things worse. A simple eyepiece, with good coatings and well-polished lenses, will show all the on-axis detail a telescope has, and absorb almost no light. That's what counts most for astronomical work.

"Zoom" eyepieces, which change focal length at the twist of a knurled ring, tend to be optical compromises, and are not recommended. There are exceptions to this rule, as TeleVue and Vixon now market zoom eyepieces at an acceptable quality.

Other Accessories:

1. Finders.

What kind of finder you get depends on how you use it. If you plan on looking mostly at fine details in bright objects, then you might buy a big finder, in the hope that most of what you look at in the main telescope will be visible in it, too. But that won't work if you push your telescope to its faint-object limits. In this case you will need a bigger finder, possibly 7x50 or 11x80. This will show stars as faint as on your charts. It helps a lot in identifying what you are looking at through the finder, if every star you see is charted, and vice-versa. Once the right pattern of stars is in the finder, you can put the crosshair where the object lies, even if it is too faint to see.

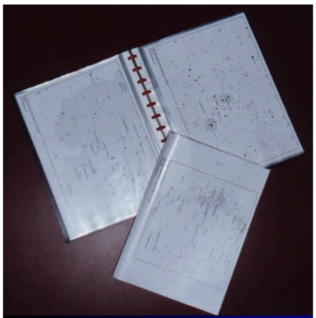
In a dark sky, a l0x40 finder reaches to about magnitude 9.5, which matches the Uranometria charts. In suburban skies, a 8x30 finder goes to about magnitude 6.5 (which would be the naked-eye limit in darker conditions), thus matches many naked-eye star atlases. Unit-power finders, like the Telrad, let you to stare at the sky with both eyes open and see a dot, circle or crosshair of light where your telescope is pointing. A peep sight, made by taping bits of cardboard to your telescope tube, may work as well, and will be much cheaper, and any magnifying "straight-through" finder (in which you look in the direction the finder is pointing) can be used with both eyes open. Let your, brain fuse the images, so you can use the finder's crosshair with the other eye.

2. Charts.

Preferences vary greatly, and the advise of other club members should be sought. What you will find useful, in order from simple to complicated, is more or less the following:

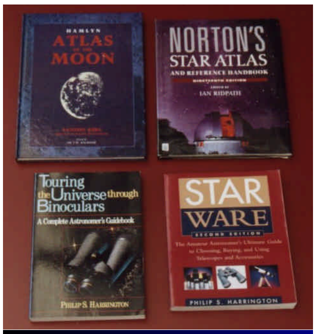
A simple planisphere, preferably a plastic one that won't sog out with dew and that may survive being sat

Other Accessories continued ...


Charts.

upon. It's a fast way to find out whether a particular object is up before observing, or to determine how long you have to wait before it is well-placed.

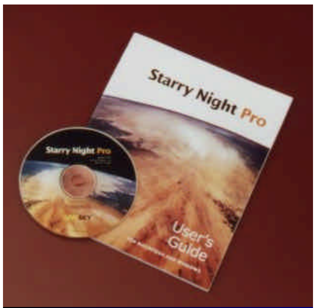
A "pocket atlas", such as Ridpath and Tirion's "The Night Sky". It is about three by five inches and half an inch thick, and may now be out of print. Also recommended is the "Collins Guide to Stars and Planets" by Ian Ridpath and Wil Tirion, published by Collins 1984 ISBN 0-00-219067-2. Another pocket atlas is "A Field Guide to the Stars and Planets" by Donald Menzel and Jay Pasachoff, with sky charts by Wil Tirion ISBN 0-395-34835-8. The "National Audubon Society Field Guide to the Night Sky" is in this same category, and worth considering at $US17.10 hardcover.



Books.

A "table atlas", bound as a book that will lie reasonably flat, showing stars to the naked-eye limit and lots of deep-sky objects. I own an old "Norton's Star Atlas", now superseded by the "Norton's 2000", but there are lots of others, the most popular and widely recommended being the Tirion "Sky Atlas 2000". The Tirion Atlas is published in 3 versions, a deluxe, a field, and a desk edition. The Norton's is more than just an atlas, it is also a comprehensive reference book, and covers just about everything you need to know.

