# Binocular Astronomy on a Budget in 2023

## Buying, using and maintaining binoculars without breaking the bank.

By Sammy Yousef
For Presentation At WSAAG Meeting July 2023

syousef@hotmail.com

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Welcome to my presentation on Binocular Astronomy on a budget in 2023. This presentation is based on a similar talk I gave at the Western Sydney Amateur Astronomy Group in July 2012. At the time of this recording I'm planning to present this talk at the July 2023 WSAAG meeting, as well as put a version up on Youtube and make the slides available as a PDF.

The aim is to provide enough information for beginners to be able to confidently buy and use binoculars without falling into any traps that may make the experience unpleasant, such as buying an unusable junk pair of binoculars, becoming frustrated with their use or damaging them by misusing them or storing them incorrectly.

I'll also speak about what to do if you have a pair that's not aligned properly but is not economical to have professionally repaired.

I'm assuming as little knowledge as possible but hoping that there is enough breadth there that even experienced astronomers should find some useful information. We have some very knowledgeable people in the club so that won't be an easy task.

# Topics

- Buying Binoculars.
  - Why budget? What do I mean by budget? Compromises.
  - Specifications and features – what does it all mean?
  - Testing at the Shop.
- Using Binoculars.
  - Resources for finding interesting objects.
  - Planning with simulated planetarium views and charts.
  - Tips for enjoying binoculars.
- Maintaining Binoculars.
  - Basic Care and Cleaning.
  - Aligning the optics on both barrels to eliminate double images. (aka “Dirty Collimating”)

At the end of the slides you will find many more references – books, web sites, and a more in depth review of each of my binoculars and bonus slides from 2012 I won’t cover tonight.

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# Disclaimers

- Presentation includes my own opinions.
  - You may disagree. Others say buy the best you can afford.
  - We have amazing expertise in this club. Do consider other opinions.
  - **But if you spot factual errors please tell me!**
- I do not own expensive binoculars.
- My eyesight is not fantastic.
  - I'm still legal to drive without glasses as of this year.
  - But I may not see as big a difference as someone with better eyesight.
  - Stigmatism means I probably use averted vision more than others.
  - I do not wear glasses when using binoculars.
- Focus is Astronomy. Terrestrial viewing has different requirements.
- Simulated Views On These Slides Are For Illustration. Not Exact Or Perfect.
  - Stellarium overlays deep sky images. Not what you'll see! I've tried to edit the screenshots to be a little more realistic.
- ******** NEVER look at the sun with binoculars! *********

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# Part 1 – Buying Binoculars

# Why Binoculars?

- Compared to a telescope.
  - Easier to use than telescopes.
  - Wide viewer - The big picture top down view of the universe.
    - See entire objects and groups/constellations. All the Pleiades, whole Southern Cross.
    - See objects in the context of their surroundings.
  - Significantly cheaper than a decent telescope.
    - But not a replacement. Handheld binoculars are not the right tool at all for small or faint objects.
- Great for getting familiar with the sky.
  - Excellent tool when starting out as a stargazer.
  - See more stars, clusters and nebula than naked eye astronomy.
- Two Eyes = Richer more natural "3D" perspective than one.
- Portable - compact and light weight.
  - Compare to trying to fit a 10"-12" Dob in the car for family holiday.
  - Less back and neck strain.
- Almost no setup – quick 5-10 minute sessions possible.
- Versatile – can be used for other hobbies – birding, sports, plane/ship spotting, concerts, zoo.
  (Though lighter, smaller binoculars may be preferable for daytime viewing.)

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So why buy budget binoculars and not a telescope? They're easier to use, significantly cheaper and give you wide views that are excellent when you're becoming familiar with the sky. They won't let you see small or faint objects like a telescope will, but they will give stereoscopic "3D" views with 2 eyes of larger objects and allow you to see those objects in context.

They're light weight and compact and take very little time to set up, making them much less of a burden if you're going on holiday.

And if you find you're not using them for astronomy they do have other uses from bird watching to plane and ship spotting, to sports and concerts. There might be better suited binoculars to those tasks but a pair you bought for astronomy will certainly work.

# Why Budget?

- For this talk budget means less than about $130 (up from $50-$100 in 2012, though <$100 and sometimes <$50 is still possible).
- It's 2023. Money's tighter than it use to be.
- If you mistreat or lose them or they are stolen they are easily replaced.
  - More likely to take them with you. Best binocs are ones you use.
- You might be able to afford a backup pair or two.
  - But don't keep them in the car on a hot day. Cheap plastic & glue.
- Variety. Can you afford or justify 3 pairs of $1000 binoculars?
- Give them to your children.
  - Would you rip apart $1000 binoculars?
    - To show your kids what's inside?
    - To align (dirty collimate) them yourself?
  - What about $100 binoculars?
- Inexpensive gift for friend or relative.
  - But don't buy a junk pair. It may put them off for life.

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Why Budget? For this talk "budget" means under about $130 although under $100 and even $50 is still possible. There are lots of good reasons to stick with a less expensive pair if you find they do the job.

It's 2023 and money's tight.

If they're a cheap pair you won't be as worried about them getting lost, stolen or damaged and you are more likely to take them with you.

You might be able to afford more than one pair as a backup or for the different qualities or so that the family can use another pair.

If they do break you'll be happier to tear them apart and show the kids how they work, which you wouldn't do with an expensive pair.

And you have more options if you're considering buying them as a gift.

# Will Any Cheap Pair Do?

- Short answer: NO!!!
  - Some only good for daytime viewing.
  - LOTS (the majority) are completely unusable.
    - Horrible colour tinges and fringing, lack of sharpness, too flexible to hold alignment, don't hold focus, "focus free", zoom mechanisms that break.
    - Children's toys, stage props, paperweights.
  - Really have to know what you're buying.
  - DO NOT expect the equivalent of $1000 views at <$100.
- If you already own a pair try them before buying more.
- Also expensive is no guarantee.
  - ****AT MOST**** you get what you pay for.

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So should we jump onto Amazon or Ebay and pick up the cheapest pair. Absolutely not. There are a lot of junk pairs out there that are unusable, will break easily and give horrible views, particularly for astronomy which requires bright clear views and not horrible inaccurate colours.

You shouldn't expect to get a pair for under $100 that is as good as a well rated $1000 pair, but with a bit of experience you can pick up a good usable pair that will last.

And there are expensive binoculars that are flawed. I like to say that at most you'll get what you pay for, but it's very possible to end up regretting the purchase.

# Budget Compromises

- Quality more expensive binoculars may give.
  - Slightly sharper views. (Significant for astronomy!)
  - Better contrast.
  - Better detail, especially in nebulas/clouds.
  - Less light loss - gather more light for the size.
  - Truer colour - Less chromatic aberration, colour cast.
  - Hold focus and collimation. No cheap flex.
  - Less sample variation. Better quality control.
  - Don’t fog up internally (Nitrogen filled, waterproof)
    - Internal focusing mechanism.
    - Some have individual focusing, not central.
  - Better build. Sturdier. May last longer.
  - Features like image stabilisation. MUCH more expensive.

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# Specifications - Overview

- Prism type.
- Magnification.
- Coatings.
- Field/Angle of view (true vs apparent).
- Exit pupil.
- Glass type (BAK-4 vs BK-7).
- Eye relief.
- Other features (rubber eyecups, tripod socket).

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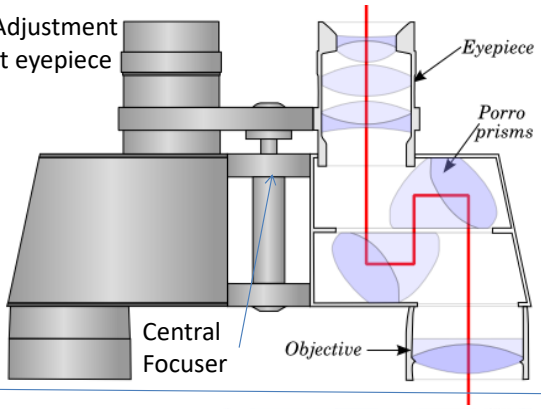
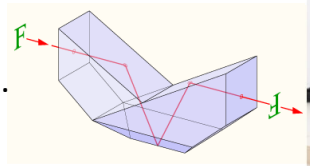
# Specifications – Prism Type

- Porro prism.
  - Less compact width.
    "M shaped".
  - More compact length.
  - Larger sizes available.
  - Cheaper.
  - Better for Astronomy.




- Roof prism.
  - Not as bright.
  - More compact width.
  - Less compact length.
  - Cost more for larger sizes than porro.



* Images from Wikipedia. See Thanks and Attribution slide for details.

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There are 2 broad categories of prism types used in binoculars. Porro prism and roof prism.

You'll be able to tell that a pair of binoculars are using porro prisms by looking at the alignment of the eyepiece and the front objective lens. If they are lined up the binoculars use roof prisms. Using porro prisms in the design instead means the eyepiece and objective lens are not lined up and the binoculars have a distinctive M shape when viewed from above, making them shorter but wider.

Porro prisms are generally cheaper to manufacture for medium to large binoculars and can give brighter views that are more suited to astronomy. You'll find a larger selection of binoculars with porro prisms. But good pairs can be found in either design.

## Specifications – Magnification and Objective Lens Size

- Appropriate magnification and objective size .
  - Given as Magnification (times) X Objective Size (mm).
  - E.g. 7x50 means 7 times magnification, 50mm lenses.
- For Astronomy.
  - Magnification between 7 and 10.
    - <7 too wide. >10 can't hand hold steadily.
  - More magnification, harder to hold steady.
  - 50mm – 70mm for hand held. 50mm is the most common.
    - <50 gathers too little light. >70 too heavy, needs tripod.
  - 7x50 vs. 10x50 hotly debated.

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Often you'll see 2 key specifications listed for a pair of binoculars – 2 numbers with a multiplication sign in between. For example 7 by 50 or 10 by 50. These are often printed on the binoculars in large print and can be in the title of the product listing when the binoculars are sold.

The first number is how much the binoculars magnify, and the second number is how large the front lenses are in millimetres. So 7x50 means the binoculars magnify 7 times and have 50mm objective lenses.

The magnification is especially important if you're hand holding the binoculars. It's difficult for most people to steadily hand hold any pair that magnifies more than about 10 times. 7 times is usually quoted as ideal since you'll start to loose the details of what you're looking at to the wobble. You can put the binoculars with larger magnification on a mount but that adds to the expense.

The size of the objective lens affects how much light we gather. If you double this number you're gathering 4 times as much light because it's the surface area that matters. A lot of binoculars suitable for astronomy have 50mm objectives and this is considered ideal because as they get bigger the binoculars get heavier and harder to hand hold for the duration of an observing session. They also get more expensive as they get bigger so you probably want to stay under 70mm regardless of the cost.

# Specifications - Coating

- Coating type.

  Without coating, Internal reflections cause light loss , ghosting, other problems.
  - OK: Coated - Some surfaces not coated so reflect light – losses up to about 10% more light.
  - Better: Multi-coated (MC) - Multiple coatings to reduce light reflection.
  - Better: Fully-coated (FC) - Every surface coated.
  - Best: Fully Multi Coated (FMC) - Every surface multiple coatings.
- Coatings can be of varying quality.
  - Some binoculars marked FMC worse than ones marked as Coated.
  - Try to avoid horrible coloured “ruby” and orange coatings.
    - Used to mask bad optics that bend different colours by different amounts.
    - Cause false colour.
    - Can cut out certain colours. You’ll lose nebulousity in some objects.
    - Lighter coatings that are blue or indigo are preferred. Green in between.
    - Bad coatings cut out more light but even badcoatings can reduce colour fringing and increase contrast.

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Coatings are important. Without coatings on the lenses and prism, you get Internal reflections cause light loss , ghosting, other problems.

The specifications will generally describe the binoculars as featuring glass has one of 4 levels of coating.
“Coated” means there is an optical surface somewhere in the binoculars that has received a coating.
“Multi-Coated” means something has received more than coating.
“Fully Coated” means every surface that matters has been coated at least once.
Or “Fully Multi-Coated” means every surface that matters has been coated with multiple coatings.

This spec is often abbreviated as MC, FC or FMC. As you might guess this isn’t very specific as they don’t tell you anything about the coatings themselves. This spec gets abused quite a bit but in general fully multi-coated is desirable.

Looking at the colour of the coating on the front lenses will tell you what colours of the spectrum that coating is blocking. Very reflective “Ruby” red or orange coatings tend to be the worst – they are there to increase contrast but they also block the light you’re trying to look at.

Lighter coatings that are clear are best but in my experience light blue or purple can be good too, with green being a little bit worse.

## Specifications – Field and Angle Of View

- Angle of view – AOV (confusingly aka True Field of View - TFOV).
  - How much of the sky you can see.
  - Usually shown as width at a distance e.g. m@1000m or yards@1000ft. But also can be expressed as an angle.
  - Related to magnification, depends also on construction and configuration of optics.
- Apparent field of view – AFOV.
  - How wide the image looks to your eyes. Tunnel vision vs. fills your view.
  - **True Field = Apparent Field ÷ Magnification.**
  - "Wide Angle" binoculars usually have an apparent field of view of 60 degrees or more. Fill your view. Less tunnel vision.
  - Trade off against long eye relief. (Further from "light tunnel".)

