Irish Federation of Astronomical Societies

Binocular Certificate Handbook

How to see 110 extraordinary celestial sights with an ordinary pair of binoculars

No ordinary binoculars! This photograph by the author is of the delightfully whimsical frontage of the Chiat/Day advertising agency building on Main Street, Venice, California.

Introduction

WHETHER NEW to the hobby or advanced amateur astronomer you probably already own a pair of a binoculars, the ideal instrument to casually explore the wonders of the Universe at any time.

The handbook you hold in your hands is an introduction to the realm far beyond the Solar System — what amateur astronomers call the "deep sky". This is the abode of galaxies, nebulae, and stars in many guises. It is here that we set sail from Earth and are transported across many light years of space to the wonderful and the exotic; dense glowing clouds of gas where new suns are being born, star-studded sections of the Milky Way, and the ghostly light of far-flung galaxies — all are within the grasp of an ordinary pair of binoculars.

True, the fixed magnification of (most) binoculars will not allow you get the detail provided by telescopes but their wide field of view is perfect for appreciating the extensive star clouds of the Milky Way, the full extent of a comet's tail, or quickly completing a variable star programme in an evening. Their greatest asset though is their simplicity; at the drop of a hat, you can be up and observing without any fuss. Ideally, you should have them mounted on some form of tripod in order to steady the view.

By the way, although binoculars are outclassed by telescopes when it comes to be able to study the Solar System family in great detail, you'd be surprised at just how much you can see in giant glasses. The rings of Saturn for example. Although the image is tiny, when the rings are wide open — as they are for the next few years — you can see them distinctly separate from the planet's globe. Any binocular will let you follow the intricate dance of Jupiter's moons as they whirl about their parent from night to night. The Moon shows an amazing amount of detail and in conjunction with a map, you can identify many features. You can glimpse a number of the brighter asteroids and comets too with binoculars.

Remember, we are not testing your ability as an amateur astronomer — we're just giving some gentle encouragement to explore our extraordinary Universe. If it's clear tonight, let's go observe ...

Binocular Certificate Handbook

Name _____

Address _____

_____

_____

Telephone _____

E-mail _____

Observing experience beginner/intermediate/advanced (please circle one of the above)

Equipment _____

IFAS club _____

NOTES: Details will be treated in strictest confidence. Experience/equipment/club info optional if you so wish

Acknowledgements

The introductory material has been gleaned from the "Night Sky Primer" section of the IAS "Sky-High" publication which the author co-wrote for the last twelve years with Liam Smyth.

The "Challenges Programme" section, and notes in the introduction on classes of deep sky objects, are derived from information supplied by Michael O'Connell, author of the Observing Challenges Messier Handbook.

Finally, I'd like to thank all the members of the Observing Cert Programme who have put in a huge amount of time and effort in devising a new initiative for Irish amateur astronomy. Time for a well-deserved pint guys!

What is IFAS?

IFAS, The Irish Federation of Astronomical Societies is the national organisation of participating amateur astronomy cubs in Ireland. The aim of the Federation is to promote the interests and development of amateur astronomical societies in Ireland.

IFAS is proud to support this initiative to encourage Irish astronomers to observe the Binocular catalogue and is honoured to officially record and reward those who document their observations in accordance with the guidelines as discussed above.

A list of participating clubs and an online discussion forum can be found at **www.irishastronomy.org**

All of the charts used in the handbook were prepared with Chris Marriott's "Sky Map Pro v.6"

The IFAS Observing Challenges Programme

We all like to be rewarded and it's nice to have one's achievements recognised. The Observing Challenges Programme is neither a competition nor a test and shouldn't be looked on like that. It is simply a way to encourage you to observe and to become a better observer. Although successful completion of the program will result in the presentation of a certificate, it is hoped that the real award will be the participation and learning gained in undertaking this exercise.

If at any stage you find yourself getting stuck or just needing advice, please feel free to log onto the IFAS website and check out the bulletin board. There, you will find hundreds of Irish astronomers who will be more than happy to help you out or just offer a word of encouragement.

Certificates and Awards

There are three levels of award available for the Binocular Observing Challenge. These levels and their requirements are listed below;

Bronze Certificate	Observe 50 Objects Sketch 10 Objects
Silver Certificate	Observe 75 Objects Sketch 15 Objects
Gold Certificate	Observe 100 Objects Sketch 20 Objects

You can observe any of the objects, in any order. The observations may also be cumulative enabling the observer to obtain all three certificates over a period of time. You will only need one Handbook to complete the requirements for all three certificates.

Once you have met the requirements for one of these levels, simply post this Handbook to the Binocular Observing Secretary. Once your observations have been verified your certificate will be presented to you at either the Whirlpool Star Party in Birr, COSMOS in Tullamore, or the Connacht Star Party in Galway, and this Handbook will be returned to you.

If you prefer, your certificate will be posted to you along with this Handbook. Your name and club will also be listed in the relevant section of the IFAS website. If you prefer to remain anonymous, please indicate accordingly and just your club name will be listed.

The Binocular Observing Secretary is: John Flannery, 5 Greenmount Lawns, Terenure, Dublin 6. Evening telephone is (01) 490 6913 or mobile is (086) 81 81 931. You can also e-mail John at skynotes@eircom.net

Prior to submitting your observing log, please contact the observing secretary via e-mail in advance of posting to ensure contact details are correct and up-to-date.

We welcome comments on any aspect of the handbook.

How to use the Handbook

The core of the handbook is the list of 110 objects incorporated into the observing challenges. Some characteristics of each object are detailed along with a chart showing the region of sky in which it lies. The difficulty level has also been graded for each highlighted object.

By their very nature, the positions of Uranus and Vesta on the celestial sphere change on a scale of days or months so the charts for these two Solar System objects are only current for some dates in 2004.

Space has been provided in the "Observing Details" section to document your observations. Make a careful note of sky conditions — and don't be spartan with your observing notes! You can make sketches in the observing blank provided on the right of each page.

A clear circle on each sky chart represents — except where highlighted — the 5° field of view typical of 10x50mm binoculars. Additional circles (labelled "by 2") indicate that a number of "star hops" may be required to find an object.

The limiting magnitude adopted for the stars shown on each chart is 6·5 and north is towards the top. We recommend you supplement these charts with a proper star atlas.

A table is provided at the back of the handbook with detailed positions of each object for use in conjunction with a star atlas. You can also tick off each object here as you observe it. A short resource guide rounds off the booklet.

The Greek alphabet is used to identify the brightest stars in each constellation. The labelling sequence doesn't necessarily start with Alpha as the brightest — in fact, 34 of the 88 constellations have at least one star more brilliant.

α	alpha	ι	iota	ρ	rho
β	beta	κ	kappa	σ	sigma
γ	gamma	λ	lambda	τ	tau
δ	delta	μ	mu	υ	upsilon
ε	epsilon	ν	nu	φ	phi
ζ	zeta	ξ	xi	χ	chi
η	eta	ο	omicron	ψ	psi
θ	theta	π	pi	ω	omega

Your Night Sky Primer

AS WITH ANY HOBBY, astronomy seems to have it's own set of terminology designed to confuse. However, with a little patience you'll soon pick up the jargon and be well on the way to knowing your way around the sky.

The revolving heavens

We all know the Heavens don't revolve, it is the other way round, the Earth rotates on its axis. But it looks otherwise and it is easier to describe things as we see them for our immediate purpose. The fact that the Earth turns on its axis about every 24 hours causes the Sun to rise in the east and set in the west,and it is due south at noon. A similar situation applies to all the other heavenly bodies except that since they appear to move relative to the Sun they are not south every day at noon.

The stars appear to drift west in such a way that any particular star is due south four minutes earlier each day or night. If you multiply four minutes by 365 you get something close to 24 hours. So if a star is south at eight o'clock tonight, it will be south four minutes earlier tomorrow, and two hours earlier in a month. In six months it will be south at about eight in the morning. In a year it will be south at eight in the evening. It follows that we see different constellations in different seasons, but over a year, we see all we can see from Ireland.

An idea of size or scale

If you have seen a picture of a total eclipse of the Sun you will have noticed that the black disk of the Moon just about covers the bright disk of The Sun.

The Sun is 1·6 million km in diameter and the Moon is 3200 km. Yet they appear nearly equal. This is because they seem to take up the same amount of the space in front of our eyes. We may say they have the same **angular diameter**. In this case it is about half a **degree** (½ °).

Degrees are further divided into 60 **arcminutes** (60') with each arcminute made up of 60 **arcseconds** (60"). The scale allows us to measure angles in the sky or the apparent size of a celestial object. For example, the Full Moon measures an average of half a degree or 30 arcminutes.

Your closed fist held at arms length is about ten degrees (10°). Your stretched out hand, i.e. from the tip of your thumb to the tip of your little finger, is about 25°. Four outstretched hands or about twice as many closed fists will take you from the horizon to zenith. The overall length of the Plough is rather more than one outstretched hand at almost 25 degrees. Some familiarity with angular measure is necessary to find your way easily about the sky.

Directions

Starting at any landmark and going right around the horizon is three hundred and sixty degrees. The **azimuth** of an object is a measure of it's point relative to the horizon as measured from true north which starts at 0° with due East being 90° and so on.

Going from a point on the horizon straight up to the point overhead — **the zenith** — is ninety degrees and a measure of **altitude**.

Astronomers use a kind of celestial longitude and latitude called **right ascension** and **declination** to accurately plot the position of an object on the **celestial sphere**.

Right ascension is expressed in hours (h), minutes (m) and seconds (s) running eastward from 0 to 24 hours right around the sky. The zero point of right ascension is taken as the vernal equinox — the point where the Sun crosses the celestial equator, moving from south to north, in its course around the sky.

One hour of right ascension is equivalent to a 15° segment of a circle. This is not the same as angular distance because close to the celestial poles the lines of right ascension converge.

An object's declination may be written in terms of how many degrees, minutes, and seconds north (+) or south (-) of the celestial equator it is.

Star bright

A star's **magnitude** refers to its brightness, not its size. The magnitude scale is a logarithmic one. A one magnitude difference is a difference of 2.512 times in brightness. A five magnitudes difference is a difference of 100 times. The lower the magnitude number, the greater the brightness.

The stars in the Plough range from about magnitude 2 to magnitude 3½. The faintest stars you see with the naked eye on a really dark moonless night are magnitude 6 or 7.

Binoculars show stars two to four magnitudes fainter, while the most powerful telescopes in the world reach to around magnitude +30. The apparent brightness of a star depends on its true brightness and its distance. The term magnitude if not qualified, refers to apparent brightness.

The term **absolute magnitude** is the magnitude a star would show if it lay at a standard distance of 10 **parsecs** (a *parsec* is the distance at which a star shows a *par*allax of one arc-*sec*ond; it is equivalent to about 3·26 light years.)

If there is a term used in the introductory section that you are still a little confused about then feel free to drop any of us in the Observing Certificate Programme a line and we'll endeavour to answer your questions. A good Dictionary of Astronomy is always a wise investment too as it will become a valuable reference source on the A to Z of the hobby.

The scale of space

While kilometres may be a convenient unit to measure distance on Earth, not so in space. Astronomers therefore use a more manageable metre-stick within the solar system known as the **astronomical unit** (a.u.).

One astronomical unit is simply the mean Earth-Sun distance which is roughly 149, 597, 870.691 kilometres — mind you, it would still take over 177 years continuous driving (within the national road speed limit!) to reach the Sun!