A "deep atlas", such as the two volume "Uranometria 2000.0", the Herald-Bobroff "AstroAtlas", or even the AAVSO variable star atlas. These atlases have a stellar magnitude limit of 9 or 9.5, and a vast number of objects. What's important here is to have enough stars charted that there are plenty in every finder field.



Software.

A planetarium computer program. I do not suggest you rush out and buy a computer, but if you already own one, you might bear in mind that there are programs that will turn your console into a window onto the simulated heavens, with features for finding, displaying, and identifying things.


Red flashlights.

Charts with lesser magnitude limits, like 7.5 to 8.5; don't show enough stars to be useful with most finders, are too cumbersome and are not recommended for use with a telescope. They have their use with binoculars.

3. A red flashlight.

So you can read your charts and notes without ruining your night vision, or that of people near you. The kinds that have a red light-emitting diode (LED) instead of a flashlight bulb are particularly good. If other observers scream and throw things, your fight is probably too bright. Note that to preserve night vision, the light needs to be very faint, almost to the extent that it is difficult to use.

4. A logbook.


Clothing.

This item is not for everyone, but some find it useful to record observations, even if it is only used to record what objects were viewed, with a certain telescope and magnification. Logbooks make fun reading when it is cold or cloudy, and often there will be reason to look up something long after the fact. Besides, if you quote frequently from your logbook, you can make your friends think you are an active observer when you really gave it up years ago.

5. Seating.

A lawn chair or banana lounge, to allow comfortable outdoor viewing with the naked eye and binoculars.

6. Clothing.

Amateur astronomy is an outdoor hobby, and exposure to the elements is normal. You will need warm, dew proof clothing and shoes. Snow gear is ideal. A balaclava or beanie to prevent heat loss from the head is essential, especially in winter. These items can be obtained cheaply from second hand shops, as you don't need to make a fashion statement in the dark.

Insect repellent.

7. Table.

A chart table and chair, which can be an outdoor picnic table and chair, at which to comfortably ex-

Other Accessories continued ...

amine charts beside your telescope.

8. Insect repellent.

Another essential. The more comfortable you are, the more you will enjoy yourself.

9. A reference library.

It is recommended that you purchase a number of books for reference. Which ones are a matter of preference and debate. The choice is simply enormous, and the opinion of members of the club should be sought.

Some recommendations are:

- "Norton's 2000" contains not only charts but is also an excellent reference.
- The "Sky Watcher's Handbook: The Expert Reference Source for the Amateur Astronomer" edited by James Muirden available for $US35.00, locally for $A70.
- "Hartung's Astronomical Objects for Southern Telescopes" by Malin and Frew, revised 2nd edition. It is an excellent guide to deep sky observing, the only one you will ever need.
- "Burnham's Celestial Handbook" by Robert Burnham, a classic in 3 volumes, $U540.35, published by Dover. Highly recommended, but getting a little dated;

After these, it is difficult to make recommendations amongst the plethora of choices available, but some other practical guides worth considering are:

- "The Amateur Astronomers Handbook" by James Muirden. ISBN 0-06-181622-l;
- "Amateur Astronomers Handbook" by J.B.Sidgwick. Dover;
- "The Observational Amateur Astronomer" - Patrick Moore ;
- "Viewing the Universe through Binoculars" - Patrick Moore ;
- "Binocular Astronomy" by Crossen and Tirion;
- "Touring the Universe through Binoculars" by Phil Harrington;
- "Bright Star Atlas 2000.0" Wil Tirion. Is a naked eye and binocular atlas;
- "Mag 6 Star Atlas" by Edmund' Scientific. Is a naked eye and binocular atlas;
- "The Southern Sky Guide" by David Ellyard and Wil Tirion, available from York Optical
- "The Sky - a users guide" by Davis Levy available from York Optical for $29.95;
- "Turn Left at Orion" available from York Optical for $49.95;
- "Skywatching" by David Levy. Harper-Collins,1995, ISBN 0-00-220028-7. Has been the subject of good reviews, and is available in the SEQAS library.
- "Nightwatch: An Equinox Guide to Viewing the Universe" Dickinson, 2nd Edition
- "The Backyard Astronomer's Guide" by Dickinson & Dyer,1991 ($U535.95);
- "Star Ware" - P. Harrington - a book about telescopes and equipment;
- "All About Telescopes" by Sam Brown Edmund Scientific. Covers everything about telescopes;
- "Build Your Own Telescope" by Richard Berry. Charles Scribner Sons;
- "The Constellations" by Motz and Nathanson - it's a nice integration of mythology, history, science and star gazing.