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The "Angle of View" tells you how much of an object you'll see through the binoculars at a given distance at any one time. It's also sometimes confusingly called "True Field of View".

Usually it's quoted as a width you'll see at distance - meters at 1km or feet at 1000ft are common. But sometimes it's also given as an angle in degrees.

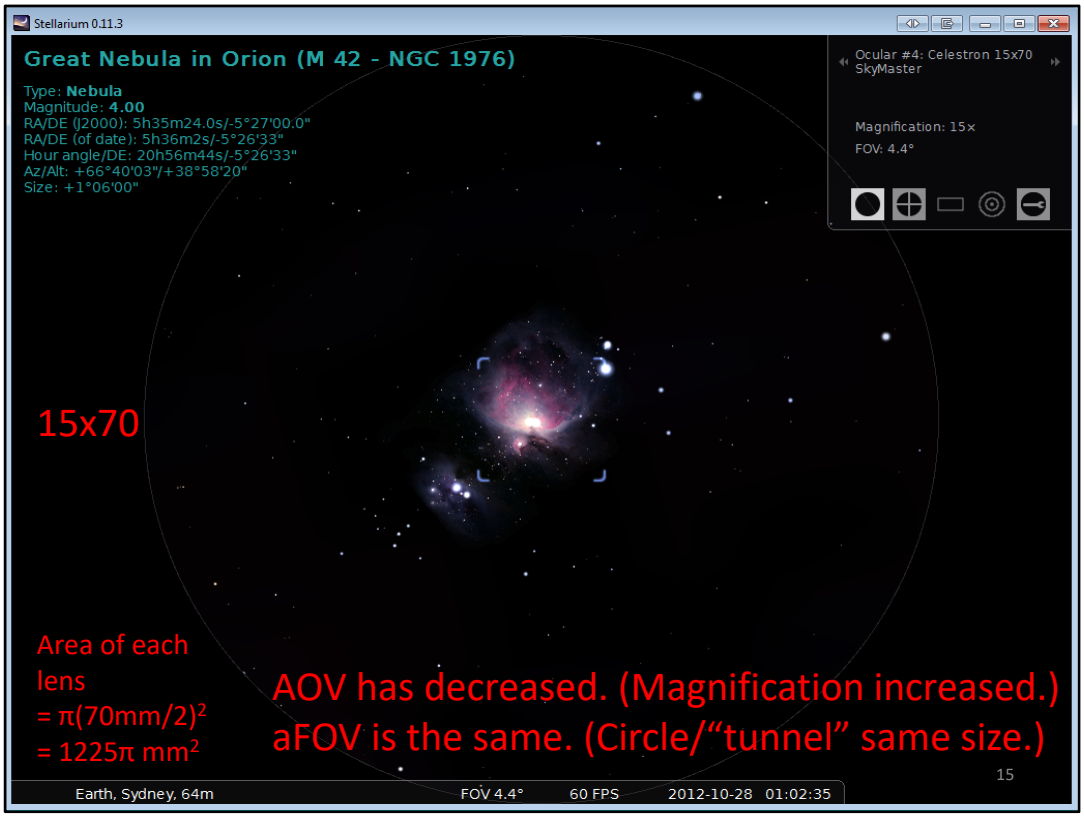
The "Apparent Field of View" tells you how wide the image looks to your eyes – how much of your vision it fills. A narrow apparent field of view is like looking down a tunnel. Whereas your eyes won't see all edges of the image circle at the same time if the apparent field of view is wide. Getting that wide view requires you to put your eyes close to the eyepiece, which can be a challenge for those who wear glasses when using them.

The true field of view depends on the apparent field of view and magnification


These next slides are simulated views through a couple of different pairs of binoculars to highlight some of the differences the specifications make.

These images are taken from free planetarium software called Stellarium. To help show the differences I've left them brighter and more colourful than what you can actually expect to see in a pair of binoculars.

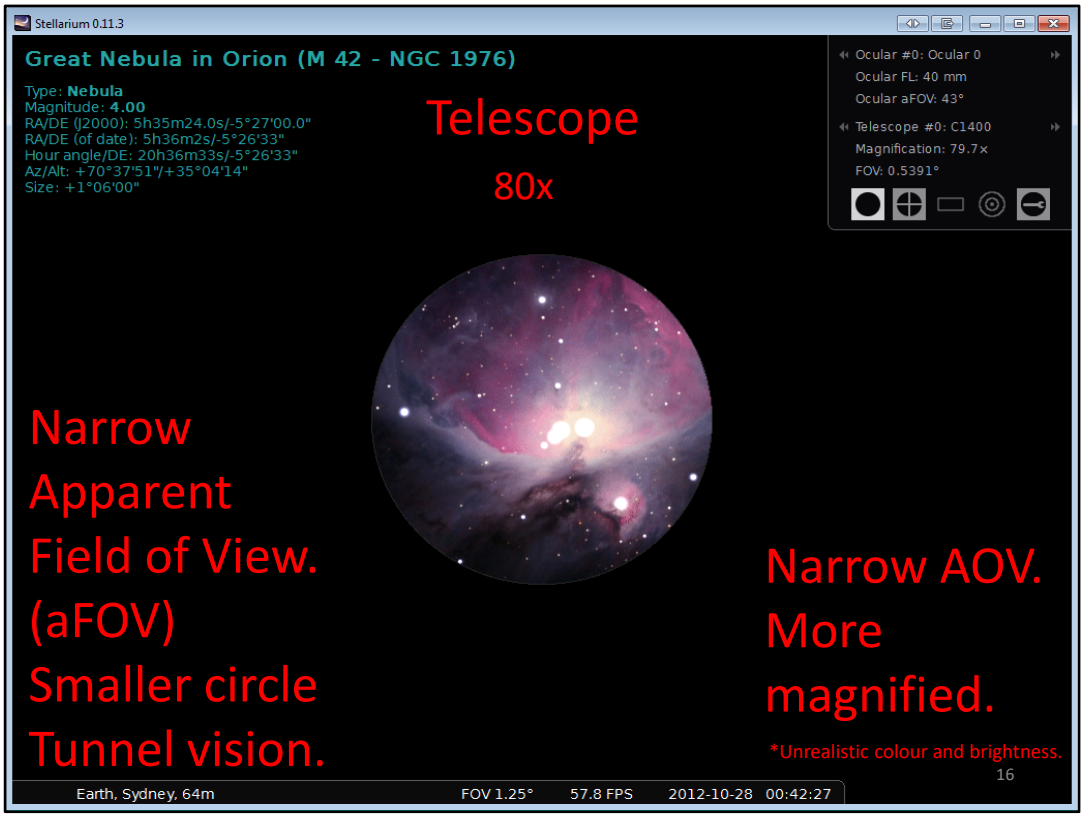
In this first image we have a view of the Orion Nebula in 7 by 50 binoculars. So a magnification of 7x and 50mm diameter objective lenses. We'll take this as our baseline.




And here we've swapped to 15 by 70 biniculars.

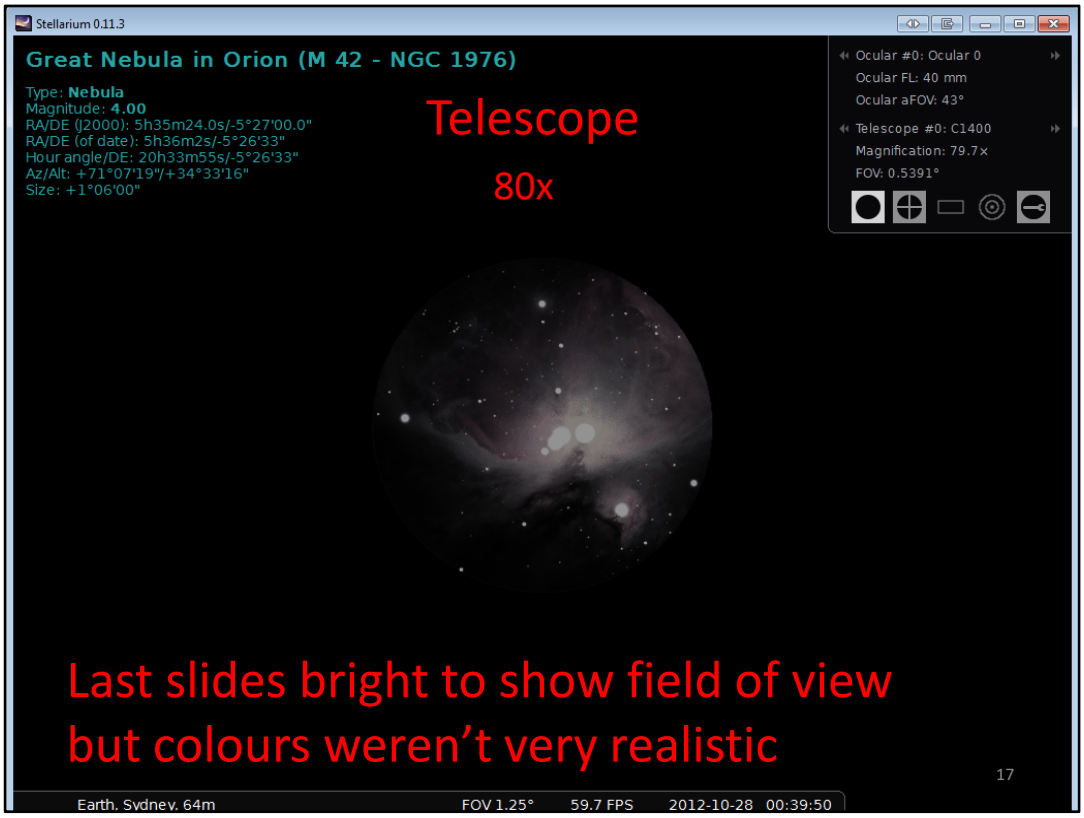
So we have gone from a magnification of 7 to 15 – the nebula is obviously bigger. But of course that means you also see a smaller portion of the sky – the Angle of View has decreased. But the circle itself is the same size. The apparent field of view is the same.

The increased magnification would normally mean the image is less bright but we've also switched to larger 70mm objective lenses so we're collecting almost twice as much light. In general as you go to higher magnification, you'll want bigger binoculars.




And for comparison this might be how much of the nebular you see magnified at 80 times in a telescope.

Again this image is a lot brighter and more colourful than you'd see at the eyepiece.




So to give you an idea this slide shows you something closer to the colour and brightness you might actually get.


And here's the 15 x 70 view with more realistic colours too.

# Specifications - Exit Pupil

- Exit pupil.
  - How big the circle of light that hits your eye is. Usually in millimeters.
  - Larger magnification means smaller exit pupil.
  - On goal is to match the opening of your eye's dark adapted pupil to maximize light. As a general rule:
    - » Younger viewers -> Pupils dilate more -> 7x ideal.
    - » Older viewers -> Pupils dilate less -> 10x ideal.
    - » Matching exit pupil with greater magnification of 10x gives illusion of improved contrast.

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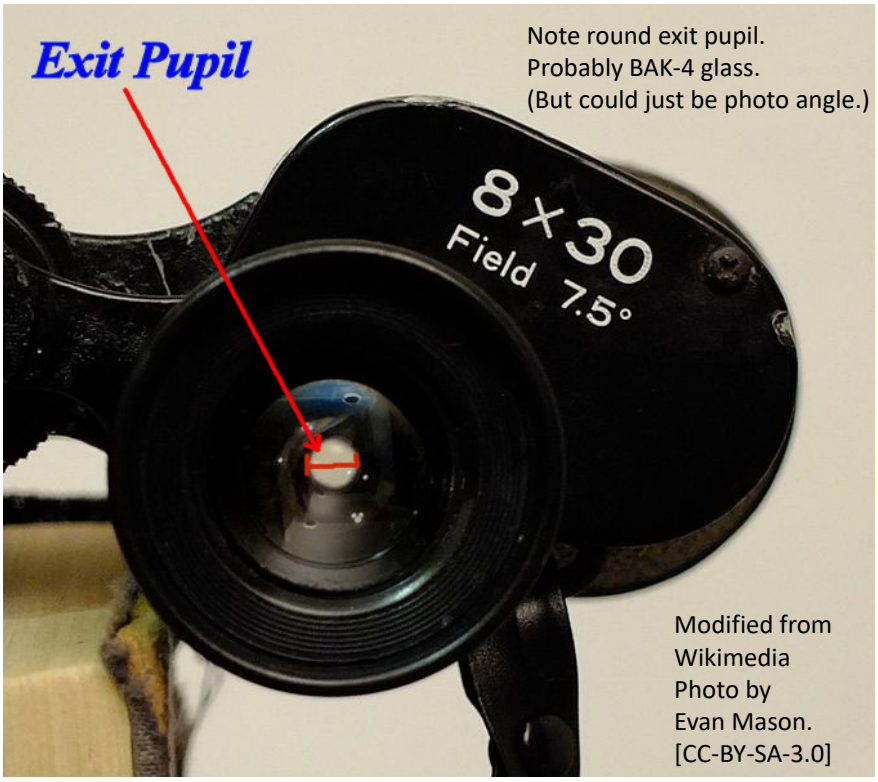
The exit pupil is how large the circle of light coming out of the eyepiece to hit your eye's pupil is. It is measured in millimetres.

If that circle of light is larger than the size to which your pupil can dilate, the light that isn't hitting your pupils is wasted and the view is dimmer than it could be.