The void between the planets may be measured in tens of millions of kilometres but to bridge the gap to even the nearest star requires kilometre-long leaps of mind-boggling proportions so we use the **light-year**. A light-year is simply the distance travelled by a ray of light in a year. We know light itself has a finite speed of approximately 300, 000 km/s so a light year can then be calculated as 300, 000 * 60 seconds in a minute * 60 minutes in an hour * 24 hours in a day * 365.25 days in a year to give a rough result of 9·46 *trillion* km!

By the way, a light-year is a measure of *distance*, not of *time*. However, looking at the night sky we genuinely are looking back in time and see celestial bodies as they were because of how long even light needs to cross the huge distances.

Once you get beyond the stars and into the realm of galaxies even the light-year becomes unwieldy when talking in large numbers. The term **mega-parsec** (1000 *parsecs*) is freely banded about by cosmologists though even they are reduced to describing distances to objects at the edge of the observable Universe in terms of their **recessional velocity**, or **red shift**, of which you'll find a quantity known as ***z*** used in equations.

All in all, space is a very big place indeed but within these pages we hope we can start you on a voyage through the wonders of the Universe that will last a lifetime.

Deep Sky Objects

The expression "Deep Sky" or "Deep Sky Objects" (DSOs) is used to describe objects beyond the Solar System (exluding stars). There are 3 basic types of deep sky objects; galaxies, nebulae and star clusters. However, this can be further broken down again to reveal a total of 8 types;

1. - Globular Clusters

Globular clusters are tightly knit groups of stars all gravitationally bound to each other. They may consist of anything from ten thousand to millions of stars and are usually all of approximately of the same age. They can vary in size from tens to hundreds of light years across. Globular clusters can be found randomly scattered in a halo around the Milky Way. An example is M13 in Hercules.

2. - Open Clusters

Open clusters are basically smaller less congested clusters of stars. Their stars are usually only gravitationally bound for a short length of time before they drift their own separate ways. They are also all of a similar age and chemical composition as they form from the same condensed nebula. However, they are generally found in the plane of our own galaxy. An example is M35 in Gemini.

3. - Galaxies

Galaxies formed in the early Universe when huge clumps of gas began to aggregate. Their cores generally consist of older suns while the arms of spirals host numerous clusters where new stars are being born. Supernovae enrich the interstellar medium with new elements. Our own galaxy, the Milky Way, is estimated to hold 250,000 million stars and is thought to be 100,000 light years in diameter!

4. - Planetary Nebulae

The term "planetary" nebula dates back to 1785 when William Herschel looked at these objects through his telescope and thought they similar to the disks of planets

Planetary nebulae form near the end of a Sun-like star's life as it goes through the Red Giant phase. A see-saw cycle of expansion and contraction causes the outer layers to be puffed off due to hypersonic winds streaming from the surface. The layers form a series of concentric shells of ionised gas around the star. Eventually, the exposed core is left as an extremely hot White Dwarf. An example of a planetary nebula is M27, the Dumbbell Nebula in Vulpecula.

5. - Emission Nebulae

Emission nebulae are clouds of dust and gas visible due to self-illumination. The gas in the clouds is ionised from absorbing the energy of nearby hot stars. As a result, emission nebulae are usually a pinkish-red hue — the effect is similar to that in a neon light. Often, young stars are born here and long exposure photos show these regions to be a spectacular swirl of gas and dust with the nascent suns embedded. An example is M42, the Orion Nebula.

6. - Reflection Nebulae

Reflection nebulae are clouds of gas and dust which reflect light from nearby stars. Light travelling through the nebula gets scattered by the tiny particles of dust. This results in the nebula taking on a slight blue colour, similar to the way the daytime sky also appears blue. An example is the wispy cirri surrounding Merope in the Pleiades.

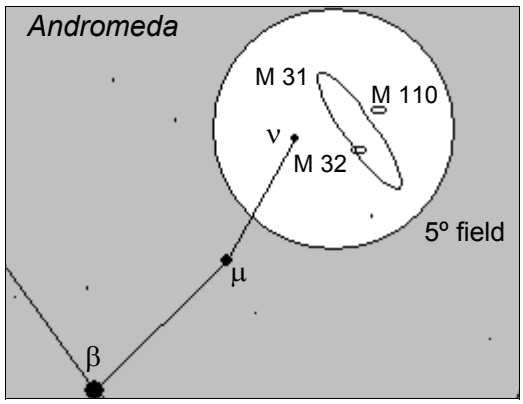
7. - Dark Nebulae

Dark nebula are clouds of gas and dust which, from our vantage point, block light shining behind it. They are typically very similar to reflection nebulae and are often seen in close proximity to reflection and emission nebulae. An example of a dark nebula is the Horsehead Nebula in Orion.

8. - Supernovae Remnants

When very massive stars die (i.e. 8 times more massive than our own Sun), they usually erupt violently. The explosion blows vast quantities of material into space creating a shell surrounding the tiny collapsed core. All that is left is a rapidly spinning neutron star called a pulsar. Material in a neutron star is packed to incredible densities — a 1cm cube of the stuff would weigh the equivalent of a supertanker! The vast majority of elements were forged in the cores of stars that exploded as supernovae. An example of a supernova remnant is the famed Crab Nebula, M1, in Taurus.

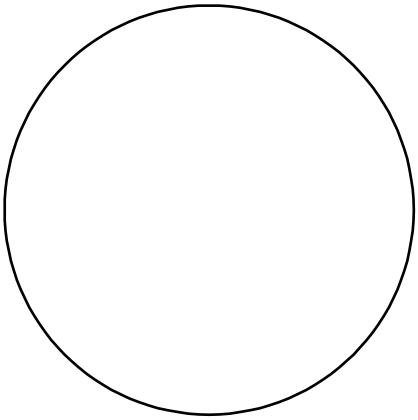
Andromeda M 31 — *the Andromeda Galaxy* easy



On clear nights, far from the glare of lights, you may spot a dim elongated smudge of light a short hop from the brightish star Beta Andromedae. Long exposure photographs reveal the object as a giant "star city" of over 100 billion suns that we know as **M31**, the Andromeda Galaxy.

Binoculars will let you trace the cigar-shaped glow which brightens a little towards the central core. Because M31 is tilted to our line of sight we cannot really appreciate the full majesty of this object but one aspect you should look for is how the light of the galaxy ends abruptly towards the northern edge. This is because of dark dust lanes in the periphery of the disk.

Larger glasses may be needed to spot two companions, M32 and M110 (both ellipticals). **M32** is a tiny spot of light slightly west of south of the nucleus of M31. Eighth-magnitude **M110** is a grey ellipse to the north. It lies twice as far again from the parent as M32.



Observing Details

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Location _____ Sky _____

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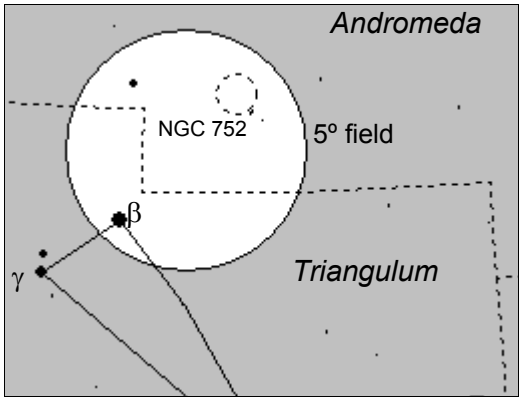
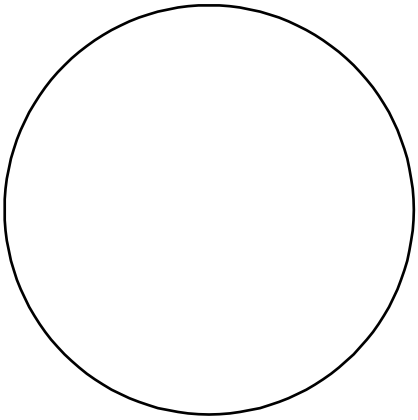
Andromeda NGC 752 — *scattered open cluster* easy



In the same low-power binocular field as Beta Trianguli is the loose open cluster **NGC 752**. Many people are unaware of this delightful object as they are beguiled by the brighter lights of the M31 star city that lies nearby. Draw an imaginary line through Gamma and Beta Trianguli and extend it about 4° to the northwest to star hop to the cluster.

It's a lovely group that shows a ragged "X" shape. The concentration of bright suns towards the centre may allow a more vivid imagination to conjure up a likeness to an alien creature flailing luminous tentacles of stars. What patterns do you see? The swarm measures just under a degree across and contains about 75 members.

The wide optical double **56 Andromedae** lies at the cluster's southwestern edge and any size binocular reveals the $6{\cdot}0^{m}$ secondary separated by 190 seconds of arc from the $5{\cdot}7^{m}$ primary. The two show a slightly orange tint.



Observing Details

Date/Time _____ Instrument _____

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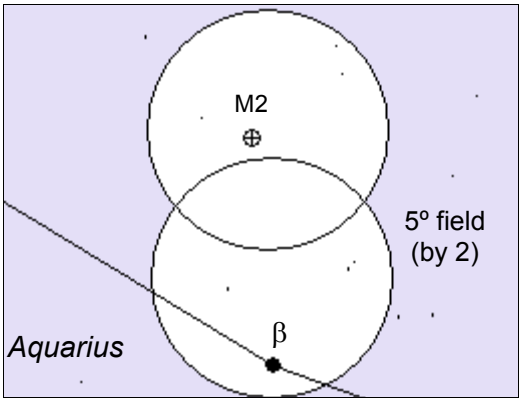
Aquarius — M 2 — *lonely globular cluster* — moderate

The bright-star poor region under the outstretched neck of Pegasus is where we find **M 2**, a bright globular cluster that looks like an out-of-focus magnitude 6·5 "star".

The wedge of stars that make up the "water jar" asterism in Aquarius helps you find the globular — 3rd magnitude Alpha Aquarii marks the apex of this wedge which points almost directly at the location of M 2, eight degrees to the west. An alternate to locating the object is to place $2{\cdot}8^{m}$ Beta Aquarii at the bottom of your low power binocular field. M 2 should be within, or just outside, the 5° field to the upper edge.

M 2 lies about 50,000 light years from us, a resident of the vast halo of globular clusters arranged around our galaxy. The Saguaro Astronomy Club database mentions that at the tremendous distance of this cluster, our Sun would be a dim magnitude 20·7 star visible only in the largest telescopes.



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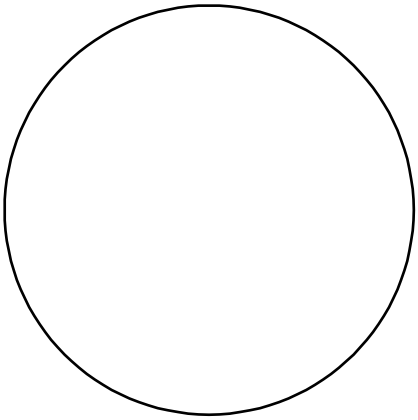
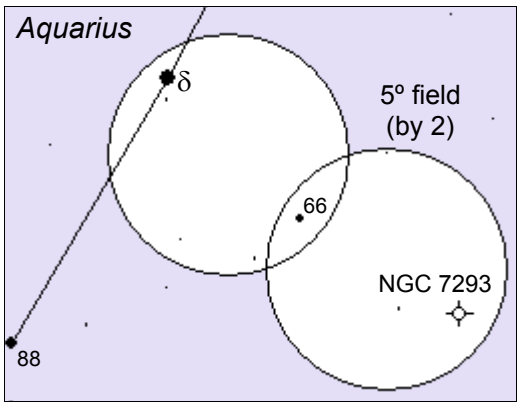


Aquarius — NGC 7293 — *the Helix Nebula* — challenge

The **Helix Nebula** measures more than a third the apparent size of the Full Moon in extent but it's low surface brightness combined with it's location in a barren region of sky classes it as a challenging object for binoculars. Dark skies are a requirement too as the ghostly glow is unforgiving under less than good conditions. The Helix is considered the closest of all planetary nebulae at 450 light years — though that is still open to dispute.