These books, atlases and guides can be purchased through the McGills Technical Books in Brisbane City, York Optical shop in Fortitude Valley, or directly from overseas. Overseas purchases of publications are sales tax and duty free, and are easily made with an overseas bank draft or master or visa card number. Most of these works can be purchased from Sky Publishing Corporation, publishers of "Sky&Telescope", or Kalmbach Publishing, publishers of "Astronomy". For further particulars please consult the magazines themselves. Other overseas purchases can also be made through Willman-Bell or Edmund Scientific, who advertise in these magazines. The cheapest source is http://www.amazons.com.

What about observing skills?

Even some experienced amateur astronomers think that seeing things comes free and easy, with no more effort than opening your eyes: But this is not always the case. Vision is an acquired skill. You must learn it, you must practice, and you must keep learning new things, and practicing them, too. Buying a bigger telescope to see more is like buying a bigger kettle to be a better cook, or buying a bigger computer to be a better programmer. Not that it won't help, but cooking and programming depend far more on knowledge and experience than on artefacts. So does visual astronomy. People with garages full of telescopes (pardon me while I try to close the door to mine) are in great part victims of materialism, marketing, and hyperbole. You cannot

What about observing skills continued ...

buy the universe, you can only earn it by diligent and patient application. Not only that, but practice is cheaper, and works better. An experienced observer may see things with a small telescope that a beginner will miss with an instrument five times larger, even with obects and sky conditions that favour both equally. What skills may you hope to cultivate? What techniques should you practice? Not all have names, but here are a few, in what I think is order of importance; what matters most comes first.

I. Patience.

It can take a long time to see everything in a field, even if you know exactly what you are looking for. The mind does a lot of the work when looking through a telescope, and it takes awhile to "train the eye";

2. Persistence.

Eyes, telescope, and sky vary from night to night, or even hour to hour;

3. Dark adaptation.

Avoid bright lights before observing: It takes your eyes hours to reach their full power for seeing faint objects. An eye patch may be useful. It can cover the dominant eye whilst consulting charts, and can then be moved to the non-dominant eye when using the eyepiece;

4. Averted vision.

The part of your retina that sees detail best, sees low light worst. Look "off to the side" to find faint objects. At the telescope, look toward your nose. In binoculars look up or down, whilst at the same time concentrating on the object at the centre of the field of view. Many observers use averted vision on faint objects, but not for faint detail in bright ones. Detecting something doesn't mean you've seen all you can. Don't let the dazzle of a galaxy's lens keep you from tracing spiral arms out beyond the width of the field. How about increasing magnification, and using averted vision to see if you can see more detail in the paler, but larger, image? Averted vision helps with double stars, when one star is much fainter than the other, even if the faint star is bright enough not to need averted vision if it were by itself. That is, averted vision seems to facilitate the detection of low contrasts as well as faint objects.

5. Stray light avoidance.

Even when it's dark, background glow interferes with detecting faint objects. Keep it out of your telescope and out of your eyes. Try eye patches and eye cups for eyepieces. Or cover your head with a dark cloth or jacket, which is often necessary to visually detect faint objects, such as Leo 1 or the Sculptor Dwarf Galaxy;

6. Moving the telescope.

The eye sometimes detects motion, or changing levels of brightness, more easily than static images. Jiggle the telescope, or move it back and forth, to make an object "pop out". Try it while using averted vision;

7. Not moving the telescope.

The eye sometimes adds up photons over many seconds; if you can hold your eye still for a long time, faint things may appear. Try it with averted vision;

8. Respiratory and circulatory health.

If you smoke, try taking a break before and during observing as carbon monoxide from incomplete combustion interferes with the ability of the blood to transport oxygen. Alcohol and caffeine are best avoided. Some observers think Bilberry can aid night vision when taken a few hours prior. Bilberry is available in most Health Food shops.