Pupils dilate less as we age. Around 7mm in our teens down to around 5mm in our 60s. For those interested I've linked a paper at the end of the slides.

The size of the exit pupil is related to the magnification, with more magnification leading to a smaller circle.

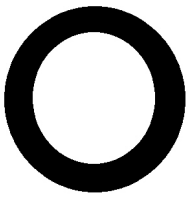
For young observers 10x magnification might be dimmer and less detailed than 7x, but for an older observer whose eyes can't take advantage of the larger exit pupil, the 7x and 10x binoculars might appear to be similar.



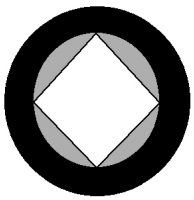

This picture shows the exit pupil on a pair of 8 by 30 binoculars with a field of view of 7.5 degrees.

## Specifications – Glass Type

- Glass type.
  - BAK-4 = Barium Crown.
    - More expensive. I've never seen cheap BAK-4.
    - Round exit pupil.
    - Less light loss.
    - But more colour fringing.
    - Higher refractive index. Bends light more.
  - BK-7 = Borosilicate Flint.
    - Diamond exit pupil.
    - More light loss at edges.
    - All cheap binocs I've seen use BK-7 glass.
- BAK4 designation can be ambiguous.
  https://stargazerslounge.com/topic/135299-when-bak4-is-not-bak4-glass-types-for-binocular-prisms/
  "The Chinese designation "BaK4" is an entirely different glass to the Schott BaK4 -- BaK stands for ***Ba****ritleich****k****ron (Barium Crown)*; the Chinese BaK4 is actually Schott PSK3, which is not a Barium Crown at all: it is a phosphate crown. PSK3 is much cheaper to make than BaK4; it also has a lower refractive index."



BAK4



BK-7

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Broadly speaking there are 2 types of glass commonly used to make prisms for binoculars. BAK-4 and BK-7.

BAK-4 or Barium Crown glass is more desirable. It produces a round exit pupil, has a higher refractive index so it can bend light more, and transmits more of the light. The one down side is increased colour fringing.

BK-7 glass is Borosilicate Flint – Using this kind of glass results in a diamond shaped exit pupil and more light loss.

Most cheaper binoculars use BK-7 glass, and some binoculars listed as having BAK4 glass actually use a different glass that's not a true Barium Crown. So at this price point it's not something you should worry about this specification too much so long as the image quality is reasonable.

## Specifications – Glass Type – BK-7


- Surprisingly difficult to photograph. Right light required behind binocs. They need a clean, but not as filthy as they look here in bright sunlight.
- Avoid damage. Never get carried away over-cleaning optics. If you have a have specialized need make sure you have the right tools.

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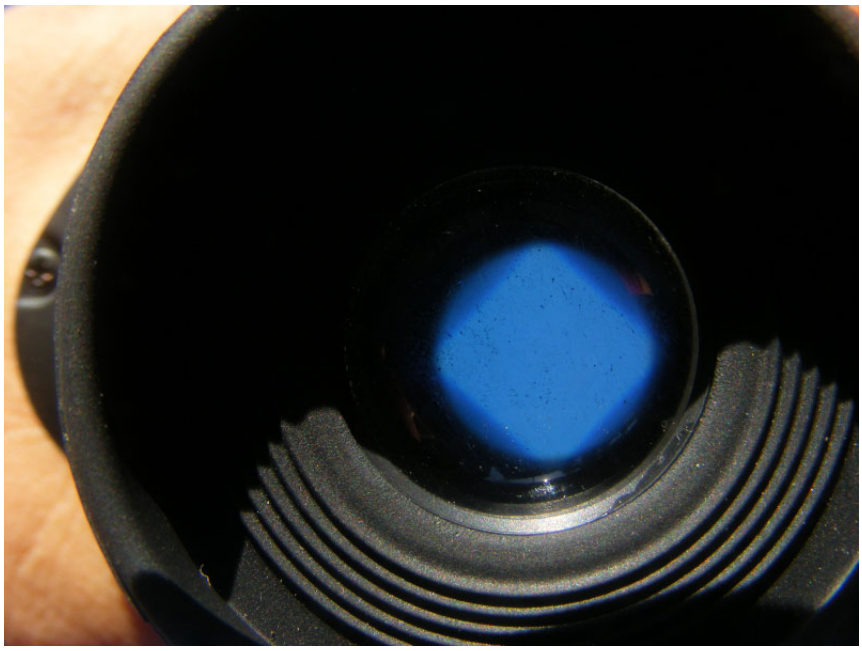
On this 7 by 50 pair of binoculars you can clearly see the edges of a square exit pupil, which tells you these are BK-7 prisms.

## Specifications – Glass Type – BK-7



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And here's a close up. Looking from slightly off center to the eyepiece while pointing at a bright uniform source of light like the sky it's usually quite easy to see the shading that gives away the use of BK-7 glass.

# Specifications - Eye Relief

- Eye relief is how far from your eye you can hold binoculars and see the whole image.
- The longer the eye relief, the less the apparent field of view.
  - You can either have wide angle or long eye relief, not both.
  - The further your eye is, the less the eyepiece fills your eye.
- Viewing beyond eye relief distance also gives tunnel vision.
  - You miss out on the edges.
- No choice if you view with glasses. You need long eye relief.
  - 16mm and up recommended.
  - Harder but not impossible to find in cheap binoculars.

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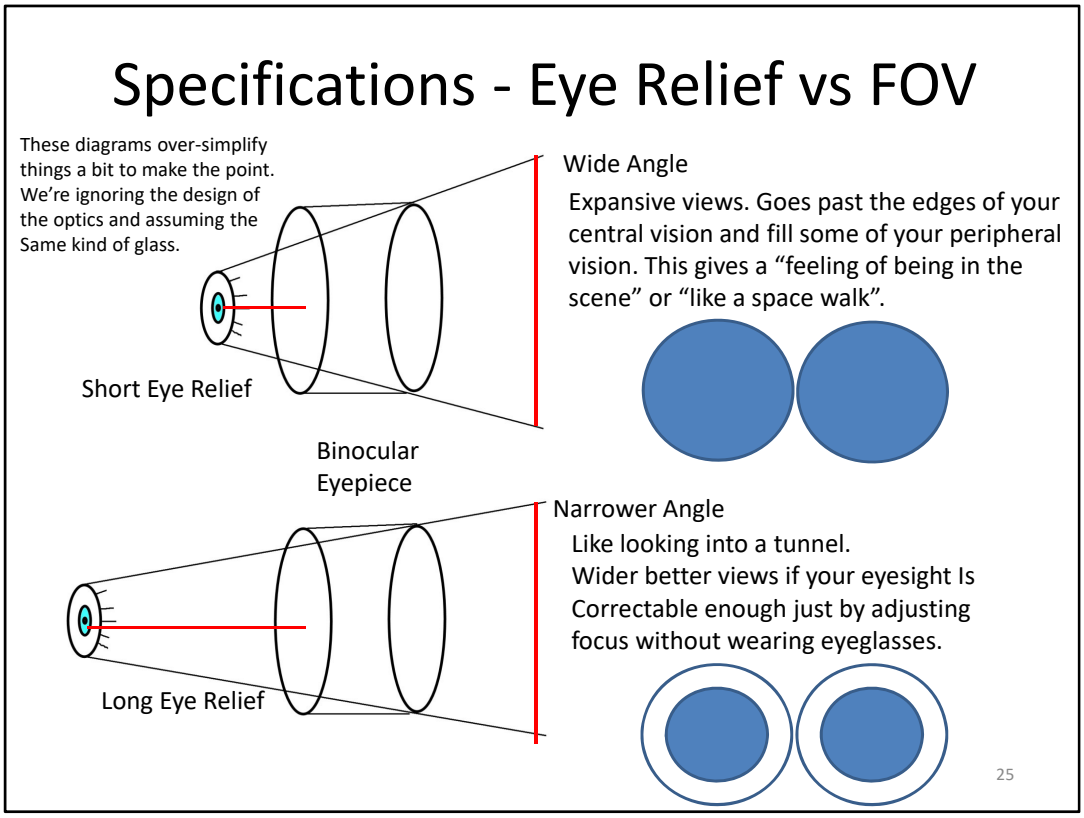
How far from your eyes you can hold binoculars and see the whole image is called the "eye relief".

Long eye relief binoculars are more suited to eye glass wearers as your eyes can sit further back from the eyepiece. But they'll have less of a wide angle, so if you don't need the eye relief you may prefer binoculars that give you that more immersive wide angle that some people as describe as feeling like you're floating among the stars.

This is an important consideration if you need to use the binoculars with eyeglasses. It can make the difference between the pair being unusable and frustrating to use. You want at least 16mm of eye relief and you might need more. Long eye relief binoculars can be harder to find since wide angles are often preferred.




This slide is a little over-simplified, but shows the trade off between wide angle binoculars and long eye relief binoculars.

Wide angle binoculars fill your vision and give you the feeling of being in the scene, but to do that they require your eyes to be closer to the eyepiece.

Long eye relief binoculars allow your eyes to be further away from the eyepiece which is necessary if you use your binoculars with eyeglasses. But the trade off is that it's like you're looking into a tunnel.

Both features are used as selling points when marketing binoculars, depending on the design.

# Other Features

- Wrist or Neck Straps, Cleaning Cloth. (often included).
- Tripod Mount Screw.
  - Highly desirable.
  - Attaches to camera tripods, and specialized tripod mounts.
- Waterproofing.
- Gas (nitrogen) filled.
- Zoom. (Avoid!!!)
- Image Stabilization.
- Camera/Digital Binoculars. (Rare, expensive, often bad).
- Night Vision. (Not suitable for astronomy).

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There are some other features, you want to be aware of.
Most binoculars come with a neck or wrist strap and some kind of basic cleaning cloth, both of which are useful if you're on a tight budget, but can often be replaced with something better.
One very desirable feature that not all binoculars have is a tripod mounting screw. That will let you set the binoculars up for other people to look at a particular object, and can be less fatiguing to use for longer sessions.
Other exotic features like waterproofing and filling the binoculars with nitrogen to avoid condensation are often expensive and not really necessary.
Zoom mechanisms break and the general advice is they should be avoided.
Image stabilization is great but expensive. Built in cameras are also expensive and usually a gimmick – you're better off with a dedicated camera.
And Binoculars that boast night vision aren't suited to astronomy.

# Where Not To Compromise

- NO zoom binoculars. (e.g. 7-21x50)
  - Not as bright.
  - Zoom mechanism linking both sides means one eyepiece may zoom more than the other. Linkage breaks easily. Usually cost more.
  - Difficult to find any good reviews of these for astronomy.
- NO "No focus" and "Focus free"
  - Not suitable for Astronomy.
  - Permanently focused on the hyper-focal distance.
  - Everything else has "acceptable sharpness". Most things a little fuzzy. "Focus free" is an ironically accurate description.
- NO highly reflective mirror-like coatings on the front objective lens.
  - Usually used to cover up horrible colour fringing and cut out most of the light.
- DO NOT buy high powered binocs to use hand held!
  - Anything over 10x is difficult. Over 12x will be frustrating.
  - You won't see more detail, due to hand shake,

    Cloudynights review. "Binocular Resolution Handheld versus Mounted"
    https://www.cloudynights.com/item.php?item_id=1410
    "a 10x50 or a 12x50 binocular for handheld use will show you everything or nearly everything that you would be able to see with a higher powered binocular."

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There are some red flags to be aware of that you should never see as a reasonable compromise.
I've already mentioned zoom mechanism. I've never seen a good review of these.
Any binocular advertised as "no focus" or "focus free" is going to only be in perfect focus at one distance, and that probably won't be infinity. They also won't allow you to adjust for differences between you're eyes. So they won't be suitable for astronomy and they will be a compromise for everything else.
You should avoid binoculars with very reflective mirror like coatings, especially on the front lens. For astronomy we want to collect lots of light from dim objects to give the brightest most detailed view. If a lot of the light is being reflected away that isn't possible. Those coatings are often made that way to block everything but a very narrow range of colours because poor design has lead to colour fringing.
And don't be tempted to buy extreme high power binoculars to use hand held. Anything over 10x to 12x is going to lead an unpleasant experience and they'll end up as paperweights.

# Specifications Not Always True

- Unfortunately manufacturers and retailers do post incorrect specifications.
- I own cheap binoculars.
  - With mismarked magnification and field of view.
  - Specifications can change without the model number changing.
  - Often specifications not given at all on cheaper binoculars.
- Beware of counterfeit branding, even on cheaper models.
- Judge Reviews Critically.
  - Watch out for fake reviews.
  - Focus on the negative reviews. Are they reasonable complaints and can you live with the problems?
- Use specifications as a guide only.
- No perfect binoculars. You will have to make some compromises, especially on a budget.

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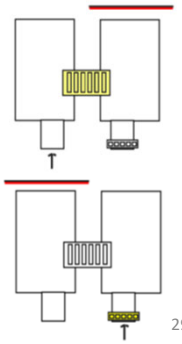
Unfortunately as with most specialized equipment, you can't always believe what you read. Manufacturers and retailers get the specifications wrong, change specs without changing the model number and some post fake reviews online. I find it useful to look for a product with good recent reviews overall then focus on whether the negative reviews are sensible. Keep in mind you're looking for a budget pair of binocs and set your expectations accordingly, but don't gamble on a pair you know has major issues.