Gary Seronik, in *Sky and Telescope* magazine (November 2003) suggests sweeping along a line joining Delta Capricorni and the bright star Fomalhaut to find the Helix. The field of the nebula is roughly midway along this line.

An alternate is to first start at $3{\cdot}2^{m}$ Delta Aquarii. Five degrees southwest of this star, and in your low power binocular field, is $4{\cdot}6^{m}$ 66 Aquarii. Now scan a similar distance again to the southwest where it should be possible to fit 66 Aquarii and the Helix in the same field of view.



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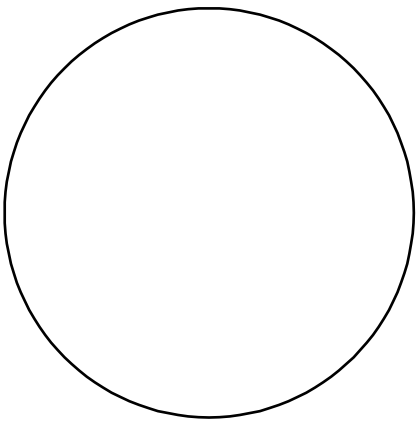
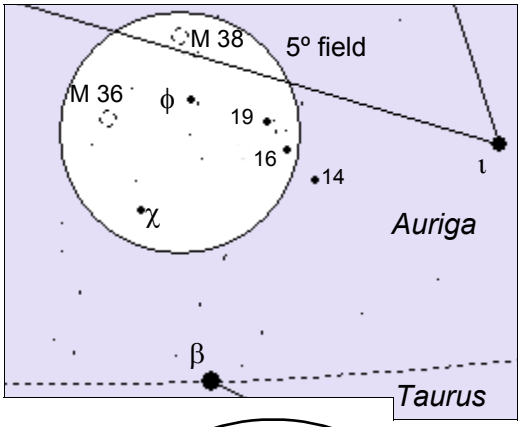


Auriga — M 36/M 38 — *open cluster duo* — easy

Framed nicely by the roughly pentagonal shaped pattern of Auriga are the open clusters **M36** and **M38**. Even the slightest optical aid will show the duo set against the background of the winter Milky Way. Scan a short distance northwest of the midpoint on a line joining Theta Aurigae and Beta Tauri and you should have little trouble spotting the pair. The two are separated by a little over two degrees and fit in the field of even giant glasses.



M36 is the smallest of the Auriga trio and appears quite compact. It lies about 4,100 light years away and contains 60 or so members.

M38 is a bit more splashy and shows as a blur of light flecked with a number of brightish suns. Phil Harrington, in his "Touring the Universe through Binoculars", comments that the stars of M38 appear to trace a diminutive Greek letter Pi. What do you think?

Observing Details

Date/Time _____ Instrument _____

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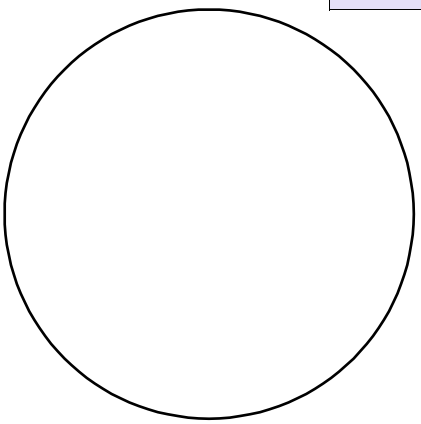
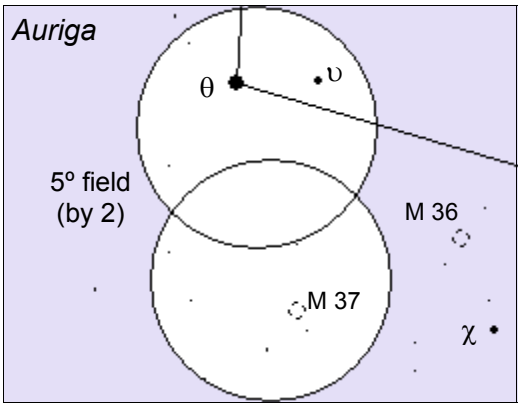
Notes _____



Auriga — M 37 — *open cluster in the Charioteer* — easy

M37 lies the other side of the reference point we used to jump off to find M36 and M38. The cluster is particularly rich and successively larger instruments will resolve more and more stellar pinpricks against the general background glow of this swarm. The combined light of its members is equivalent to a magnitude 6·2 star.



M37 contains an estimated 500 stars and is the most remote of the Auriga trio at 4,400 light years. All are actually at a comparable distance but we know they are not associated by virtue of the fact that they are dissimilar in age.

The youngest is M36 with an estimated age of 25 million years. Next is M38 whose stars are about 220 million years old. M37, on the other hand, contains some red giants and is believed to have formed some 300 million years ago.

Observing Details

Date/Time _____ Instrument _____

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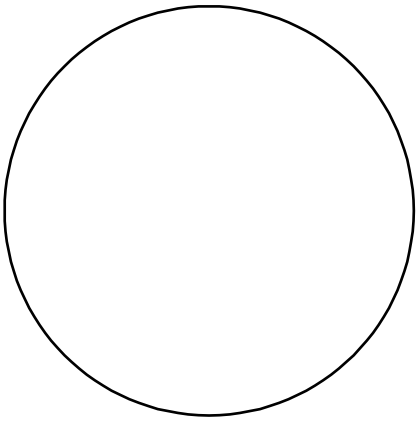
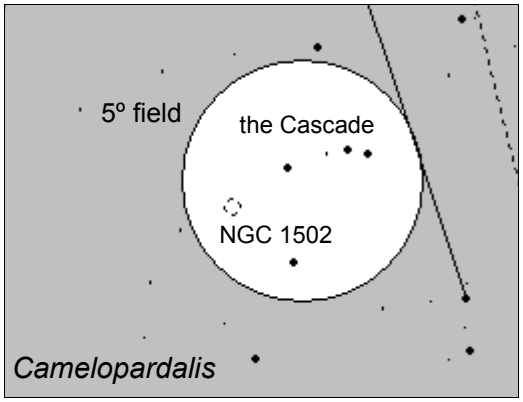


Camelopardalis — Kemble's Cascade — *stars splashed across the sky* — easy



This is a wonderful asterism that was known to a few observers but did not get wider notice and the adopted moniker until highlighted by Walter Scott Houston in his monthly *Sky and Telescope* column. Houston had learnt of the object through a Canadian amateur astronomer, Fr. Lucian Kemble.

The stars of the celestial Giraffe are dim so you may have to start your sweep from Alpha Persei in order to find this stellar rivulet. Scan 13º — or two-and-a-half 10x50mm binocular field-widths — northeast of the star and you'll pick up this delightful ribbon of suns that spill through your binocular field. The brightest are magnitude five and range down to ninth magnitude.

At the southeastern end is the open cluster **NGC 1502**, a compact group that shows well in this star-poor region of sky. It appears as a starry huddle with a few more scattered eighth magnitude attendants.

Observing Details

Date/Time _____ Instrument _____

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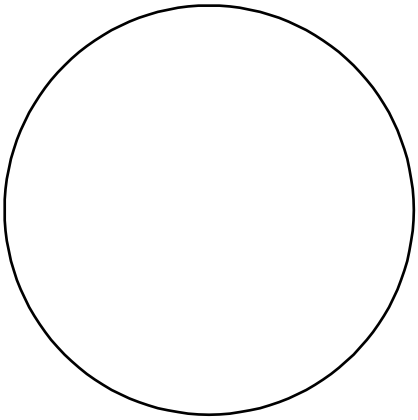
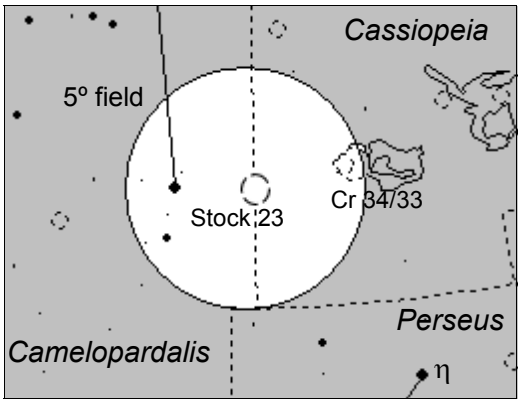


Camelopardalis — Stock 23 — *open cluster on the Cam-Cas border* — easy



Stock 23 is a cluster that was regularly overlooked by cataloguers for many years. However, it became better known following an article by John Pazmino in the March 1978 issue of *Sky & Telescope* about his "discovery" of the object and subsequently inherited the title of "Pazmino's Cluster".

Stock 23 is 5½º northeast of Eta Persei and shows a number of points of light set against a general background glow. There's an attractive pattern of brightish stars just to the east with the most prominent shining at magnitude 4·2. One of the more imaginative descriptions of the cluster is that it resembles a man, arms flailing, fleeing a swarm of bees!

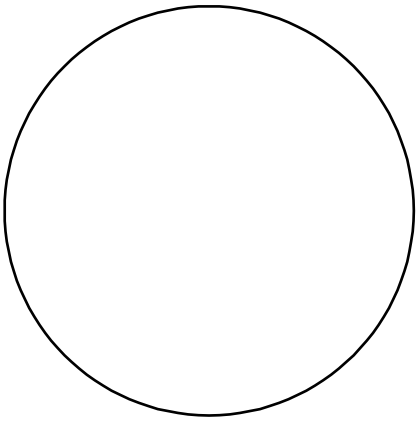
Swing your binoculars a little to the west and you start encroaching on the rich star fields of the Milky Way in Cassiopeia. Just a little west of Stock 23 are two very coarse open clusters catalogued by Per Collinder as numbers 33 and 34 on his list.

Observing Details

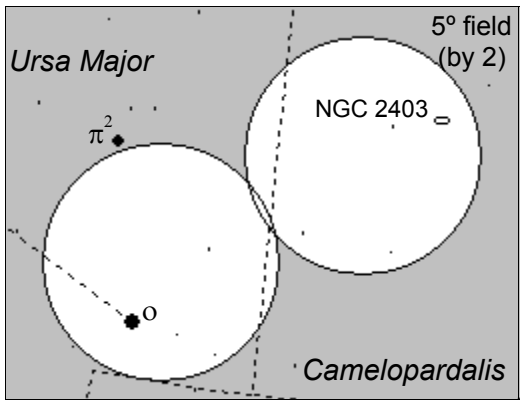
Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____



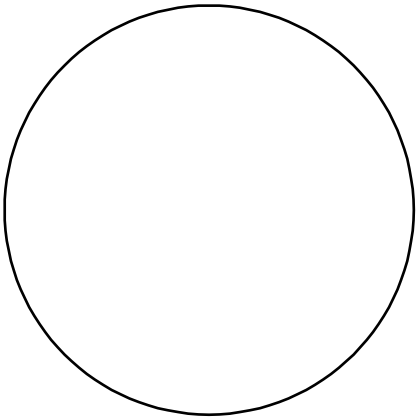
Camelopardalis — NGC 2403 — *face-on spiral* — moderate



A supernova in this galaxy in August 2004 has probably led **NGC 2403** to be added to many observing lists. Walter Scott Houston, in his "Deep Sky Wonders" column in *Sky & Telescope* magazine called NGC 2403 the brightest galaxy north of the celestial equator not to have a Messier number.