9. Safety.

It is not advisable that you go out to remote sites by yourself, in case of accident or illness. This is why SEQAS schedules numerous filed nights during the year. Also, when moving around at night in the dark, do so cautiously and slowly, to avoid walking into something or tripping up.

10. Comfort.

It is important to be comfortable and relaxed to allow yourself to see all there is to be seen.

11. Etiquette.

Field Nights are an excellent opportunity to observe away from the degrading effects of light pollution and mingle with fellow astronomers. There are a few rules you need to observe:

(a) During the dark of the Moon, all light sources should be dim red light only. No white light is to be used anywhere near the observation site (otherwise known as the "red light district"). The reason is simple: white light destroys night vision, something which can take up to an hour to fully develop.

(b) If you arrive after dark and are not sure where to go, leave your car at the entrance and walk to the observers. Don't drive your car, headlights blazing, right through the observation area. Before you leave, warn others before your turn on your car headlights or other white lights.

(c) Loud music can be annoying. Remember, not everyone shares your taste in music played at 2am.

(d) Tread very warily around the telescopes, particularly ones unfamiliar to you. Many scopes will have power leads running off them, and tripping over these at night can lead to injury and one very irate

What about observing skills continued ...

telescope owner!

(e) Don't walk in front of a scope that is being used for photography, particularly if you are flashing around a red torch. This will leave a bright red streak on the film,, ruining the photo.

(f) At astrocamps, please be quite around the sleeping areas at all times. On a good night the keener astronomers will stay up all night viewing the heavens and try to sleep through the morning or take an afternoon nap. It's hard enough to sleep during the day without having to contend with noise made by the inconsiderate few.

(g) Remember, the charge for accommodation at astrocamps is negligible, way below any commercial sites. The cost does not include room service, and it is up to all participants to leave the rooms and facilities in a tidy state. At the end of a camp it does not take long to clean up if everyone pitches in and lends a hand.

(h) Finally, out of courtesy, do not touch a telescope without the owner's permission. Its operation may be totally unfamiliar to you and there is a good chance that you will damage it in your ignorance.

About Light Pollution:

The washed out sky of light polluted big cities is noticeable to all. This does not mean that you can't do astronomy in these conditions. The moon, planets and double stars are unaffected by light pollution and the glare of the moon. These objects, and variable stars, can be studied from your backyard. What light pollution does affect is the visibility of deep sky objects, as these are intrinsically faint. To get away from the effects of light pollution, you need to go to remote areas well away from civilisation. This is why SEQAS organises regular field trips to dark sky sites, away from Brisbane.

About the Sun - WARNING!

The Sun is not a telescopic object. It should never be viewed through a telescope without adequate filtration. The only totally safe method for viewing the Sun in white light is by solar projection onto another surface with your eye well away from any light path. With solar projection, your telescope should also be stopped down to a maximum of about 2 to 3 inches in aperture. If you own a large telescope and you do not stop down the aperture, it will likely self destruct from solar heating!

Eyepieces used for solar projection should be of the cheaper variety with simple designs, as solar heating can damage the glue between the multiple elements of expensive eyepieces. Binoculars can also be used for solar projection, but care should be taken not to overheat and damage the binocular prisms.

All finder scopes and other optical elements should be capped when in the Sun. This includes telescopes left out overnight. Care should be taken with any mirrors or lenses during the day, as inadvertent damage can very easily occur if they focus the rays of the Sun. The Sun can be viewed through a telescope, provided it has safe and adequate filtration that rejects over 99.9"/o of the Sun's light.

If you do not take heed of these rules, the responsibility for any damage to telescopes, optical elements and your retina is your and yours alone! If in any doubt, please contact the SEQAS Solar Section Director regarding safe solar viewing.

Is there more than this?

After learning the sky and having observed most major celestial objects, many observers come to a fork in the road. The choice is to persist with fainter and fainter objects, move to areas other than sky gazing, or lose interest.