# Testing - Basic Use – Setup and Focus

1. Aim at the same object from the same distance for the whole process.
   - Something with sharp lines or writing 30 to 100 meters away is ideal.
   - At night a planet, the moon or a star works.
2. Set the interpupillary distance – the distance between your eyes - by folding the barrels closer or pulling them apart at the hinge or hinges.
   - When adjusted properly you can cover the objective (large front) lens for each eye in turn and you should still see the object through the center of each eyepiece without needing to move.
3. Cover right objective (large front) lens and focus side left side with the center focus wheel.
4. Cover left objective (large front) lens and focus the right side with the the diopter dial on the right eyepiece (small back) lens.

29

If you're lucky enough to be able to test the binoculars you want to buy in person, you'll want to know ahead of time how to use them.
Basic use is easy once you know what to do.

First you want to set the distance between the barrels to match the distance between your pupils and then you want to focus each barrel. You should choose something at an intermediate to long distance and keep that distance constant as you focus each barrel.

Ideally don't squint as this will blur your vision. Rather cover the front lenses in turn making sure to avoid touching them which will leave smudges.

The standard mechanism on most binoculars has one wheel or barrel at the center that adjusts the focus both lenses. Looking at the one object you have chosen, you need to adjust that center wheel first looking through the left eyepiece, while covering up the front lens of the right barrel. Once the left eyepiece is in focus cover it and look at the same object through the right eyepiece. Now twist the right objective eyepiece "diopter adjustment" so that the same object is also in focus on the right.

## Testing - Basic Use - Tips

5. Both eyes are now set to the same focus. From now on only use the center wheel to focus at different distances. No need to touch the diopter.
6. For the most steady views possible rest your elbows on something steady if available, or on your torso if not.
7. To view a subject quickly without hunting, look at the subject with just your eyes and then pull the binoculars up in front of your eyes.

This Cornel Lab bird watching video demonstrates set up and use nicely. However I would not rely on marking the diopter on budget binoculars and would set up focus at least once per session. https://www.youtube.com/watch?v=pkPzl-VPmo4

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Now that both eyepieces are set to focus on the same thing, when you need to refocus for something at a different distance, you only need to use the center wheel.

A couple of other things to keep in mind. Bracing your elbows or arms on something will steady the view, and a technique that gets easier with a bit of practice is to look at whatever you want to view with your naked eye and then bring up the binoculars between yourself and the object.

It's very difficult to demonstrate basic use in this format, so I've also provided a link to a video that demonstrates this well.

# Testing At The Shop - Build

- Test the copy you are actually buying. Much variation between copies especially for cheaper binoculars
- No loose parts (inside and out) – lenses, focus controls.
- No internal dust, chips, paint flecks, smudges, oil/fluid.
- Easy precise focus – how easy is it to dial in the focus exactly on the object you're looking at?
- Hold focus - Push against eyepiece gently then a little more firmly. Does focus change? You don't want to refocus constantly.
- Collimated (both sides aligned) and hold collimation. No double images! Double images cause eyestrain and headaches.
  - Throw one eyepiece out of focus to make double image obvious . Your brain has more trouble merging misaligned images if one is out of focus.
  - No significant flex or play, otherwise they won't hold collimation. Gentle pressure only!!! Don't break them.
  - Round exit pupils. No cats eyes. (Diamond OK for BK-7.)

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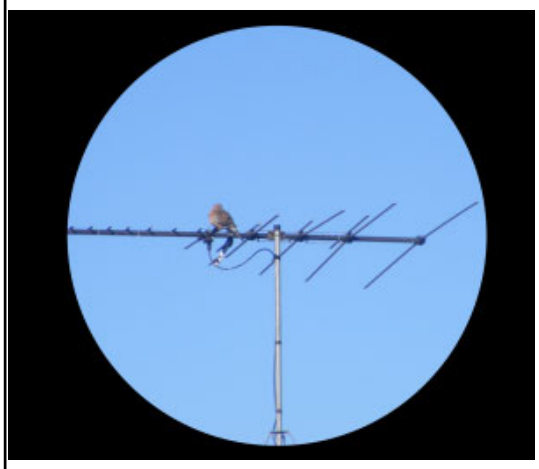
Now that you know how to use them, what should you be looking for when you test binoculars.First of all, if possible, test the copy you'll be taking home. There can be quality issues and sample to sample variation with anything made cheaply.
You want to make sure that the focus controls work and that they are free but not loose. Look for dust, chips, paint flecks, fluid sticky residue, especially on the inside which isn't easily cleaned.
Good binoculars will be easy to focus and hold focus. They should be comfortable to use and there should be no massive amount of play or flex.
Check the collimation - once adjusted you should see a single image aligned in both eyepieces without having to strain to make them come together.

# Testing At the Shop - Collimation



Correctly Collimated.
No effort forming one image.

Uncollimated.
Double Image.

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Here's are simulated views through binoculars to show the difference between what you'd seen in a pair that is collimated vs one that isn't. Once you have the distance between the barrels correctly set and the object in focus, you shouldn't have to strain or work to avoid double images.

# Testing At The Shop - Clarity

- Bright, clear and sharp on both sides with no defects.
  - Learn to focus both lenses correctly.
    - Central focuser with right eye covered or closed.
    - Then diopter (right side eyepiece) with left eye covered or closed.
  - Text makes a good target to test sharpness.
  - Test sharpness at the edges as well as the center.
- Correct colour.
  - Minimal or no chromatic aberration (CA)/colour halos.
    - Easier to see with high contrast e.g. dark object on light background.
    - In a shop look for signs, telegraph poles and street lights, brightly lit or brightly backlit objects.
    - CA halos can be purple, red, green or blue. Due to filters used to cover up cheap prisms and lenses that split colours.
  - No colour tinge. Objects in real colours. Also due to filters.
- Apparent field of view and eye relief.
  - Do the binoculars fill your field of view?

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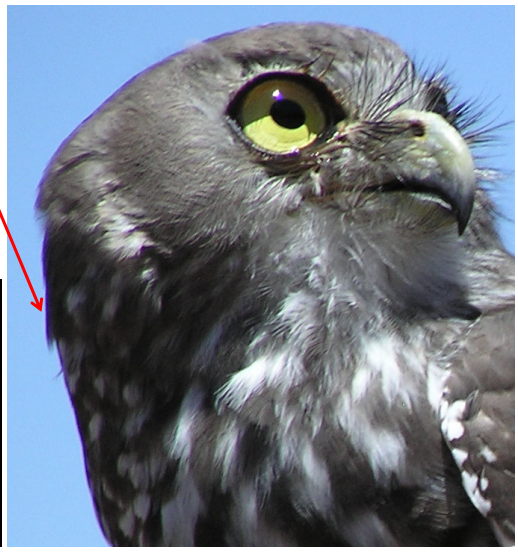
You should also be looking to make sure the view is bright, clear and sharp through both eyes. Checking against objects with straight edges and signs with different sizes of text can be helpful. The edges might not be quite as sharp as the center but there shouldn't be a very large reduction in quality.

You should take note of coloured halos. The less of those the better. And the image shouldn't be heavily tinged or unnatural in colour.

If you intend to use them with glasses make sure there's enough eye relief and that they're comfortable to use with the glasses on.

# Colour Casts and Fringing

Purple halo. Chromatic aberration (CA) aka colour fringing. Notice that it's only happening on the side of the bird that is in shadow. i.e. where there is a high contrast (difference in brightness) between sky and subject. No surprise that it happens when viewing bright stars against a dark sky.




Colour casts can vary in how obvious they are depending on light and what you are looking at. Look for pure white object to judge. Look with at it without binoculars then with. Does the colour change?

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Here are some simulated images showing colour cast and fringing. You can see that the colour on the left sign is warmer and more natural whereas the colour on the right sign has an unpleasant green tinge to it that means some of the colours are being cut out. Compare the colours you see through the binoculars with what you see with your naked eyes.

The purple fringe around the bird isn't great. You're going to see the fringing with high contrast - where you have a bright object near a darker one. That's why you're seeing it more on the left side of the bird which is in shadow right next to a bright blue sky. Some amount of CA is acceptable and expected, especially with cheaper binoculars, but it is going to affect astronomical so the less the better.

## Testing At The Shop - Comfort

- Comfortable to hold. Fit well in your hands.
- Neck strap length and comfort.
- Weight.
- Balance naturally and not too front heavy.
- Eye relief. Test with glasses on if you wear glasses!
  - Do they have folding eye cups for eyeglass wearers?
  - Consider whole family if you view with them.
- Test with and without glasses if you are just near or far sighted. Can you get away without using glasses?
- Interpupillary distance range. Distance between your eyes
  - Adjustable by bending tubes of binoculars closer or further apart.
  - Must be able to form 1 circle when looking through your binocs.

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I've already mentioned comfort, but this is a really important consideration. You're looking for a pair of binoculars that are a pleasure to use and will encourage you to take them out. So consider the weight, balance and comfort holding them. If you think the strap is too short you might want to factor in replacing it when you consider the price. If you wear glasses try the binoculars with and without to see if either or both work. Make sure you can set the distance between the lenses to match your eyes. You should easily be able to merge the view from both eyepieces into one circle – if you can't, that pair is not for you.

# Testing At The Shop - Features

- Central focusing.
  - 1 main focuser, plus a diopter adjustment.
  - Once you set your diopter adjustment you won't need to readjust for different distance. Just adjust main focuser.
- Tripod adapter socket.
  - Plastic tripod adapters cost about $6-$15 on Ebay.
  - Mount binoculars to camera tripod (Or more expensive parallelogram mount.)
  - Accept large camera tripod $50-$100.
  - Detail won't be lost due to hand shake.
  - Lets you use larger magnification binoculars. (>10x)
  - At this price point most binoculars have horrible lens caps and tripod mount covers that won't stay on. (Acceptable compromise. Do your best not to lose them.)

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Look for the features we discussed earlier. Rarely you'll see binoculars with individual eyepiece focus instead of a central focuser. They will require you to refocus each eyepiece for each distance. You view objects at virtual infinity for astronomy, so won't change focus distance often. Still these are still slower to use and for non-astronomical use they will quickly become frustrating.

You should look for binoculars with a screw for a tripod adapter. They're often hidden under a small cap at the front of the hinge between the barrels. Adapters are cheap if you already have a camera tripod that can hold the weight.

Unfortunately lens caps at this price point tend to have terrible tolerances and fit too loosely meaning that they are always falling off. If they do fit well this may be an indicator that there has been some attention paid to the quality.

# Can’t Test At The Shop

- How bright they are for Astronomy?
  - But compare with others for daytime brightness.
- How much detail and nebulosity you will see.
  - Depends largely on coatings which act as filter.
- How moisture will affect them. (”Fogging”)
- Internet reviews can be very useful.
  - If manufacturer hasn’t changed the specifications.

  …and the reviews are genuine.
  - Look for multiple reviews listing show stoppers: Easily broken, misaligned, bad image quality, don’t stay in focus.

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There are some things you won’t be able to test for at the shop, and that’s why reviews are important.

Some of the things you can’t test until you’re under a dark sky include how bright they are for astronomy, how much detail you see in various objects, and how easily they fog up.

Reviews can be manipulated and manufacturers can change the product over time, but at least you can look for people reporting show stoppers. If lots of people are reporting that they’re poor quality, aren’t aligned or have a particular issue it may save you a bad purchase.

# Manufacturers And Retailers

- There are good unbranded binoculars out there but known brands are safest until you have some experience.
  - Budget astronomy specialists.
  - Astronomy specialists and camera manufacturers.
  - Luxury brands.
- Less likely to get ripped off a with reputable astronomy retailers.
  - If you can support a local supplier whose prices are reasonable and lets you test please do. They're a dying breed.
- See references for links to binoculars you can buy in 2023.

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One way to improve your chances of bringing home a quality pair of binocualrs is to stick with well reviewed models from known manufacturers and retailers. There are manufacturers that specialize in astronomical binoculars and telescopes. Camera manufacturers make good binoculars too, but not many budget pairs.

Once you have some experience you can start to look at some of the lesser known brands without it being as big a gamble. I have occasionally come across a bargain, like one pair I bought at a homeware bargain store for $25 about 15 years ago that is almost as good as some of my best.

I'm not here to sell you any particular brand but in the notes I've given links for some cheap binoculars available in 2023.

As for where to buy, if you find a local store that has reasonably priced binoculars and they let you test them, consider supporting them. As everything moves online they're a dying breed.

Like shopping for other products, you'll need to keep an eye out for scammers, fake reviews and incorrect specifications.

# Part 2 – Using Binoculars (For Astronomy)

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Once you've acquired a pair of binoculars, what should you do to get the most out of them?

# Planning Your Observations

- WSAAG Newsletter.
  - Excellent charts produced by our members by hand.
- Powerhouse Museum monthly sky guides. https://www.maas.museum/observations/category/monthly-sky-guides/
  - (Seems to have replaced Sydney Observatory sky guides which use to also include a podcast.)
- Phone apps (often have a Northern Hemisphere focus)
  - Star Walk Astronomical News
- Books
  - See more information section for recommendations.

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As with all astronomy planning is key. I'm going to go through some specific suggestions of what to look at shortly. But first let's talk about some of the best sources of information available for picking targets. These aren't specific to binocular observing, so you might want to keep in mind that larger objects are going to be best for low magnification.