The fact that this object lies in the relatively obscure constellation of the Giraffe doesn't help either but with a little tenacity you should be able to spot this almost face-on spiral as an elongated glow of light with a slightly brighter centre. Scan 7¾° northwest of Omicron Ursae Majoris where you'll find it set in a field showing some stars arranged in a stretched rectangle shape.

The galaxy is about 8 million light years away and a probable member of the Ursa Major galaxy group that also includes M81 and M82, 13½° away over the border in the constellation of the Great Bear.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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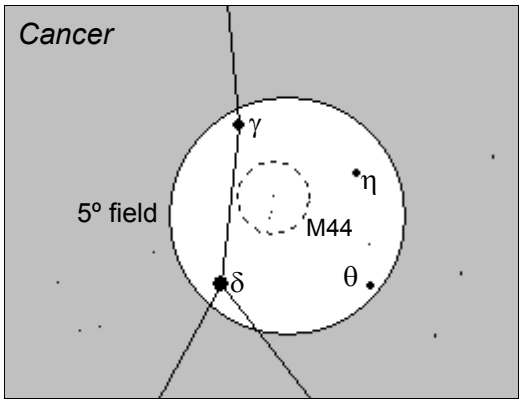
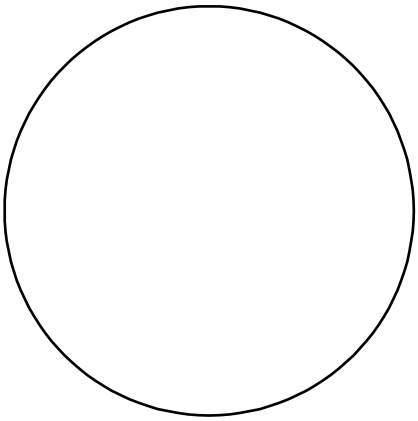
Cancer — M 44 — *the Beehive cluster* — easy



One of the most celebrated objects in the sky is the naked-eye star cluster **M44**, dubbed the Beehive. The group is nicely framed by the four stars making up the body of the celestial Crab — δ, γ, η, and θ Cancri. Recent measurements place M44 at a distance of 577 light years with the cluster's age estimated to be about 400 million years.

Two lovely binocular doubles lie within M44's boundaries; **ADS 6915** (Burnham 584) and **ADS 6921**. Both lie towards the southern edge of the cluster as part of a sort of tipped-over "house"-shaped asterism that is reminiscent of the constellation Cepheus.

ADS 6915 is a triplet of suns of around seventh magnitude at the "roof" of the "house" with the star right at the apex of the triangular arrangement being brightest. ADS 6921 is a quadruple system but only the two more luminous members will be seen in binoculars.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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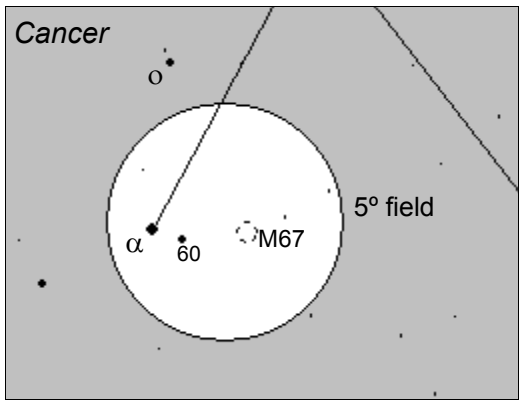
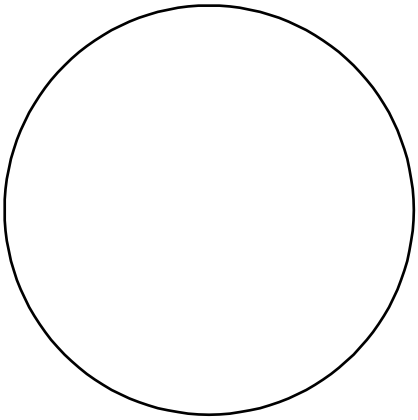
Cancer — M 67 — *ancient open cluster* — easy



Within the same binocular field as Alpha Cancri (Acubens) is the ancient galactic cluster **M67**. The cluster is seen as an elongated mottled haze about two degrees west of the star. Larger glasses let you glimpse a sprinkling of the brighter 9th magnitude members of this association while an unrelated 8th magnitude sun lies just outside its northern edge.

M67 is considered one of the oldest galactic clusters known with an estimated age of four billion years. This poses the question as to how its stars have remained gravitationally-bound over such a long period of time.

Most open clusters are disrupted after a few hundred million years following encounters with other clusters or by successive passages through giant interstellar gas clouds during their orbit around the galaxy. The key to the survival of M67 however lies in its great distance (1,500 light years) above the plane of the Milky Way.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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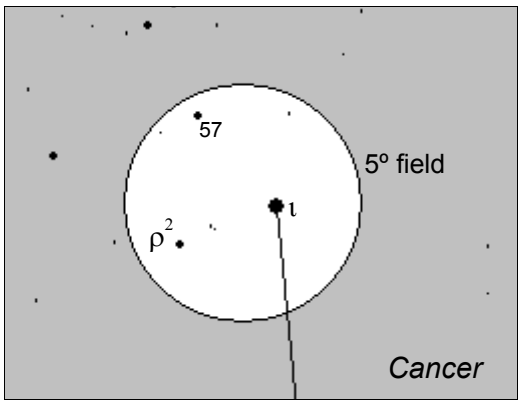
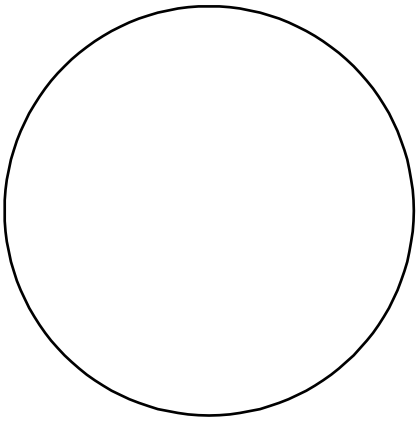
Cancer — Iota — *double star* — moderate



The beautiful double star **Iota Cancri** lies a little north of the Beehive cluster. Binoculars show the yellowish primary (at magnitude 4·2) contrasting nicely with the bluish-white companion (magnitude 6·6). The separation between the pair is 31 seconds of arc.

It's also set in a lovely field that shows two nice curving chains of stars tapering to a point. The pattern suggests a diminutive version of the constellation Perseus. What do you see?

The Iota pairing is pure chance. Neither component has shown a change in separation or position angle since 1828, and so we must accept that it is just an optical double. Larger glasses may allow you split **Struve 1266** in the same field. This double consists of reasonably equal magnitude companions (8·2 and 9·3), with a separation of 23 arc-seconds.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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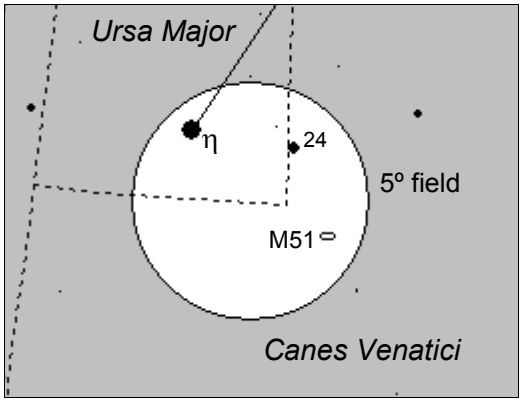
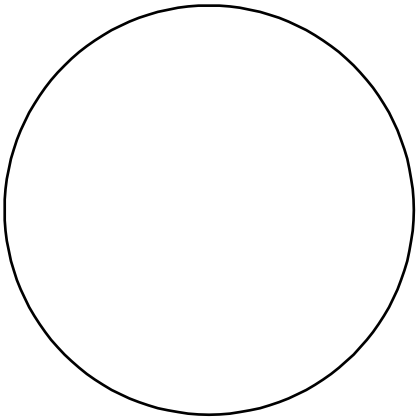
Canes Venatici — M 51 — *the Whirlpool galaxy* — moderate



Images of the Whirlpool Galaxy, **M51**, define the popular view of a far-flung starry spiral. Although a telescope is required to yield hints of its classical shape, along with the irregular companion NGC 5195, binoculars are sufficient to show it as a blur of light not far from the last star in the handle of the Plough. Larger glasses will show the main galaxy and it's lesser attendant as two spots of light immersed in a general greyish glow.

Take the time to really examine the view you see. As your skill as an observer increases you will begin to notice more subtle details. In what direction do you see M51 orientated? Does the blur of light you are seeing appear uniformly bright or does one part appear brighter than the other?

M51 lies a little under four degrees southwest of Eta Ursae Majoris; you can star hop to 24 Canes Venaticorum from where you just need to go another 2° to the southwest to find the galaxy.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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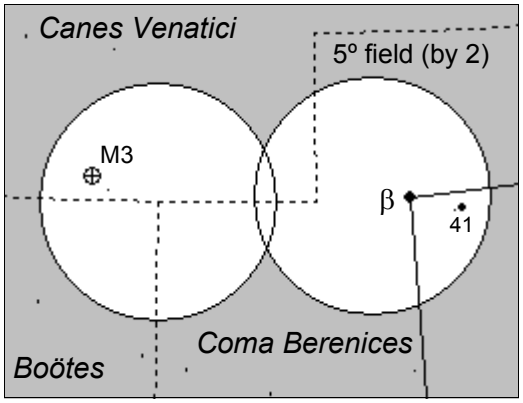
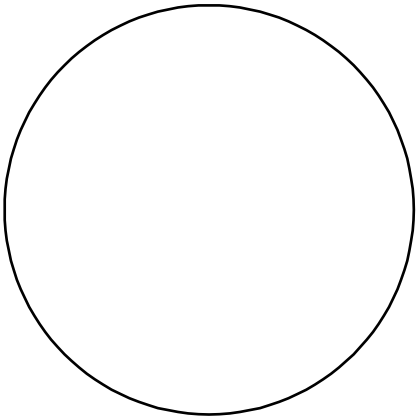
Canes Venatici — M 3 — *globular cluster of the Springtime sky* — moderate



A rewarding globular to track down in the Hunting Dogs is **M3**, shining with the light of a magnitude 6·2 star and thus visible to the naked eye under very good conditions. There is no nearby reference star to lead you straight to this stellar swarm but it lies roughly midway along a line joining Arcturus and Alpha Canum Venaticorum. An alternative is to try "star hop" from magnitude 4·2 Beta Comae Berenices — the cluster is 1½ times the standard five degree binocular field of 10x50mm instruments east of this star.

M3 is some 33,900 light years distant — further than the Sun's distance from the Galactic centre — and contains an estimated half a million stars. Some of these — the so called "Blue Stragglers" — appear much younger than the majority of the ancient suns in the globular. It is now believed that these stars have had their cooler outer layers stripped off through close stellar encounters as they wandered through, or near, the heavily populated core of the cluster.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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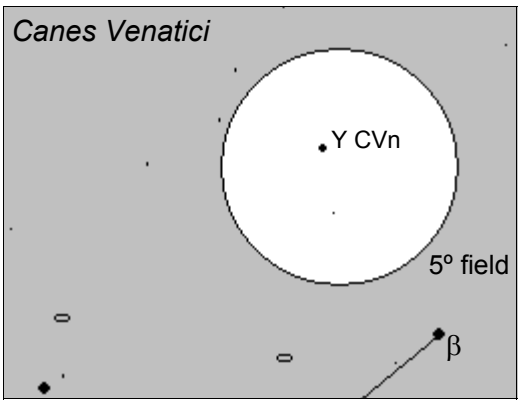
Canes Venatici — Y CVn — *La Superba* — moderate



Y Canes Venaticorum is a fine example of a class of objects known as Carbon Stars. These are suns towards the end of their life cycle which have inflated to the red giant stage and show spectra rich in the lines of carbon molecules. The carbon molecules absorb wavelengths of light towards the blue end of the spectrum so these stars show a vivid red hue.