Most who persist realise that there is always something more to learn. Areas of serious interest available to the amateur with limited equipment cover supernova searching, variable star observations, planetary observations such as Jupiter transit timings, planetary and deep sky sketching, counting sunspot numbers, asteroid occultations, grazing occultations, comet hunting and nova search. Telescope making is a fascinating field with many adherents, as is astrophotography and CCD imaging.

More well equipped amateurs can make contributions to astronomy by doing photometry of variable stars, and supernova and asteroid searches.

Those who do lose interest usually rekindle their activities at a later time in their lives, as it is hard to let go of something as intrinsically interesting as astronomy.

Glossary:

AAVSO - American Association of Variable Star Observers;

aperture - diameter of the mirror or lens of the telescope. Aperture fever is when someone is always saying "I want more aperture".

asterism - group of stars in the sky with a unique name but without being a recognised constellation, e.g. the mirror of Venus or the Saucepan in the constellation of Orion.

celestial co-ordinates - the grid lines on the celestial sphere which are used to describe the location of any celestial object by reference to its RA (or Right Ascension) or DEC (Declination).

celestial equator - the projection of the Earth's equator onto the celestial sphere.

celestial objects - sky objects, such as the Moon, Planets, stars and star clusters, nebulae and galaxies

celestial sphere - the imaginary sphere encircling the Earth, on which is located all celestial objects in two dimensions.

CCD - is a Charge Coupled Device which is an electronic detector, used in many video cameras, and useful in astronomy as a substitute for film in recording images. These images are downloaded to and processed by personal computers.

collimation - alignment of the optical elements of a telescope. Poor collimation describes the out of alignment condition which degrades optical performance.

constellation - a formally recognised star pattern occupying a designated area of the celestial sphere.

DEC - declination is measured on the celestial sphere as the angular distance north or south from the celestial equator,in degrees

deep sky objects - all objects beyond the solar system.

ecliptic - the apparent path of the Sun across the celestial sphere. The planets describe paths within 12 degrees of this path, in an area known as the zodiac.

eye relief - the distance the eye needs to be placed behind the eyepiece to focus the image. Thus good eye relief will result in the eye at a comfortable distance behind the eye lens of the ocular, whilst poor eye relief will result in the cornea of the eye being very close to the eye lens of the ocular. Generally, the shorter the focal length of the ocular, the smaller the eye relief.

equatorial mounting - a telescope mounting aligned with the Earth's axis to allow tracking of celestial objects by driving one axis only.

faint fuzzies - deep sky objects

Focal length - is the distance from the primary mirror or lens to the point where light is focused.

focal ratio, F number or f ratio - is the ratio of the diameter of the primary to the focal length. For example an 8 inch telescope with a focal length of 48 inches is f6. A fast focal ratio is a low number, such as f4 or f5, a slow focal ratio is a high number, such as f7 or f8 or greater.

light bucket - term often used to describe large dobsonian telescopes, due to their superior light grasp.

light gathering power or light grasp - is the ability to collect light and place this light at the focus for closer examination with the eyepiece. The more light collected, the brighter the object appears.

newtonian telescope - is a telescope that uses a mirror located at the bottom of the telescope tube to collect and focus light, which is then reflected out to the side of the tube by a diagonal mirror or prism. Named after the inventor, Sir Isaac Newton.

night vision - the process of dark adapting the eye, where after 5 minutes the eye pupil will enlarge to its maximum diameter, and after 30 or more minutes, the visual purple will increase in the retina to provide highly sensitive night vision. This night vision is destroyed by any bright light, and the process has to start over again.

ocular - another (more technically correct) name for eyepieces.

Planetarium - device for simulating the night sky.

Planisphere - star map overlayed with a horizon mask, which is used to show the bright stars and constellations visible at any given time and date, at a given latitude.

Primary - is the first or major lens or mirror responsible for gathering the light. The diameter of the primary is the usual quoted telescope size or aperture.

RA - right ascension describes the location of an object on the celestial sphere east or west of the vernal equinox, in hours and minutes.

vernal equinox - also know as the first point of Aries, the point on the celestial sphere where the celestial equator is bisected by the ecliptic. This is the apparent point where the Sun is on March 21. The ecliptic is the apparent path of the Sun on the celestial sphere.