First of all there is our very own WSAAG monthly newsletter, which includes excellent suggestions for what to observe. Objects are selected and charts drawn by hand by our members who have many years of observing experience and do an wonderful job guiding you to interesting objects.

There are also other periodic sky guides like the Powerhouse Museum sky guides. These appear to have replaced the Sydney Observatory sky guides which use to be produced alongside an audio-guide style podcast. Many phone apps and some PC software also produce periodic observation guides as part of the package and some are very well done.

Sky guides can be found in book form too for those that prefer that. The advantage of sky guides like this is that they present handy information about what you can observe now or soon. But other books that list objects by different criteria can also give you an idea of what keep a look out for other when the objects do come to view.

Make sure your guides are applicable to the sky locally to you. There are a lot of Northern Hemisphere resources available that will highlight objects you can't see from

in and around Sydney.

# Stellarium With Binoculars

- Use Stellarium for quick planning, or on your mobile phone.
- For closer to realistic views.
  - Set up date, time and location correctly.
  - Set absolute scale to match limiting magnitude you expect.
  - On PC set up 'Oculars' plugin for your binoculars/telescopes.
  - Install the add-on catalogs for more stars.
- Use night mode if you take a laptop out.
- My bad habit – Duck in and out of house. Terrible for dark adaptation, but laptop not exposed to dew. Use night mode.
- Simulation is not perfect. Uses deep sky images nothing like what you can expect to see. I have edited some of the following pictures to be more realistic by reducing brightness and colour in the nebulae.
  - Sketches can be better, but I don't sketch well.

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An excellent tool for planning your observations is planetarium or charting software. I like to use Stellarium because there are free versions on PC and mobile. This makes it easy to use not only ahead of time but also when out observing.

It's not difficult to use but it's worth getting familiar with the settings menus and shortcut keys to change date, time and location to match where you'll be observing. It's worth setting up your absolute scale and limiting magnitude to match the local conditions as well. I also like to set up the Oculars addition to give me a circle that matches the field of view of the binoculars or telescope I'm using. And if you find that you're at a dark sight and seeing a lot more stars than come up in the software, you should be aware that there are addon catalogs you can install to fill that gap.

One bad habit I have because I'm lazy is I'll duck in and out of the house to look at Stellarium on my desktop. The better way is to use a laptop and a night mode filter of some kind.

Keep in mind these simulations aren't perfect. They use deep sky images with more detail than you're likely to see, and cameras don't see the same way our eyes do. Sketches and hand drawn charts can be more accurate or better for locating things. But they require skill to make. Again, the WSAAG newsletter comes to mind.

# Binocular Objects - Solar System

- Moon is a larger target than the planets.
- Comets.
- Artificial satellites.
- Planetary alignments.
- Planet against a particular constellation.
- Rest require too much magnification for binocs when viewing individual objects.
  - Venus, Mars, Jupiter as coloured discs.
  - Crescent shape for Venus – phases.
  - Jupiter's Galilean Moons. (Need good eyesight.)
  - If you want to try with binoculars, consider using a mount to steady them.

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Ok so lets talk about some specific objects to look at if you're getting started, and take a look at some simulated views.

Within the solar system, there are plenty of targets for your binoculars.

The moon is obvious but shouldn't be overlooked. If there's a bright comet in your sky you should definitely take the opportunity to see that while you can. And you can use various software to plan looking at artificial satellites including the International Space Station and The Hubble Space Telescope. There are usually plugins for planetarium software that give you time accurate simulated views. But you'll need to set your time and location correctly. And you need an Internet connection to get the latest data.

Due to their size the planets tend to be harder and often are nicer with a telescope which allows higher magnification. But you should still take a look through your binoculars at least once if you haven't already for the experience. Think about using a mount if you have access to one, since the smaller detail requires a steady view at low magnification.

# Extrasolar Binocular Objects

- Messier Objects,
  - M6 (Butterfly Cluster.)
  - M7 (Ptolemy's Cluster.)
  - M42 (The Great Orion Nebula.)
  - M45 (The Pleiades.)
- Crux and The Jewel Box.
- Theta Carinae (Southern Pleiades.)
- Eta Carinae.
- Omega Centauri.
- Magellanic Clouds.

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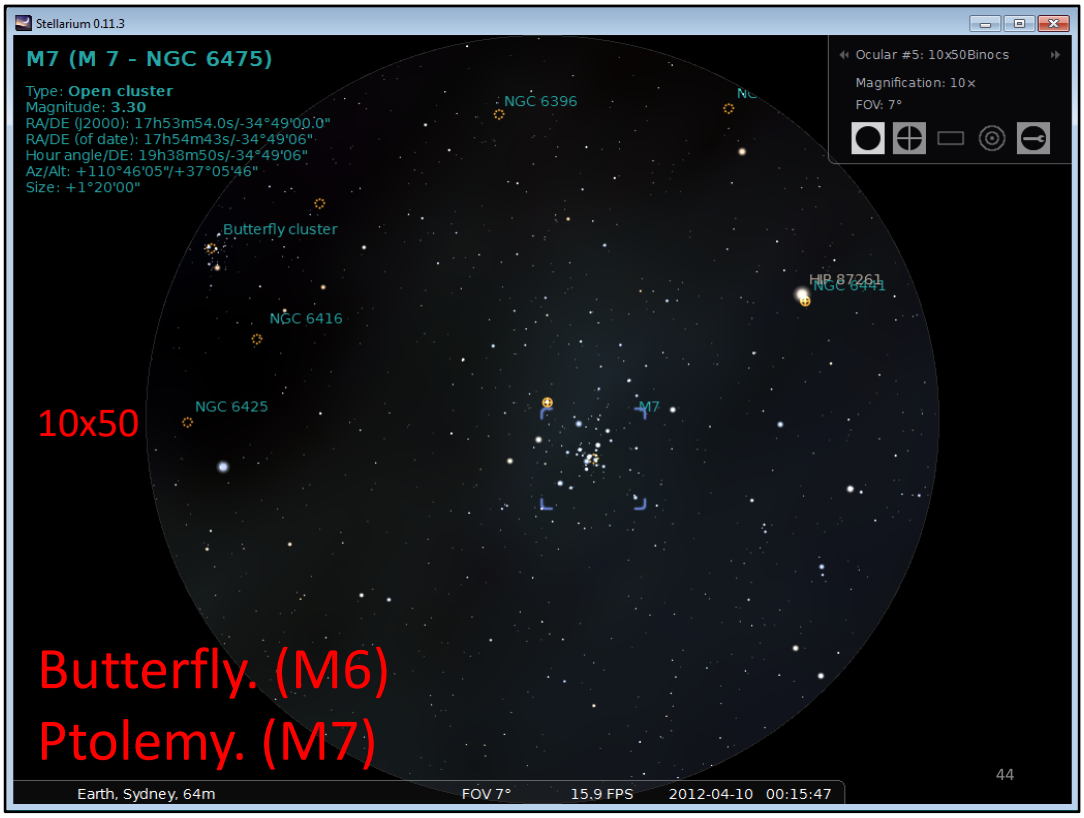
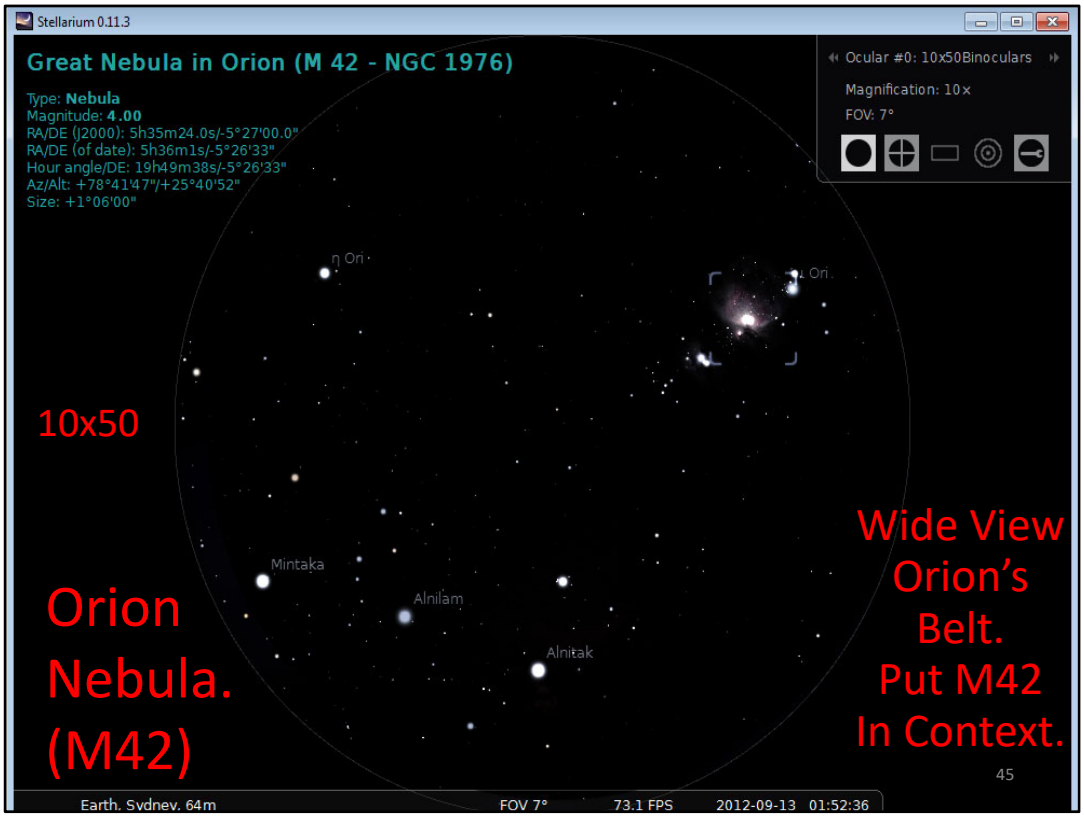
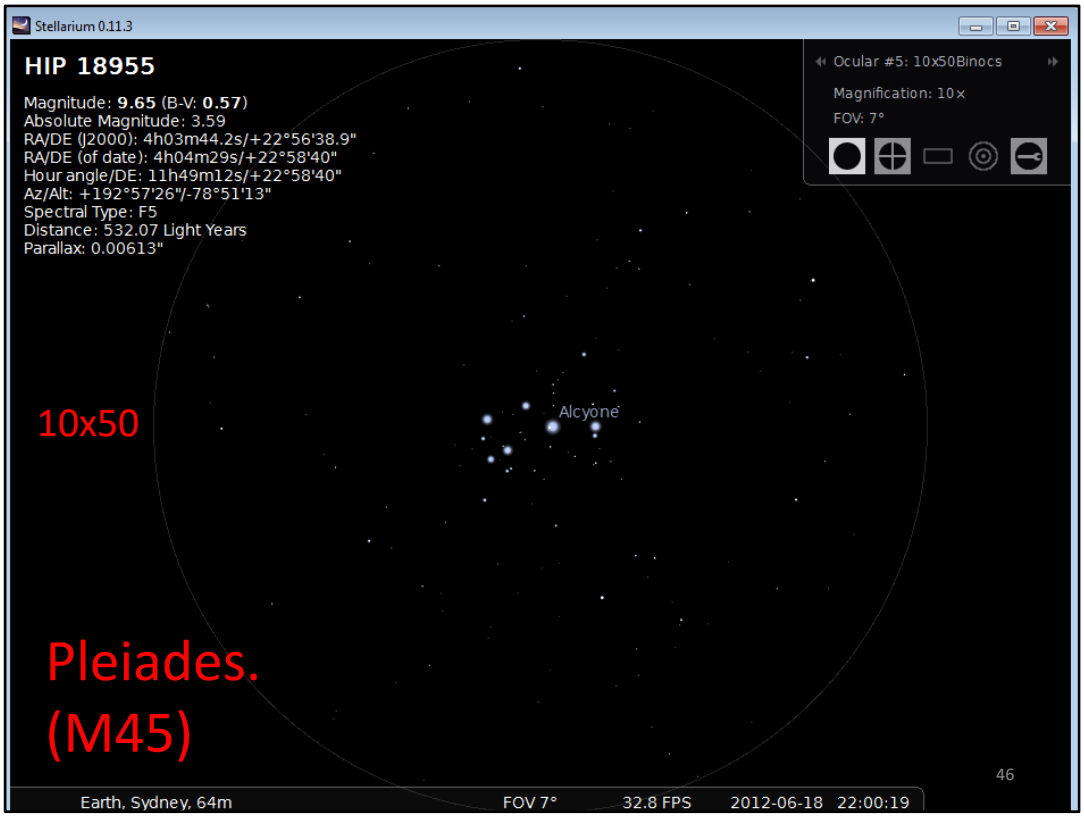
Now let's take look at some simulated views of a few deep sky objects I've selected.




Some of the Messier objects are large and quite colourful and pleasing to the eye through binoculars. M6 – The Butterfly cluster and M7 Ptolemy's Cluster are stand-outs and definitely worth looking at.