As with all red giants, Y CVn is a variable star and fluctuates between magnitudes 4·8 and 6·3 in a period of about 160 days. The star was dubbed La Superba by the late-nineteenth century Italian astronomer Angelo Sechii on account of the extraordinary red colour. It is 710 light years away and is one of the coolest naked eye stars. Unusually, water vapour has also been detected in the outer atmosphere of Y CVn.

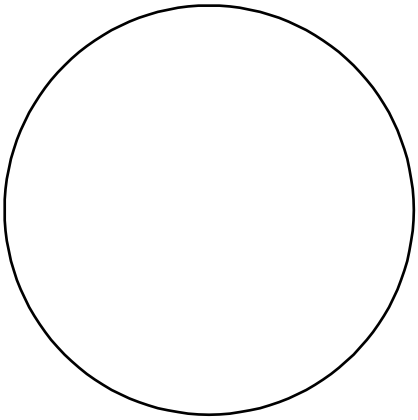
This delight can be found four degrees northeast of the magnitude 4·2 star Beta Canes Venaticorum (Chara). Make a note of what tint you see here.

Observing Details

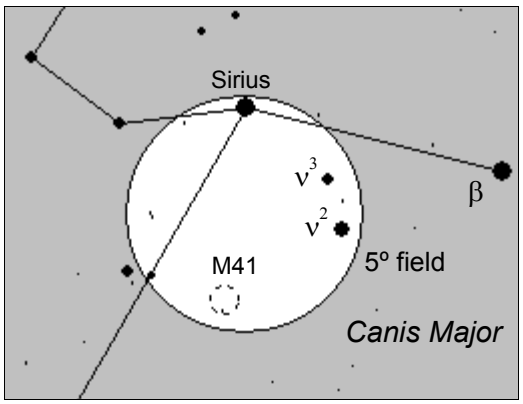
Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____



Canis Major — M 41 — *a bright open cluster hangs from the collar of the Greater Dog* — easy



Diamond-like Sirius shines bright during February evenings, sparks of many hues as it shimmers low above the southern skyline. But how many are aware of another gem — one of the deep-sky — that lies within the same binocular field as the Dog Star?

M41 is a beautiful galactic cluster found 4° almost due south of Sirius and any power binocular shows a sprinkling of stellar diamond dust. Push the magnification a little higher and you'll see a little more of the group's estimated 150 or so members resolved. The stars appear to be arranged in some rather nice lines and chains but see if you can tease out other patterns.

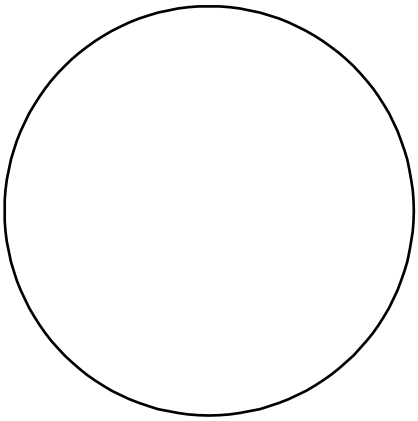
The cluster's integrated magnitude is 4·5 which means that it is possible to glimpse M41 with the naked eye from a dark site but it's low altitude may defeat your initial atttempts. It was actually recorded as early as the fourth century BC by Aristotle when he noted it as a "star with a tail".

Observing Details

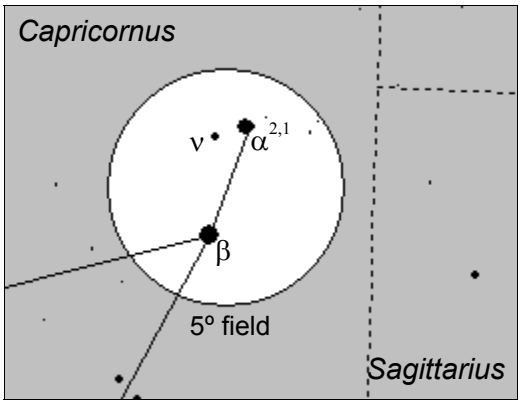
Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____



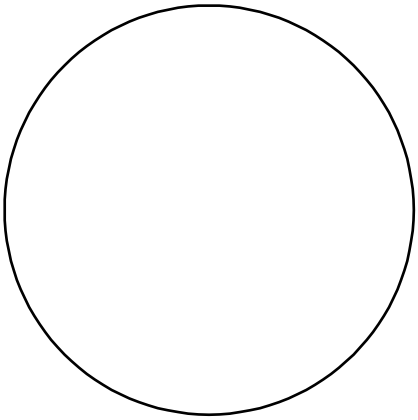
Capricornus — Alpha — *optical double star* — easy



The *lucida* of the dim zodiacal constellation of Capricornus is an attractive sight for even the smallest pair of binoculars. The star labelled **Alpha** is actually a pair of unrelated suns a little over six arc-minutes apart — making them relatively easy to split with just the naked eye.

Alpha[1], to the right as you look at it, is a primrose-yellow $4{\cdot}2^m$ sun 1,300 light-years distant. Alpha[2], a little brighter at $3{\cdot}6^m$ and much closer at 150 light-years, shows a light-orange tint. Both are genuine doubles in their own right but a small telescope is required to see the fainter companion of each.

A true pairing in the same field is **Beta Capricorni** (Daibh). Brighter $3{\cdot}4^m$ Beta[1] is a pale-orange hue while $6{\cdot}1^m$ Beta[2] is blue-white. They are actually just two of the components in a complex multiple system consisting of at least five, and possibly eight, suns (see James Kaler's stellar web site at www.astro.uiuc.edu/~kaler/sow/dabih.html).



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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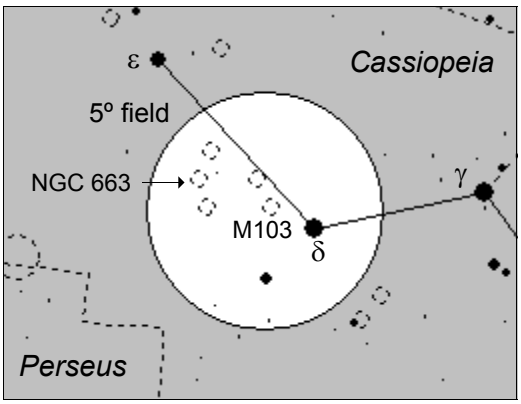
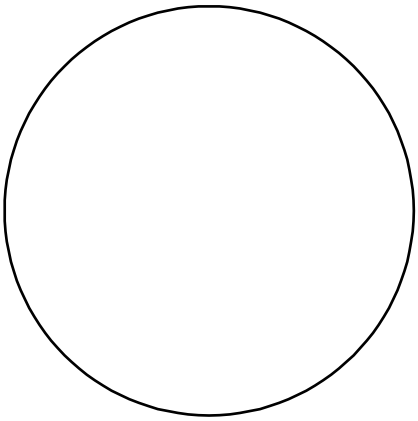
Cassiopeia — M 103/NGC 663 — *open clusters sprinkled on the Milky Way* — easy



It sometimes seems that wherever you point your binoculars in Cassiopeia you are sure to find an open cluster. The constellation is chock full of these stellar aggregations to delight the binocular observer.

A degree northeast of Delta Cassiopeiae (Ruchbah) is the small open cluster **M103**, appearing as a fan-shaped glow in smaller binoculars but resolved into a number of pinpoints of light in larger instruments. Just 1½° further to the northwest is **NGC 663**, a broader group where some of the brighter suns are easily seen. A detailed star chart will help you identify some other NGC clusters that are in the area too.

M 103 is relatively remote at 8,500 light years and is estimated to be about 25 million years old. Over 150 stars are considered members of the group. NGC 663 is a little closer at 6,300 light years.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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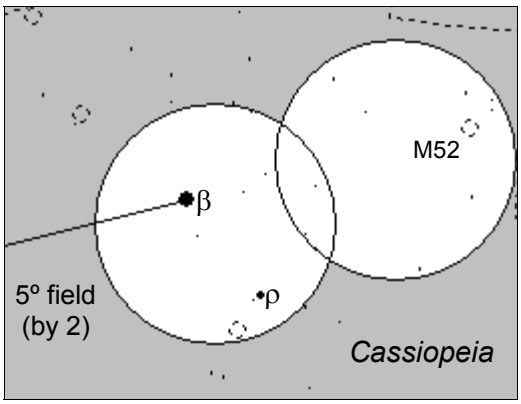
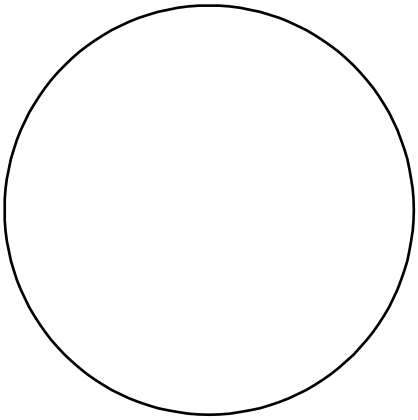
Cassiopeia — M 52 — *open cluster* — easy



M52 is removed a little from the stretched "W" shape of the constellation of Cassiopeia but is relatively easy to find. Draw a line from Alpha to Beta and extend it for the same distance as that between the two stars and you'll find the cluster.

Lower power binoculars show a small haze but with larger glasses you'll begin to pick out a few of the brighter stars from the general glow. The orange-tinted star 4 Cassiopeiae is in the same field, shining at magnitude 5 while a small line of slightly fainter suns is just to the west. The cluster, located about 5,000 light years away, is highly compressed and contains maybe 200 members.

The region of the Milky Way here is quite rich and repays careful sweeping with binoculars. Two photographs of Cassiopeia with many of the star clusters labelled are in Craig Crossen & Wil Tirion's "Binocular Astronomy".



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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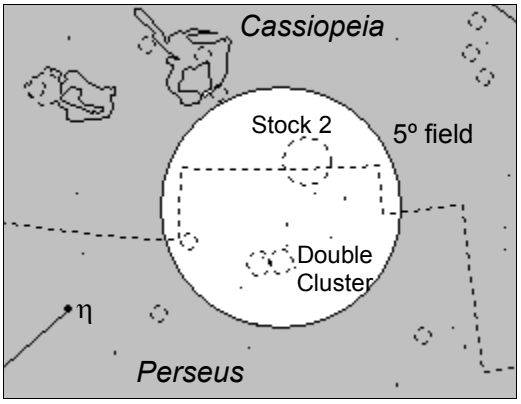
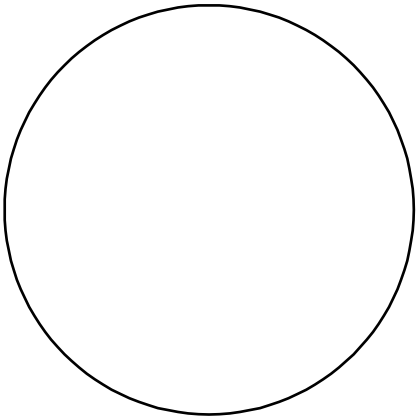
Cassiopeia — Stock 2 — *open cluster* — easy



Within a few degrees of the Perseus Double Cluster (see page 39) are a number of fine star clusters often overlooked by observers. On the border of Perseus and Cassiopeia you will find **Stock 2**, a delightful group spanning a one degree diameter. Larger instruments show a number of lines of of ninth magnitude stars curving away from the cluster's centre.