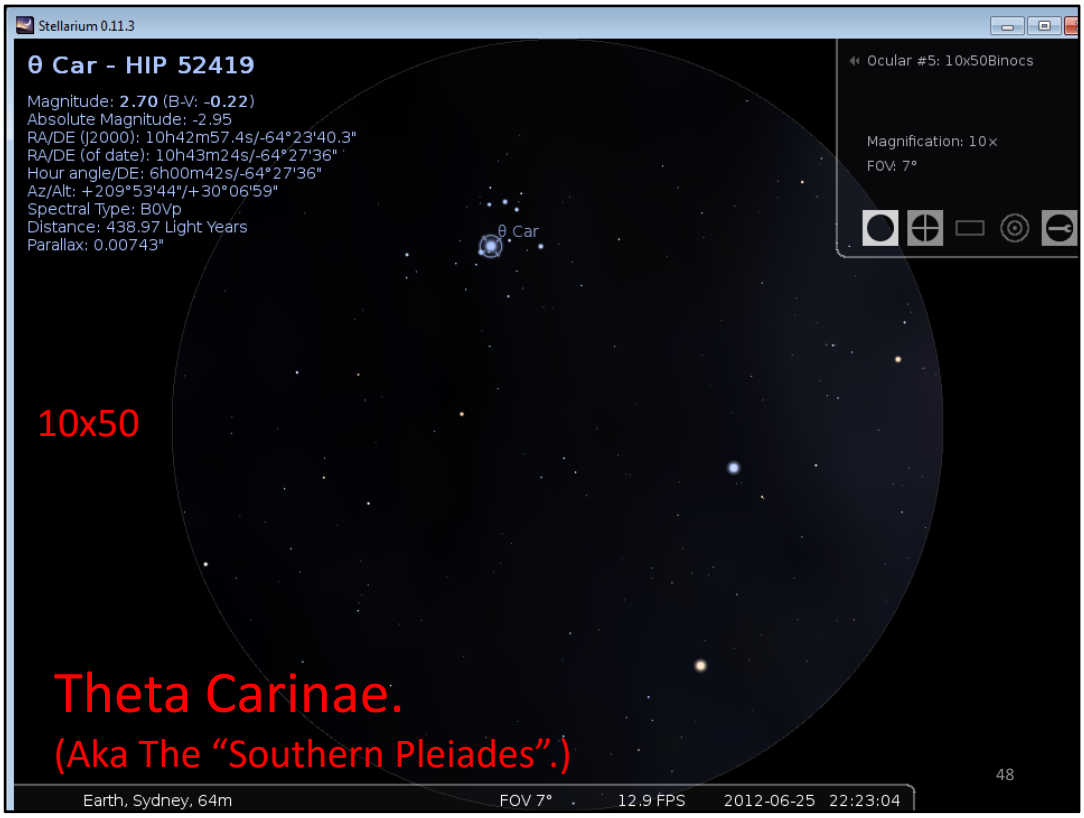



M42 is the Orion Nebula. You can fit the Nebula and the stars of the belt of Orion in a wide view pair of 7x50 or 10x50 binoculars.



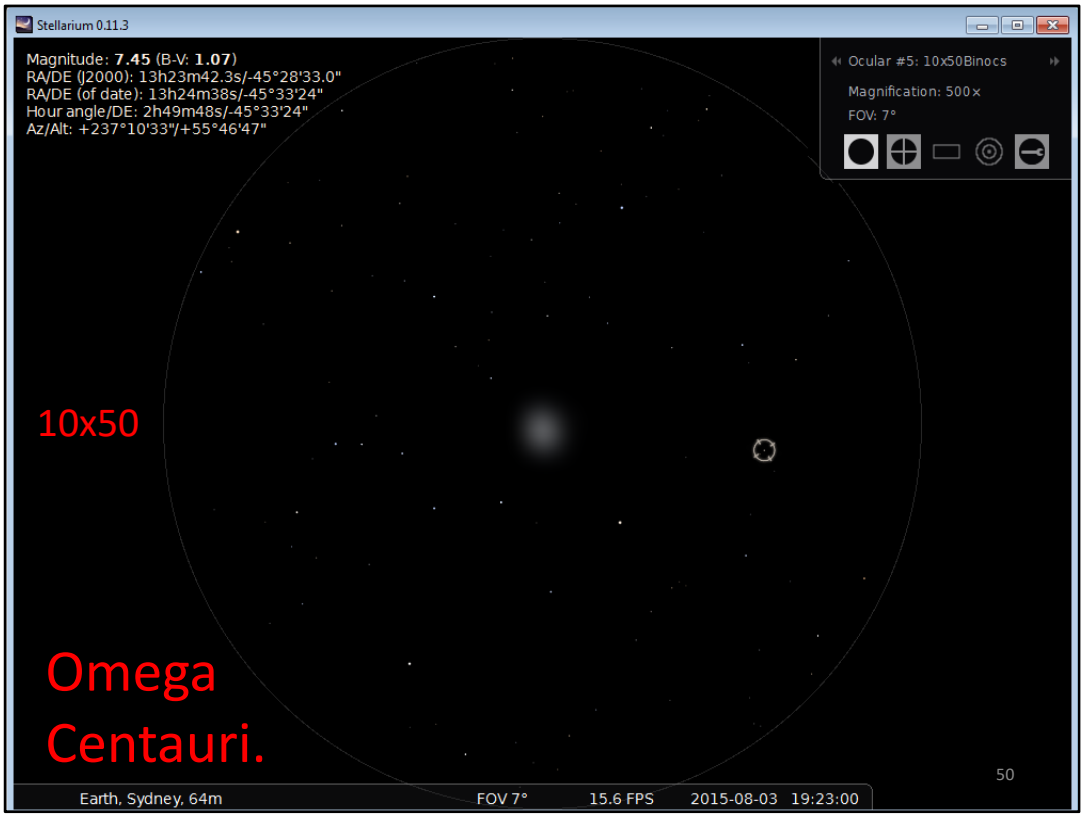

M45 The Pleiades is spectacular in a telescope but you can step back and look at the cluster in context in a pair of binoculars.


Using binoculars you'll be able to fit the entire Southern Cross in one view and you'll start to be able to make out the Jewel Box near the left most star on the cross, Mimosa.

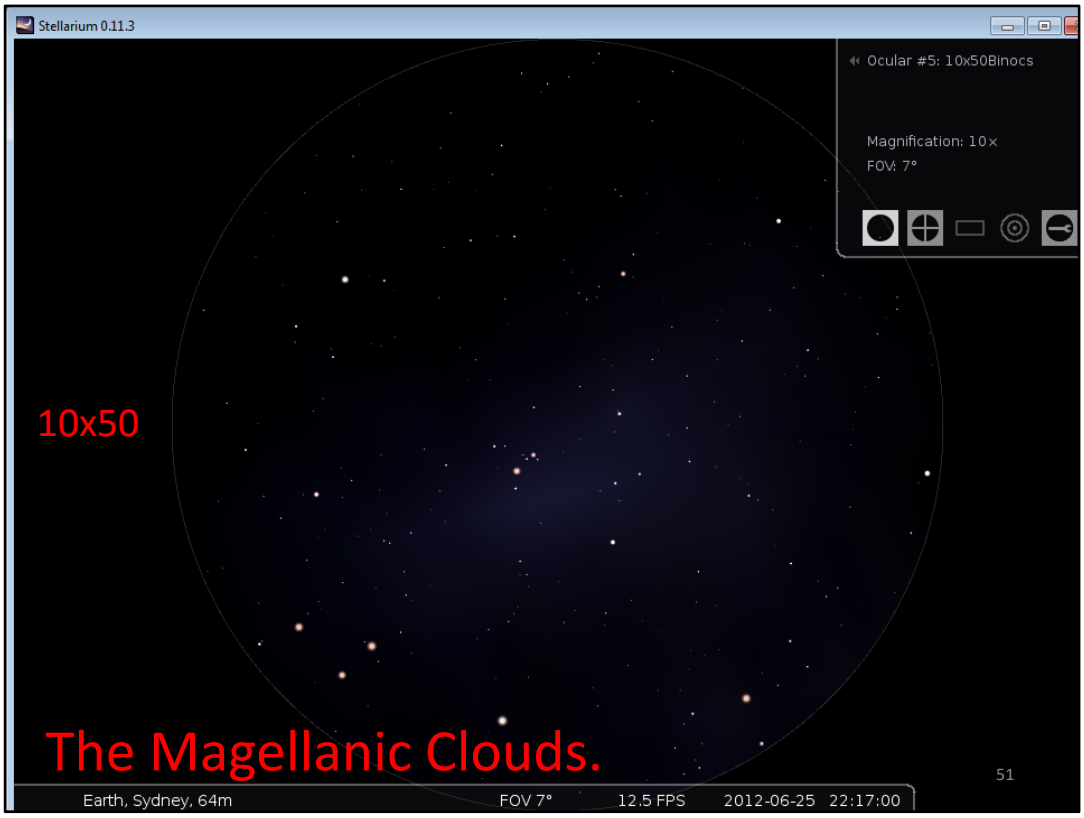



Theta Carinae, nicknamed "The Southern Pleiades" is another great target. It has always reminded me of a dog's paw.


You can get a lot of fun out of looking up objects you've heard about if they're wide enough for binoculars. For example you might read about Eta Carinae and want to take a look with your own eyes. Even when they're not as spectacular as you were hoping, you've gained a little more familiarity and experience with part of the night sky.




Omega Centauri can be seen as a fuzzy ball in small binoculars. Seeing it in binoculars first will help you really appreciate the view resolving the stars using a large telescope.




And the Magellanic Clouds are breathtaking.

None of these simulated views are going to do justice to the real thing, so going out and looking with binoculars is definitely one of the easiest and most worthwhile things you can do when you get the chance.

# Galaxies

- External Galaxies.
  - NGC 5128 - Centaurus A.
  - M87 - Virgo A.
  - NGC253 - Sculptor Galaxy. (Silver Coin/Dollar Galaxy.)
  - M31 - Andromeda Galaxy.
  - Northern Hemisphere.
    - M81 - Bode's Galaxy.
    - M82 - Cigar Galaxy.
  - Only 100 years since understood these are outside our galaxy! In 1923 Edwin Hubble found Cepheid stars in the Andromeda Galaxy which proved it was outside the Milky way.

52

I find galaxies really hold my fascination. All of us have grown up taking it for granted but it's only 100 years since we've known the galaxies aren't just nebulae inside the Milky Way. In general galaxies are easier to view with a telescope but that's better appreciated if you've tried with binoculars first.
M31 is the Andromeda Galaxy and one of the better ones to look at through binoculars.
M87 is another Messier object accessible with binoculars.
Centaurus A and NGC 55 are harder to see but may also worth a try under dark skies.
In the Northern Hemisphere M81 – Bode's Galaxy and M82 The Cigar Galaxy are an easier option.
Don't expect to see too much detail. In small binoculars these objects can be fuzzy and require you to use averted vision.

# Tips For Enjoying Binoculars

- Understand what you see, to enjoy what you see. Google every object you look at.
  - Don't expect movie special effects, astronomy magazine or Hubble vision.
  - For jaw dropping views get away from light pollution.
- "Sweep" the skies at different times of the year. You'll be amazed what catches your eye.
- Increase the objects you can see at any time of year. Observe early morning as well as night on different dates.
- A lot depends on seeing conditions. Take more than one look.
- The computer is your friend. Use Stellarium, Cartes Du Ceil and other star chart and sky simulation software before you go out.
- Enjoy and make the most of whatever instrument you have.
- Keep the binoculars handy for quick 5 minute sessions.
- The people you live with can be excellent observing companions.

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And that brings me to one of my tips for enjoying your binoculars. We're all been desensitized to movie effects and long exposure photos. A lot of people bring those expectations to their observing and feel let down. I think the key is to actually understand what it is you're seeing. It's then easy to be amazed at what you've managed that with your own eyes.

Some more tips

When you don't have anything particular in mind to view try sweeping the sky. You'll find things you don't know about catching your eye and then you can go back and try to work out what it was you saw.

You can increase the number of objects you see throughout the year by planning a mix of early and late sessions. Keep your binoculars handy and use them often when the conditions allow. Share your observing with your family, friends and room mates if you can get them interested.

# Part 3 –
# Maintaining Binoculars

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# Basic Care and Cleaning

Mostly obvious if you've owned anything optical – glasses, camera, telescope. Optics.

- Keep fingers off glass.
- Dry brush first: Brush off dirt and dust first. Be careful not to rub in hard dirt that will scratch the lenses.
- Use a soft (optionally damp) microfiber cloth or tissue (no aloe!).
- Be careful with alcohol (Isopropyl and Methanol).
  - Some plastics, lens coatings and writing/markings will be eaten away.
- Soap/detergent and water is safer but can streak.
  - Non alcoholic eye glass cleaning fluid works well.

- Physical Care.
  - Avoid bumps and knocks.
  - Store in a case of some kind.
  - Use a strap to avoid dropping them, especially in the dark.
  - Keep away from sand, glitter, flour ("colour run" craze a few years ago).
  - Store in a cool, dry place with dessicate satchels.
    Avoid things coming apart in the heat or getting infested with mould.

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This slide covers care and cleaning tips that most amateur astronomers are already familiar with. Most of this would also be obvious to anyone who's owned eye glasses or cameras. I'll quickly cover this anyway in case it is useful to someone new here or online.

You want to keep the optical surfaces clean and smudge free. Keep your fingers off the glass. When you do need to clean the lenses, brush off any dirt to avoid scratches before using a microfiber cloth to give them a wipe. If you're using tissues in a pinch, don't use tissues that feel rough to the touch and might scratch the surface, and make sure the tissues are not infused with aloe.

If a dry cleaning isn't enough because something has stuck to the surface, use non-alcoholic lens cleaner like that you'd use on eye glasses to avoid smudging. Isopropyl alcohol can be a good optical cleaner, but there is also a risk that it will eat away coatings, plastic and markings on the binoculars. I can tell you from personal experience that even trying it on a small patch first can lead to more damage than is acceptable. Unfortunately the only way to know is to try.

It's always a good idea to store your binoculars carefully to avoid damage. Storing them in a case when not using them is always a good idea. Keep them away from small particles like sand, glitter or flour. Bumps and knocks could cause parts to shift or dislodge and alignment problems. A neck or hand strap is good to avoid dropping them. Don't get them wet and if you do dry them off immediately. Store them in a case with some dessicate pouches to keep the moisture and fungus away. Many binoculars come with a dessicate in the packaging, so don't throw it out and think about replacing it if

you still have your binoculars after a few years. though you should think about replacing them after a few years.

# How To Align ("Dirty Collimate")

- Aligning both sides to look at the same thing. Not a true full collimation. You won't be aligning lenses, just the prisms.
- Unaligned binoculars worthless. Professional fix not economical for <$130 binocs. **At your own risk**. But try before discarding. Nothing to lose!
- I found it easiest to adjust them while actually observing bright star at night.
- Alternately use a daytime target. Antenna or tower.
  - Make sure you're not going to upset neighbours!
  - Can be easier to put binocs on a tripod, but be careful they don't fall or get scratched if screwdriver slips. Use both hands.
- Other techniques including projecting the sun onto outline of eyepieces. Should line up. (But why expose your binocs to excessive heat?)
- Aim to have round exit pupils. Make note of what you change. If you end up with "cats eye" shaped exit pupils, undo changes and try aligning the other side. May need to change a little on each side.

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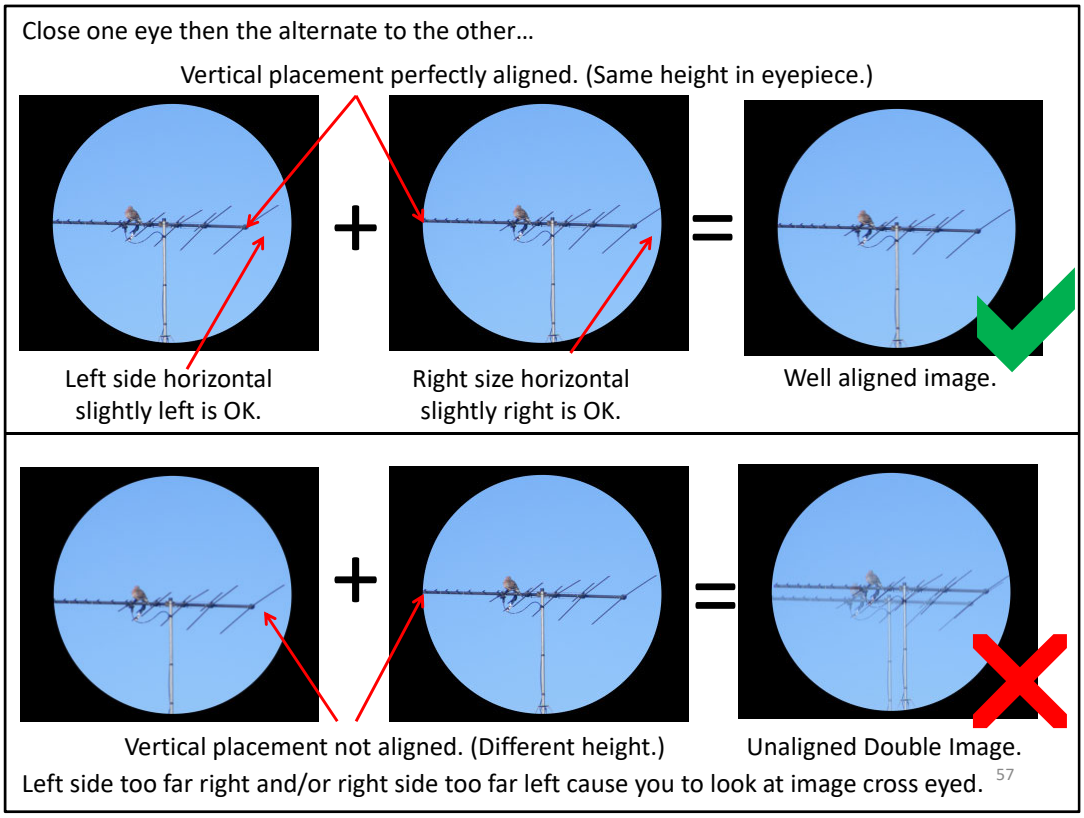
One common problem with binoculars – especially cheap ones - is that can be out of alignment or "not collimated". This can literally give you headaches and will make using them difficult or even impossible. If you buy a pair and they're not collimated, the best thing is to send them back if you can. Other than the manufacturers there aren't a lot of services for aligning binoculars, and even if you find a place that will do it, if you have to pay for it on a cheap pair, it will cost more than the binoculars did.

If you're stuck with a pair that isn't aligned It might be worth having a go to fix them yourself before you throw them away and buy a new pair. I wouldn't recommend you try this with an expensive pair unless you're completely out of options. I must emphasize that if you try this it should be a last resort and you do it at your own risk.

First of all you want to confirm that the pair really isn't collimated. You'll need to find a target to test them on. Bright points of light like stars at night, and straight lines like power lines or antennae in the day make good targets. Whatever your target, keep in mind you should do this somewhere that's not going to upset a privacy conscious neighbour.

Once you've confirmed there's a problem with the alignment you're going to want to look back at the object to check that you've improved things. Make small changes and confirm after each one.




Once you've adjusted the distance between the barrels properly so that one circle is formed, and focused the binoculars, the images above the line on this slide show you what the view through a well aligned pair should look like. It should take little or no effort for the images from both eyes to match and merge into one. If you're seeing a double image after adjusting them like the bottom right image, there is an alignment issue. Some familiarity with a pair that is aligned helps to confidently determine this is the case.

# Prism Alignment Mechanics

- First make sure there is no flex, flop or play, or you're wasting your time.
- Locate collimation screws. The hardest part. May need to remove glue.
- Peel back rubber covering to reveal the screws.
- Need very small precision or jeweler's screwdriver.
  - On both pairs I've aligned the smallest flathead was what I needed.
- Make very small adjustments, especially if you aren't actually viewing while you turn the screw.
- On each side, one screw will move the image perpendicular to the other.
- Once you're happy with them re-glue. Don't use too much since you may need to align again later.

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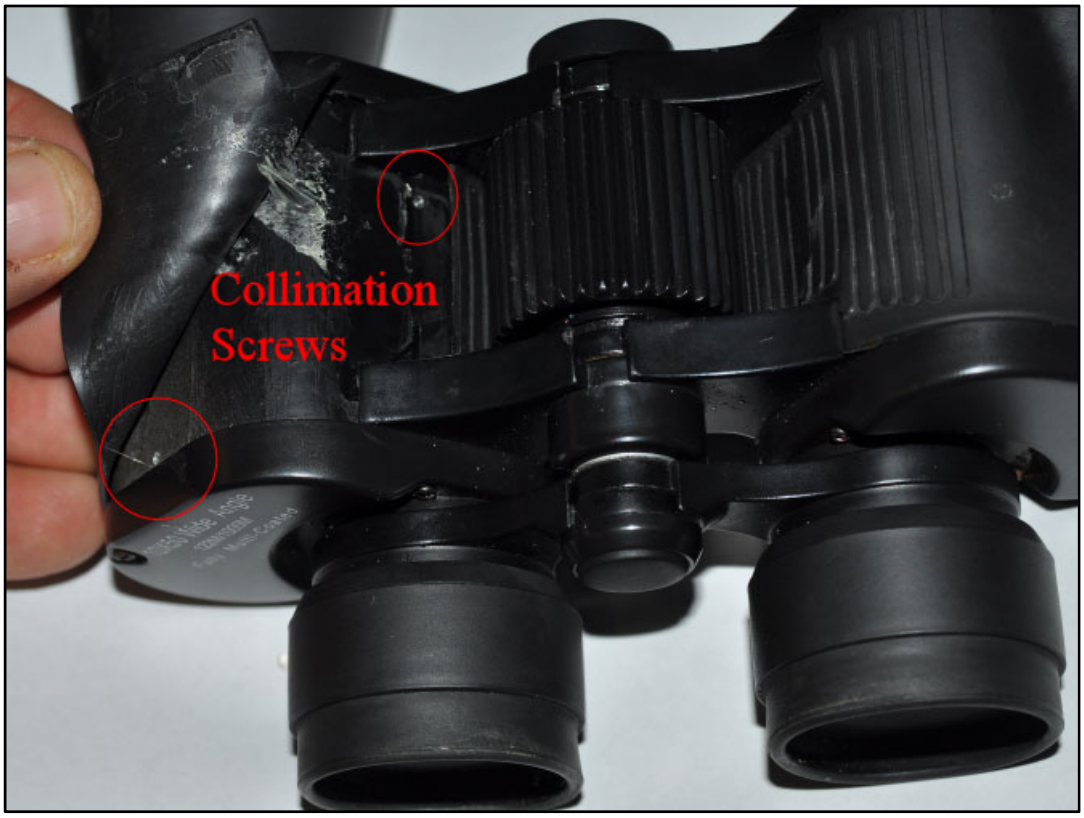
Most binoculars come with collimation screws that are used at the factory to achieve reasonable alignment. And that's what you'll be using to align your binoculars. You'll need a precision or jeweler's screwdriver. The pairs I've worked on had flathead screws. You need to make very small adjustments and check the alignment. If you've made things worse, turn the screw back to where it was and go the other way. Usually you'll have 2 screws that adjust the alignment in perpendicular directions to each other.

Before you start you'll want to check what happens when you very gently try to twist the barrels to make them align. If there's too much flex or they flop and don't stay in position, you'd have to fix that before adjusting the collimation screws since any flex may have a bigger effect than those screws. If you can't fix that, it might not be worth spending the time.

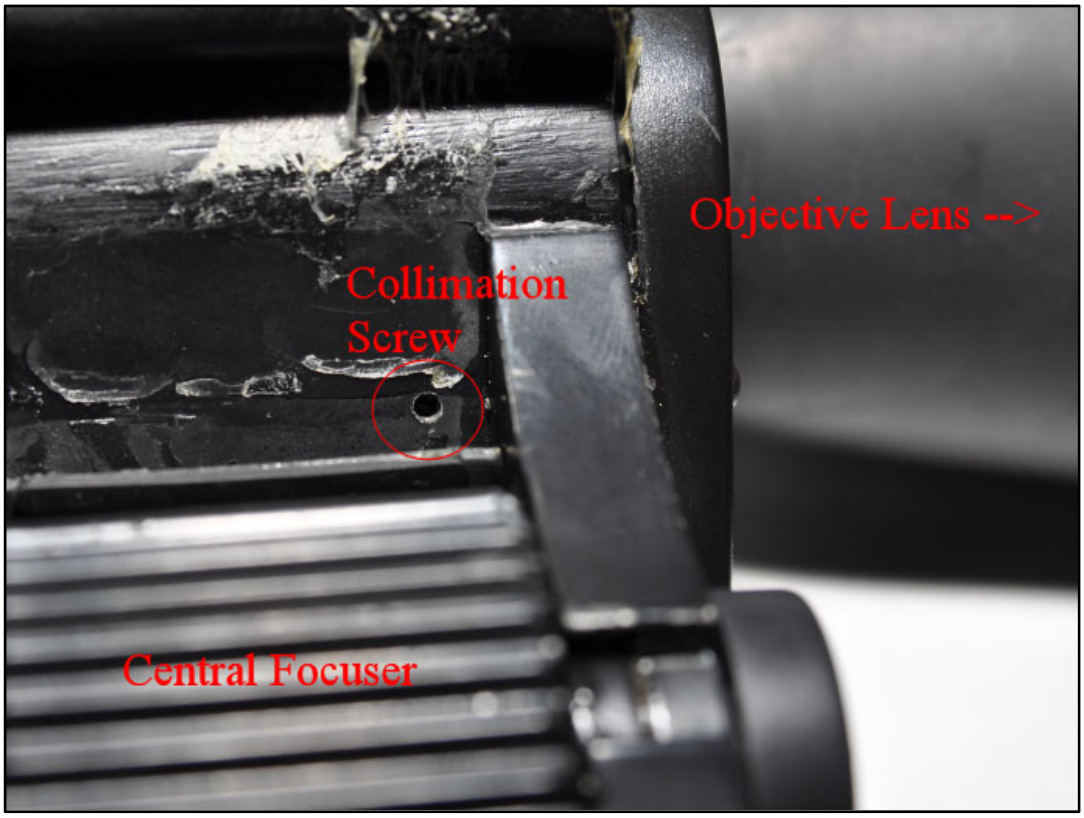



Unfortunately the screws aren't usually out in the open. Getting to them typically means peeling back the rubber, and dealing with sticky glue. This might be difficult to do without tearing or damaging the rubber. These slides show you where the collimation screws were on one pair of binoculars I had but they may be located elsewhere on other binoculars.