Interestingly, many of the clusters and associations we see in Cassiopeia are actually features of the next spiral arm of the Milky Way out from the one where we are located. A dearth of interstellar material looking in this direction of the sky opens a window through which we can study the stellar groupings in the Perseus Arm (we lie on the inner edge of the so-called Orion Arm). Stock 2, about 1000 light years distant, and the naked-eye stars of Cassiopeia, are foreground objects that have been found to be within our own spiral arm.



Observing Details

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Location _____ Sky _____

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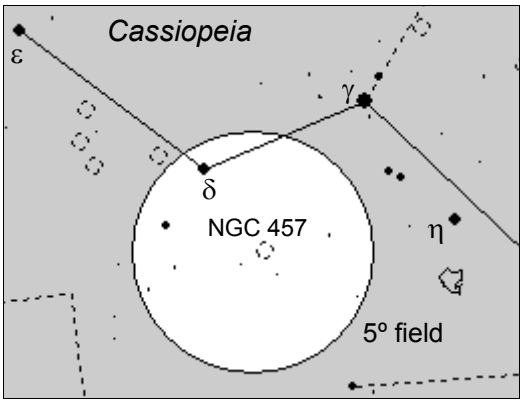
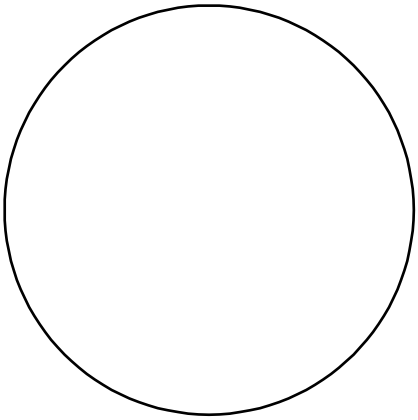
Cassiopeia — NGC 457 — *the E.T. cluster* — easy



NGC 457, variously dubbed the E.T., the Owl, or the Dragonfly cluster, is a lovely binocular object 2° southwest of Delta Cassiopeiae. Low powers will show the group as a comet-shaped glow but higher magnifications will resolve the cluster's suns beautifully. The two brightest stars, Phi Cassiopeiae and HD 7092, are actually in the foreground but are the "eyes" of whatever figure you may see.

See what you interpretions you come up with for the way the stars are strewn here – some observers see a plane with the two brighter un-related suns marking twin jet exhausts! The cluster lies in the Perseus arm of our galaxy and is about 8,000 light years distant. The age of the group is not dissimilar either to that of the better know Double Cluster in Perseus.

You'll might also see **NGC 436** in the same field as NGC 457; it's more diminutive but higher magnifications will help resolve its stars.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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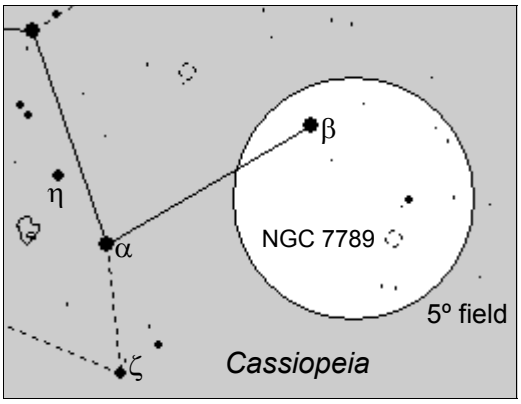
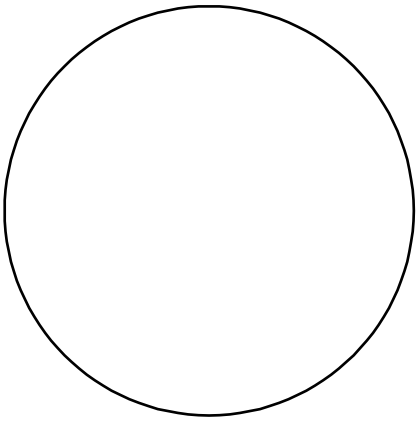
Cassiopeia — NGC 7789 — *open cluster* — easy



This is one of the less well known Cassiopeia objects but is a highlight of your tour of the Queen's open clusters. The group was overlooked by Charles Messier but was found by Caroline Herschel, brother of William, in 1783.

Scan 3° southwest of Beta Cassiopeiae (Caph) and you'll stumble across a moderate glow. The stars of NGC 7789 are uniformly faint so you won't resolve them but the group is set in an attractive star field. Less than a degree to the south is a pretty smattering of stars that includes fifth magnitude Sigma Cassiopeiae. It serves to enhance the scene.

The cluster is 7,600 light years away and contains roughly 1000 stars. It is also surprisingly old with an estimated age of 1·9 billion years. The stars of most open clusters break their gravitational bonds and disperse after just a few hundred million years .



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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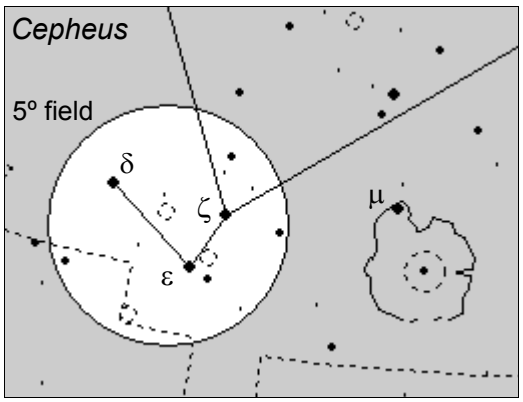
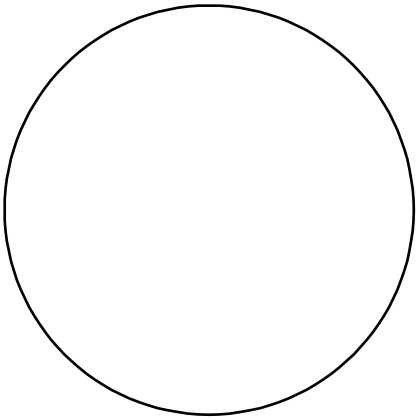
Cepheus — Delta — *prototype Cepheid variable* — easy



Delta Cephei has earned it's place in the annals of astronomical research through the discovery, by Henrietta Leavitt in the early 1900s, that Cepheid type variables have a direct relationship between their luminosity and period. The fact allowed astronomers to simply derive, in a few steps, a Cepheid's distance based on measuring it's period. This breakthrough gave scientists a yardstick for measuring distances out to about 10 million light years and revised our concept of the scale of the Universe.

Delta Cephei itself fluctuates between magnitudes 3.5 and 4.3 in a (rounded) period of 5.33 days — the website of the American Association of Variable Star Observers (www.aavso.org) has useful finder charts with comparsion magnitudes of stars convenient for making brightness estimates.

It's also a double with a 6th magnitude bluish-white companion 41 arc seconds away — making for a nice colour contrast with the orange primary.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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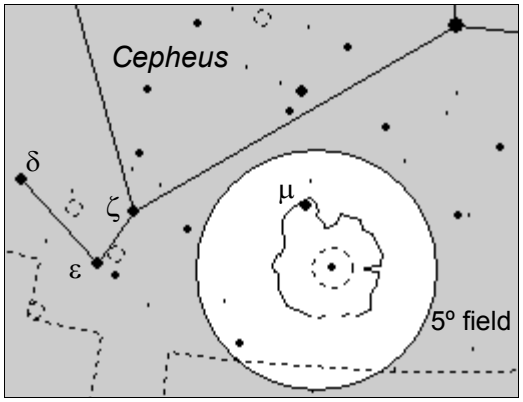
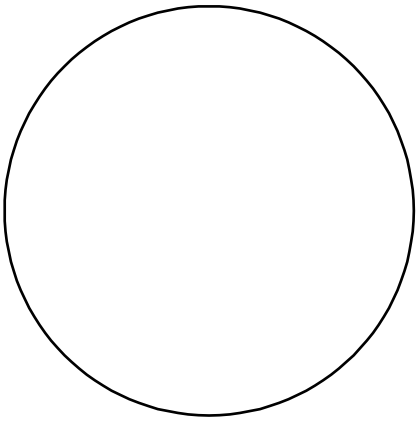
Cepheus — Mu — *the Garnet Star* — easy



In the southern part of Cepheus lies one of the more dramatically coloured stars in the sky. Mu Cephei is an irregular variable star that flickers by about a magnitude but normally shines at just a little under fourth magnitude. It shows a remarkable deep-orange tint in binoculars. The moniker for the star was given by Sir William Herschel, discoverer of Uranus.

Mu Cephei is a cool M-class Red Giant near the end of its life. It's considered one of the largest and most luminous stars we know of. If you plopped it into the middle of our Solar System, it would extend out to halfway between the orbits of Jupiter and Saturn. Most Red Giants have very tenuous outer layers anyway so the comparison is arbitrary. The star probably started out with 20 to 25 solar masses and so is fated to explode as a supernova in the future. It lies 2,700 light years from us.

Most people think all stars are white but Mu Cephei will surprise!



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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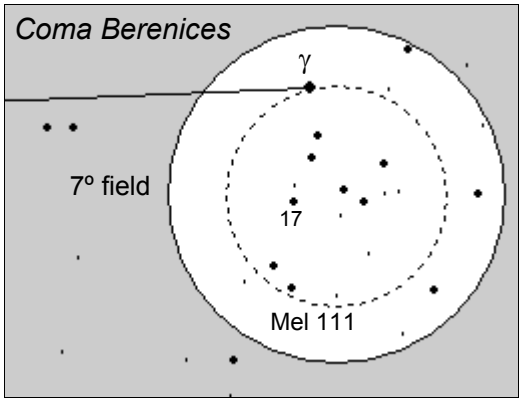
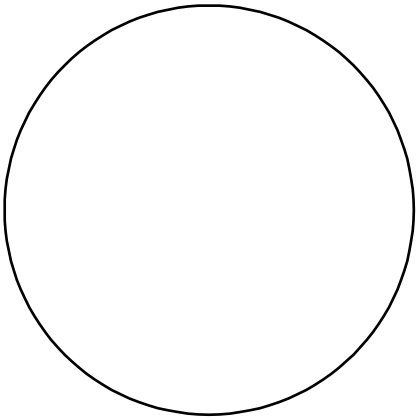
Coma Berenices — Mel 111 — *nearby open cluster* — easy



The smattering of stars which make up most of the constellation of Coma Berenices are all actually part of one of the closest clusters to our Solar System. **Melotte 111**, 288 light years distant, ranks as the third closest open cluster (after the Ursa Major group and the Hyades). The group is spread over almost 5° of sky so low power binoculars or the naked-eye are the *only* way you'll appreciate it.

Chains of stars appear to hang from Gamma, itself probably not a true member, with about 80 or so identified as belonging to the cluster. You'll also spy the wide binocular pairing of 17 Comae Berenices, consisting of two white type-A suns that shine at magnitudes 5·3 and 6·6 respectively.