You might be able to feel a small hole under the rubber but usually you'll have to start peeling it back and guessing.

As I said this isn't something I'd be comfortable doing on a very expensive pair.


When you're done you'll need to glue the rubber back on carefully avoiding the optics and the screws themselves. You want to use the minimum amount of glue you can get away with since you might want to get back in to adjust them again and you don't want to tear the rubber. Make sure you have suitable glue ready – something that works with rubber, plastic and metal but nothing too permanent so no epoxy.




Sometimes the screws are sunken into the body and you need to adjust them by feel through a small hole. Look for the adjustment screws both at the front and back of the binoculars.

I hope you never have to do this kind of surgery on your binoculars. As I said it's a last resort. But if you do this and have any success I'd be interested in hearing about your experience.

# Thanks and Attribution

Thank You.

- WSAAG for allowing me to present.
- For feedback from members at the Ice In Space Forums, WSAAG, friends and family.
- For my wife and kids for their patience while I put this together.
- And thank you all for listening!

Wikipedia/Wikimedia Images.

- Antilived - https://commons.wikimedia.org/wiki/File:Binocularp.svg
  under CC BY-SA-3.0 - https://creativecommons.org/licenses/by-sa/3.0/deed.en
- Fred the Oyster - https://en.wikipedia.org/wiki/Binoculars#/media/File:Abbe-K%C3%B6nig_prism.svg
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- Evan Mason - https://commons.wikimedia.org/wiki/File:Exit_Pupil.JPG
  - under CC-BY-SA-3.0

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And that brings me to the end of my talk.
Thank you for listening.
I'd also like to thank.
WSAAG for allowing me to present.
My friends and family for their feedback and patience.
And those whose images I used for some of the slides.

I'll make the slides available online and at the end there will be references and my binocular reviews from my talk in 2012. And of course I'm open to feedback so feel free to contact me.

# References and Further Reading

# More Information – Binocular Guides

- Cloudy Nights Binocular Reports.
  https://www.cloudynights.com/category.php?category_id=90&pr=1
  Home / CN Reports / Binocular Reports
- Binoculars - A Basic Guide for Astronomy.
  – by Dennis Simmons. Excellent diagram of parts of a pair of binoculars. Great alternative explanations if you didn't understand anything here or just want a different (opposite) opinion. He recommends expensive binocs
  https://www.iceinspace.com.au/index.php?id=63,374,0,0,1,0
- Nikon Sports Optics Binocular Guide.
  https://imaging.nikon.com/sport-optics/best/
- Binocular Terms.
  https://www.bestbinocularsreviews.com/glossary-binoculars.php
- Best Binocular Reviews. (By brand, by use, guides.)
  https://www.bestbinocularsreviews.com
  https://www.bestbinocularsreviews.com/wide-angle-binoculars.php
- Zoom Binoculars VS Fixed Magnification Binoculars.
  https://www.optics-trade.eu/blog/zoom-binoculars-vs-fixed-magnification-binoculars/[65]

# More Information – Things To See

- ~~Sydney Observatory Monthly Sky Guides.~~
  ~~http://www.sydneyobservatory.com.au/category/astronomy/monthly-sky-guides/~~
- Powerhouse Museum Monthly Sky Guides. https://www.maas.museum/observations/category/monthly-sky-guides/
- The Astronomical League Binocular Programs.
  Southern Sky - https://www.astroleague.org/al/obsclubs/sskybino/ssbinoc1.html
  Messier - https://www.astroleague.org/al/obsclubs/binomess/binomess.html
  Double Star - https://www.astroleague.org/programs/BinoDS_Intro
  Deep Sky - https://www.astroleague.org/al/obsclubs/dsbinoc/dsbinoc.html
- Binocular Sketches.
  http://rodelaet.xtreemhost.com/binocular_astronomy.html
- Other Simulated Views. https://www.brighthub.com/science/space/articles/24224.aspx#
- Ice In Space Forums.
  https://www.iceinspace.com.au/forum/

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# More Information - Books

DISCLAIMER: These books have been recommended by others. I do not own them.

See amazon.com and other sites for reviews.

Beware focus on Northern Hemisphere objects. (Many northern objects are not visible here, and key Southern Hemisphere objects are missing.)

- Touring the Universe through Binoculars (A Complete Astronomer's Guidebook)
  Philip S. Harrington
  ISBN-10: 0471513377
  https://www.philharrington.net/sw8.htm
- Binocular Astronomy
  Craig Crossen
  ISBN-10: 0943396883
  1st Edition (According to one book review 2nd edition is not approved by author)
- Binocular Highlights
  Gary Seronik
  ISBN-10: 1931559430
  https://garyseronik.com/my-books/

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# More Information - Books

- Stargazing with Binoculars
  Robin Scagell, David Frydman
  ISBN-10: 1554078210
- Binocular Stargazing
  Mike D. Reynolds
  ISBN-10: 0811731367
- Patrick Moore's Exploring the Night Sky with Binoculars
  Patrick Moore
  ISBN-10: 0521793904
  (includes Southern hemisphere constellations)
- Heavens Above!
  A Binocular Guide to the Southern Skies
  Robert Bee
  ISBN-10: 1876409665

# More Information – Other

- Collimating Binoculars
  https://www.cloudynights.com/item.php?item_id=416

  https://falakbeen.blogspot.com/2012/05/collimating-orion-worldview-10x50-wa.html

  https://binocularsky.com/binoc_collimating.php

  https://www.youtube.com/watch?v=WHtOJAgo-DM

- Dark Adaptation of Eyes By Age
  https://pubmed.ncbi.nlm.nih.gov/20506961/

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# Budget Binoculars Available in 2023

Branded

- Celestron 71198 Cometron 7x50 Binoculars.
  https://www.amazon.com.au/Celestron-71198-Cometron-Binoculars-Black/dp/B00DV6SI3Q

- Celestron UpClose G2 10x50 Porro Binoculars, Black (71256).
  https://www.amazon.com.au/Celestron-UpClose-10x50-Binocular-71256/dp/B006ZN4TZS

- TASCO Essentials Porro Binoculars with Carrying Case and Neck Strap.
  https://www.amazon.com.au/gp/product/B072MB2QHJ

Off Brand Binoculars

- Wuciray 10x50
  (Very cheap in April 2023.
  They look ok but I don't have personal experience these.)
  https://www.amazon.com.au/dp/B09C2345RF?psc=1&ref=ppx_yo2ov_dt_b_product_details

Note: I am not affiliated with any of the companies involved in making or selling these binoculars. These are not affiliate links and I get nothing for recommending them.

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I've listed 3 branded models here that I have tried and were good and that you can still get in 2023 for a reasonable price. The one at the bottom I bought as a gift for a friend that is a part time photographer. TODO: What did she think of them.

Even with the branded ones I tend to see reviews of an uncollimated pair that would be unusable without fixing or sending back, but so far I've been lucky and only ever bought one bad set myself.

# About Me - My Astronomy Background

- Lifelong fascination with Science and Astronomy.
- Member of WSAAG since 2009.
- Own a couple of Dobsonian telescopes, a couple of refractors, and too many binoculars.
- Did an astronomy masters degree “for fun” about two decades ago.
- Way too casual a stargazer. Go months without viewing sometimes. Others here have much more observing time to their name.
- Amateur photographer (who came to it through wanting to do astrophotography).
- Know something about optics but am by no means an expert.
- This talk is a revised version of a WSAAG talk I gave in July 2012.

# Bonus Section – Old Binocular Reviews

*I won't be going through these slides from my 2012 talk.*

*Reasons include:*

- *Brevity.*
- *The binoculars discussed are no longer for sale new in 2023. Prices are what I paid more than 10 years ago.*
- *I haven't reviewed many binoculars that are for sale now and can't justify buying more just to test them. I'm happy with the ones I kept.*
- *This is all subjective and much more personal.*

*I've left these in the slide decks for those who may be interested in what differences exist between budget binoculars.*

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# List Of Binoculars

**10x 50**

1. Tasco Zip 10x50 Model 2023 (older version, no tripod mount). Selling for $70-$110 in Australia or about $35 in the US. I got an old unused pair cheap on Ebay.
2. Andrews Communications 10x50 WA - which look very similar to Saxon 10x50 BFWA marked as FC. $49 2012 price. Marked as 122m@1000m.
3. Dick Smith Digitor 10x50, marked as FMC. $40 (2012 price). Marked as 122m@1000m.
4. Binoculars marked and boxed as Bushnell 20x50 Powerview but which have a field of view I'd expect from 10x50. Marked as 69m@1000m but they fit the Southern Cross in so this is just plain incorrect. $30.

**7x50**

5. "Winner" branded 7x50 bought in about year 2000 for more money than they were worth from a Disposal store. $TOOMUCH. My first pair bought ~yr2000.
6. Unbranded 7x50 bought at Homeart around 2005 or 2006 marked as Coated. $25 at the time.

**Other (Not Suited To Astronomy)**

Tasco 12x30, Bushmaster 8x21, Bresser 6x21 (kids binocs).

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# Differences Summary

- Tried to compare side by side on the same night. But seeing varies moment to moment.
- Even at this price point there are differences in quality.
- Some have more precise focus. Tasco 10x50 and Digitor 10x50 very sharp compared to Bushnell 20x50.
- Some harder to focus than others. Andrews 10x50s difficult. Digitor 10x50 Easy. Tasco zip focus hard (touchy).
- Some hold focus better than others. Tasco 10x50 needs only gentle nudge on eyepieces and it's out of focus.
- Angle of view different. Digitor 10x50 don't quite fit Southern Cross in field. Tasco, Andrews and Bushnell do.
- Apparent field of view. Tasco, Andrews, Bushnell have wider AFOV than Digitor.

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# Differences Summary (Continued)

- Nebulosity looks different in each.
  - Digitor 10x50 shows little nebulosity on Eta Carinae at home - but better in darker skies (presumably due to ruby coating).
  - Tasco, and Andrews show Eta Carinae much better.
  - Surprisingly Digitor 10x50s show Omega Centauri slightly better than Tasco and Andrews.
  - The Digitor ruby coating is very much a filter.
- Protective eye cups fall off Bushnell and Digitor easily. Andrews 10x50 are tethered and can't fall off.
- No tripod adapter socket on Tasco 10x50. All the rest have one.
- Build quality varies. None are very sturdy but Andrews 10x50 and Tasco 10x50 are more solid that Digitor 10x50 and Bushnell.

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# Tasco Zip 10x50 Model 2023

- Possibly optically my best pair overall. 8-8.5/10.
- Do not hold focus well. Never lean into them or rest them on my head.
- No tripod adapter. Only usable hand held.
- Show nebulosity well in Eta Carinae and about equally well for Omega Centauri.

## Andrews Communications 10x50 WA

- Optically not as happy with these as I thought I would be. About 8/10.
- Different but not significantly better than Digitors.
- Not the easiest to focus – hard to make fine adjustments. But do hold focus well.
- Other mechanics very good. Can't lose protective cups as they are attached to the body.
- But high contrast orange filters horrible. One more thing that can break.
- Show nebulosity well in Eta Carinae. Omega Centauri OK.

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# Dick Smith Digitor 10x50

- Sharpness very good - probably 8/10. Both copies I've owned.
- But ruby coating seems to cut out almost all of the nebulosity on Eta Carinae in light pollution. Better away from city. Improve contrast on Omega Centauri though.
- Bad colour cast/fringing. Especially in daylight/bright light. Even horrible ruby ovals due to sun glare in some conditions.
- Other pairs I've tested in store had more obvious colour cast. Sample variation may be higher than even other cheap pairs.
- Most magnification of any pair. Not quite able to fit in Southern Cross
- Surprised at how well these hold up. Really all you're missing compared to other pairs is true colour and nebulosity. Would buy these in a heartbeat if nothing else readily available.
- Build quality not brilliant. First pair lasted about 6 years before they broke. Screws started rusting after about 2-3 years. I'm fine with that for $40.
- Have been available for at least a decade.

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# Bushnell 20x50 Powerview

- Optically 7-7.5/10. Not the sharpest for nighttime viewing, but still quite usable.
- Build is not fantastic.
- Mismarked. No way are these 20x50. Magnification between 8x and 10x.
- Viewing in daylight mild colour tinge changes depending on where you point them in relation to the sun. Either side can become slightly cooler (more blue).
- Cheap. Happy to take these when there is more risk of them being lost or stolen.

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# Homeart Unbranded 7x50

- Optically very good. 7-8/10.
- Hold focus and collimation.
- Build quality OK.
- Absolute bargain at $25. Bought in Erina Fair Homeart around 2006. An unlikely find.

# "Winner“ 7x50

- Optically good. 8/10.
- Overpaid. Very little difference between this pair and Homeart 7x50s.
- Old and showing their age. One side is loose and has play. But have lasted over a decade so far.

# Various Small Roof Binocs

- 6x21 through to 12x30.
- Only good for brightest stars.
- Difficult to spot Omega Centauri at all from my back yard.
- Smaller apparent angle of view (tunnel vision).
- Okay for bird spotting, plane spotting during the day.
- Good for very young children who can't handle bulk of a bigger pair.
  - Learn to use binoculars.
- Even cheaper. About $12 (2012 price).

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