Melotte 111 lies close to the North Galactic Pole so from the present viewpoint in our 220-million year long circuit of the Milky Way we see the group directly above as we look up and out of the plane of the disk.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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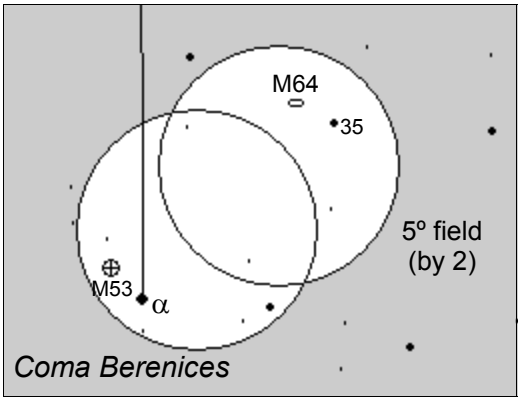
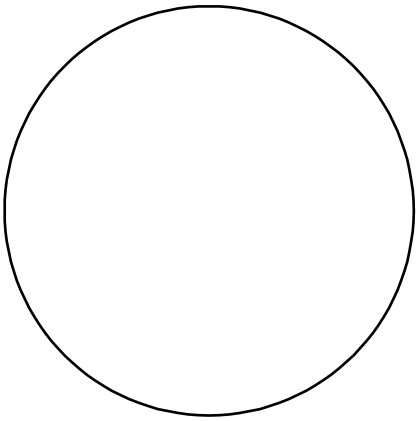
Coma Berenices — M 64 — *Black Eye galaxy* — challenge



The heavy obscuration of the near-nuclear region of **M64** by dense clouds of dust is a giveaway as to why this galaxy is nicknamed the Black-Eye. It was recently shown to have two counterrotating systems of stars and gas in the disk.The compression of interstellar clouds due to each region "rubbing" off the other has led to intense bursts of star formation.

The galaxy can be found as a small oval blob of light roughly one third of the way along a line traced from Alpha to Gamma Comae Berenices (both stars are of magnitude 4·3) — the distance between the two stars is about 15° . It has been suggested that larger binoculars will hint at the dark patch that smears the nucleus though it takes ideal conditions to do so.

M 64 is 19 million light years from us and has a diameter of 51,000 light years. It is a probable member of the Canes Venatici I Galaxy Cloud.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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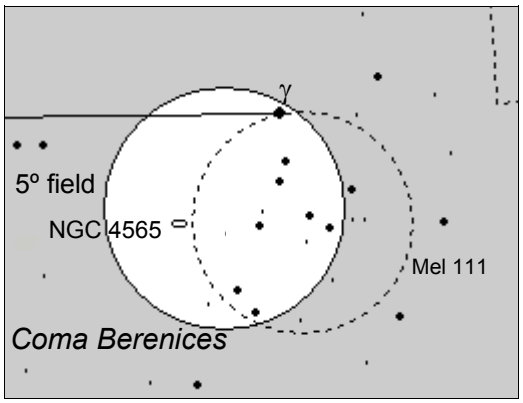
Coma Berenices — NGC 4565 — *the Needle galaxy* — challenge

The very large edge-on galaxy **NGC 4565** has been suggested by many people as that most closely resembling our own Milky Way if we could view it from a distant point in its equatorial plane. The galaxy is 31 million light years distant and a member of the huge Coma-Virgo cluster.

The 3º field of larger binoculars will just about allow you fit in both Gamma Comae Berenices and NGC 4565. Even 10x instruments though will show NGC 4565 as a pencil-thin slash of greyish light orientated in a northwest-southeast direction on the eastern edge of Melotte 111.

Observations by HST and ground-based telescopes have shown that NGC 4565 shows bending or warping at the edges. This is normally due to a close companion galaxy but none has been found nearby. A similar warping effect has been detected in the disk our own Milky Way in recent years.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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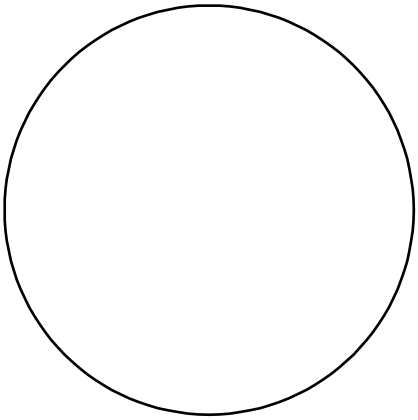
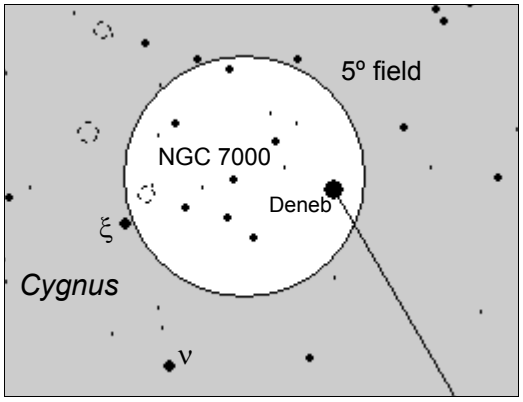


Cygnus — NGC 7000 — *the North American Nebula* — easy

Low power binoculars are the ideal instrument to sweep up this extended object that lies 3° east of Deneb. Measuring some 120' x 100', even higher magnification glasses begin to lose the effect of the shape. The best way to see **NGC 7000** in fact is with the naked eye. Look for a what appears to be a bright detached portion of the Milky Way.

Long exposure photographs bring out the classical shape of the nebula which resembles that of the North American continent. You should be able to trace some of the outline in binoculars and maybe even spot the Atlantic/ Carribbean coast

NGC 7000 lies 1,600 light years away and is a vast H-II complex where new stars are being born but our views are hindered by the heavy obscuration due to dark foreground dust clouds intruding into the region.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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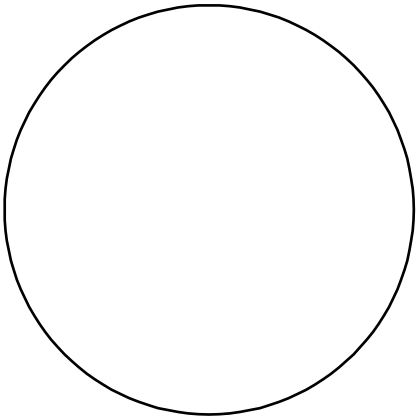
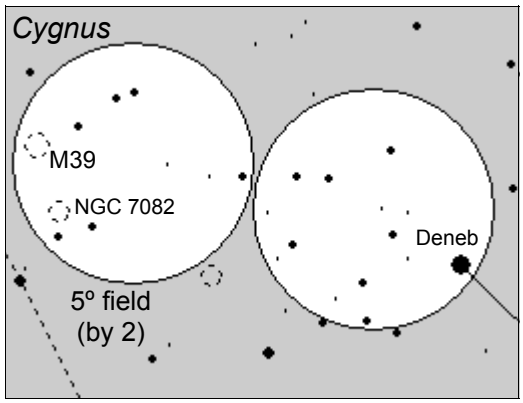


Cygnus — M 39 — *a jewel of the Swan* — easy

M39 lies outside the general cross-shaped pattern of Cygnus and can be found by scanning along the Milky Way from Deneb towards the Lacerta border.The cluster is nine degrees from Deneb but is so obvious that there is no risk of sweeping past without recognising it.

The cluster contains a nice sprinkling of bright stars with a handful just breaking the seventh magnitude barrier. The overall impression of the group is of a blunt-nosed wedge of suns that narrows towards the direction of Deneb. Your eye will tease out other little patterns within the swarm which is quite loose.

M39 is only about 800 light years away and the stars are roughly 270 million years old with some evolving towards the red giant phase. Between 50 and 100 suns are counted as members of the cluster.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

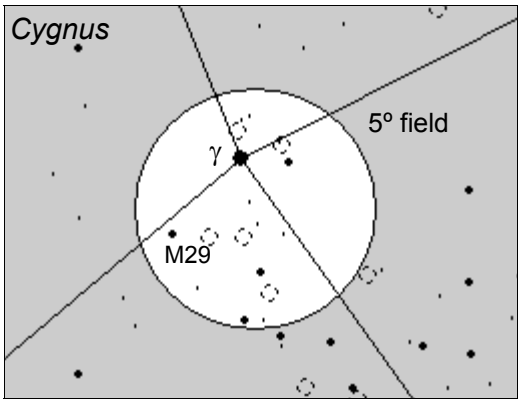
Notes _____

Cygnus — M 29 — *open cluster under the wing of the Swan* — moderate

The Celestial Swan glides overhead during the late-summer and early-autumn months and is liberally feathered with many open clusters. Sheltered under one of the wings of Cygnus is **M29,** one of only two such Messier objects within the constellation's boundaries.

The association is found a little under two degrees southwest of magnitude 2.2 Gamma Cygni (Sadr). The position in a particularly rich star field means that you may at first have a little difficulty identifying the cluster but it will appear as a small knot of a number of brightish stars in larger glasses. Smaller instruments show a general grainy glow.

M29 is heavily obscured by interstellar dust and would be three magnitudes brighter but for this fact. It's age is estimated at 10 million years and the brightest star may have a luminosity 180,000 times that of the Sun. It is not particularly populous with only some 50 or so stars claiming membership.



Observing Details

Date/Time _____ Instrument _____

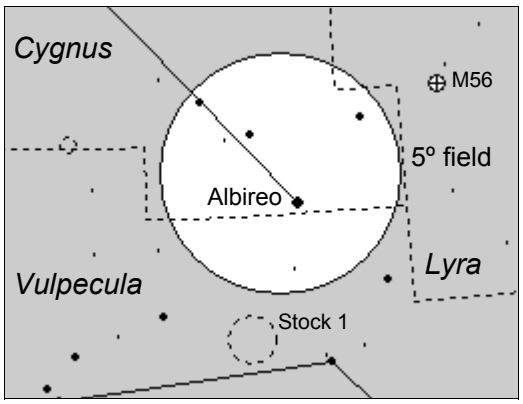
Location _____ Sky _____

Notes _____

Cygnus — Beta — *the celestial traffic light* — easy

One of the most beautiful double stars in the sky in **Beta Cygni**, or Albireo (the "Hen's Beak"). The brighter magnitude 3 star shines with a deep-yellow hue while the magnitude 5 companion appears like a sapphire. Little wonder that the combination of colours has lead Albireo to be nicknamed the Celestial Traffic Light. The separation of the two is 34 arcseconds making them visible in low power binoculars though higher magnification makes the job a little easier.

There has been some dispute as to whether the two are physically associated though modern studies have shown that they form a genuine pair. The actual separation between the two is quite large and the orbital period is probably over 7,000 years. The brighter component has a very tight-in companion which isn't resolvable in a telescope but inferred from spectroscopic studies. The distance from us to Albireo is 380 light years.



Observing Details

Date/Time _____ Instrument _____

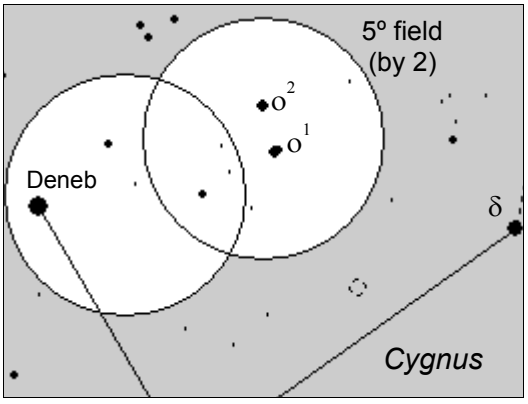
Location _____ Sky _____

Notes _____

Cygnus — Omicron — *delightful triple star* — easy

An easy object for binoculars is the wide optical pairing of **Omicron**[1] and 30 Cygni. The two are separated by 338 arcseconds but close by to orange coloured Omicron[1] you will spy a fainter blue companion at less than a third of this distance. All are set in a field liberally sprinkled with many faint stars making for a very attractive sight. Slowly sweep from Deneb towards Delta Cygni and you will spot the Omicron[1] group midway along this line.

The primary is an interesting star in its own right as it is an eclipsing binary with a very long period of 10·42 years. The main star is an orange giant 150 times the diameter of the Sun that is shrouded in a gaseous envelope that may extend out to twice the diameter of the star itself. The smaller companion orbits in a plane presented nearly edge-on to our view at a distance of 1·9 billion kilometres from the primary. Eclipses are gradual as the secondary's light is first dimmed by the primary's atmosphere.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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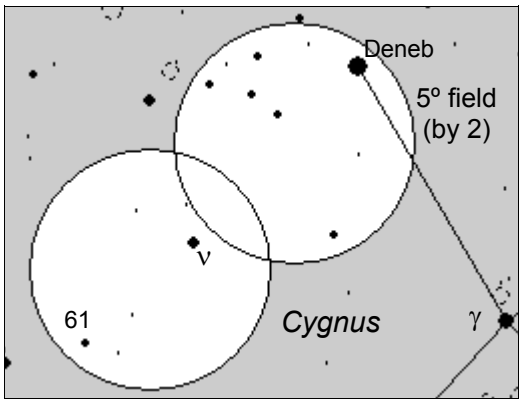
Cygnus — 61 — *measuring the Universe* — easy

One of the most famous stars in the sky is **61 Cygni**. The star rose to prominence by being one of the first to have its distance measured through the technique of parallax by the German astronomer Friedrich Bessel in 1838. Although Henderson had applied the same method a few years earlier to measure the distance to Alpha Centauri, and Struve had computed a distance for Vega, Bessel's results were the first reliable ones published. To boldly veer off the subject a little, knowledgeable fans of *Star Trek* probably know 61 Cygni better as home to the Tellarite race.

The star may be a little hard to find at first as it lies at the fringe of naked eye visibility in an average sky. Scan halfway along a line joining Deneb and Zeta Cygni, an outlying member of the easternmost wing of the Swan (a distance of 8º). 61 Cygni appears as a tight pairing of magnitudes 5·3 and 5·9 orange coloured stars set in a rich field of the Milky Way.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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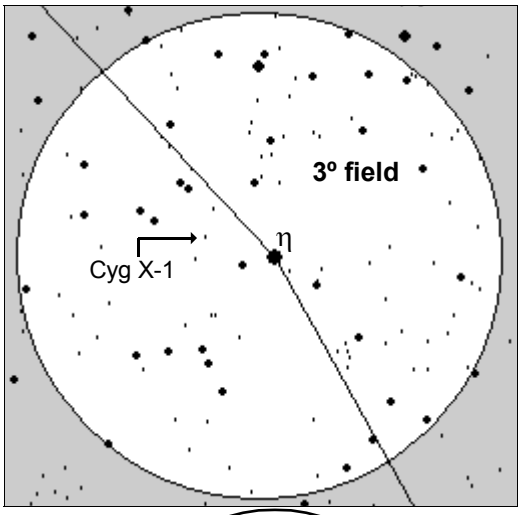
Cygnus — HDE 226868 — *habouring a black hole?* — challenge

This is one of the binocular handbook objects you won't actually see! Why so? Well, all you will spot is the visible companion to what many astronomers believe is one of the best black hole candidates we know.

Also known as Cygnus X-1 after being the first X-ray object found in the constellation Cygnus, the X-ray source was precisely identified in 1971 as being associated with the ninth magnitude star **HDE 226868**. The star is a blue supergiant orbiting a massive object in a period of just under six days. From the period, we can compute the size of the invisible "star" which comes out at 10 solar masses. Such an object should be seen in visible light but the best fit model suggests that it is actually a black hole.

The blue supergiant HDE 226868 is in the same binocular field as Eta Cygni, appearing as a magnitude 8·9 mote of light 23 arcseconds northeast of Eta and anchoring a corner of an isoceles triangle of similarly bright suns.



Limiting mag. = 9·5

Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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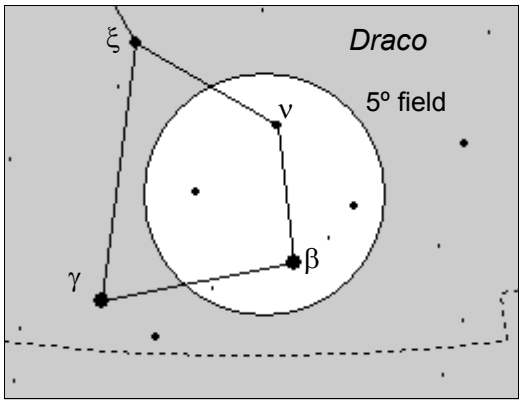
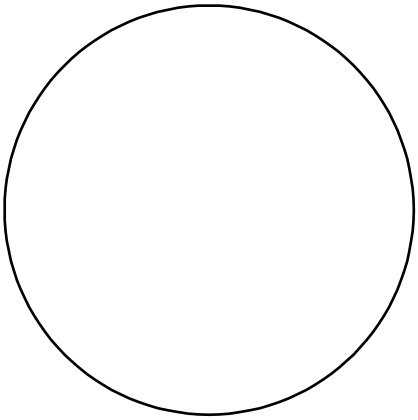
Draco — Nu — *double star in the Dragon's head* — easy



The constellation Draco, the Dragon, winds its way gracefully around the Celestial Pole and is is visible right throughout the year from our latitude. Although it contains a paucity of deep sky objects for binoculars, there are a number of lovely double stars to track down.

One of these is **Nu Draconis**, the faintest star of the four that make up the dragon's head. The two almost equally bright suns of the pairing are separated by 62 arcseconds and can be split by most binoculars.

Gark Seronik, in *Sky and Telescope* magazine, offers a useful pointer to how tight a double you can split in binoculars. Divide 300 by the magnification of the binocular and you get the closest separation, in arcseconds, you'll be able to split (e.g. 300/10x = 30"). An extra caveat applies if the primary is much brighter than the secondary; then, the glare from the first star overpowers and makes the task of separating the two more difficult.



Observing Details

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Location _____ Sky _____

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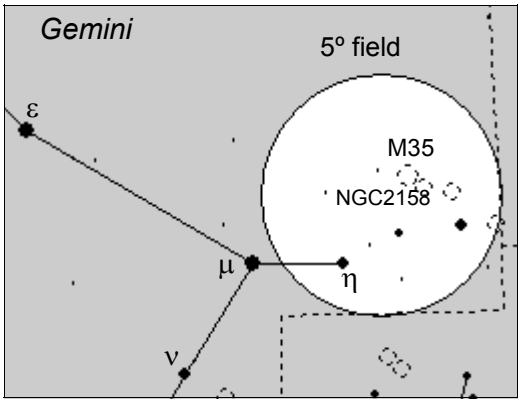
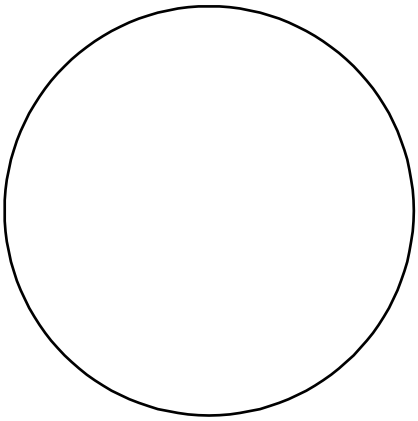
Gemini — M 35 — *open cluster at the Twin's feet* — easy



One of the finest clusters of the winter sky is **M35**, found 2¼° to the northwest of magnitude 3·3 Eta Geminorum. The group contains hundreds of stars within a diameter equivalent to that of the Full Moon.

Binoculars will reveal many pinpoints of light set in a soft background glow while switching to larger instruments bring even more stars into view. The cluster is located 2,800 light years away and has an integrated magnitude of 5·3 making it just visible to the naked eye from a dark site.

Large binoculars may let you spot the more intriguing **NGC 2158** half a degree south west of M35. This rich cluster, 16,000 light years away, appears as a hazy blur of light that requires good conditions to spot. The great distance of the swarm means we do not see it well but we do know that its stars are ancient with some estimates making it over a billion years old.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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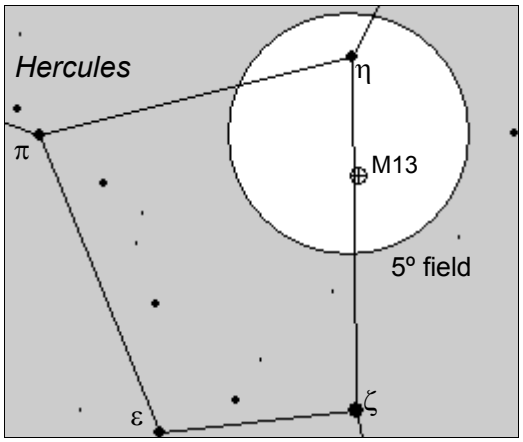
Hercules — M 13 — *the Great globular* — easy

A third of the way along a line joining Eta and Zeta Herculis is **M13**, one of the finest globular clusters north of the Celestial Equator. Binoculars will show a nice spot of grainy light with two equally bright stars either side of the cluster. Keep Eta at the top edge of your binocular field and it's a cinch to spot this swarm of possibly a million ancient suns.

Look just to the east of the globular and you'll see a nice chain of stars; the westernmost is the brightest while the rest are strung out to give the appearance of a lazy comet tail. Your sky explorations will turn up many of these chance arrangements of stars adjacent to deep-sky highlights.

Edmond Halley discovered M13 in 1714 and noted that 'it shows itself to the naked eye when the sky is serene and the Moon absent.' The combined light of it's myriad suns translates to that of a 6th magnitude "star". M13 is 25,100 light-years away and measures 145 light-years from edge to edge.



Observing Details

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Location _____ Sky _____

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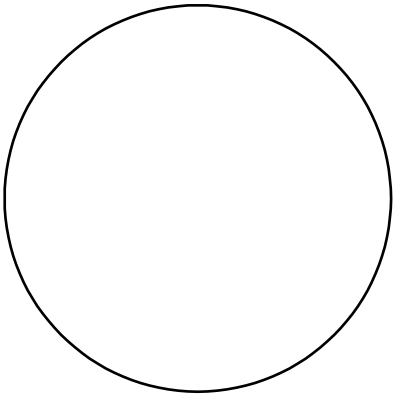
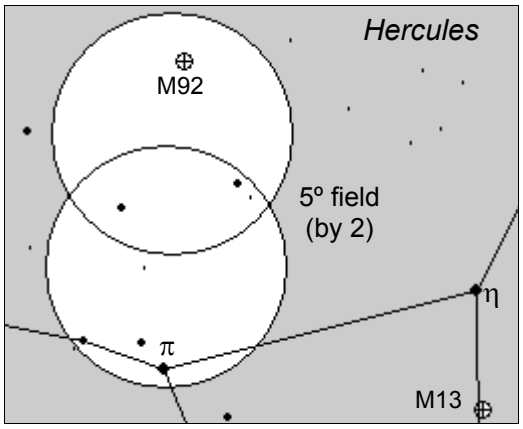


Hercules — M 92 — *an overlooked globular cluster* — moderate

Hercules hosts another Messier globular, **M92**, which languishes somewhat in observing backwaters because of it's proximity to the more illustrious M13. It's a little more distant too than M13 at 26,700 light-years and looks more condensed in binoculars – you might confuse it with a similarly bright star a little to the east if your instruments are not perfectly focussed.

There's a lovely scattering of many faint stars below the cluster in the same field that vague trace out a large southwest pointing arrowhead. To find M92, scan a little over one 5° binocular field-width north from Pi Herculis, the star marking the top-left corner of the "Keystone" asterism.

A piece of trivia is that the effect of precession of the Earth's axis over a 25,800 year period causes the North Celestial Pole to pass within one degree of the cluster. Such was the case about 10,000 BC and this will next occur in 16,000 AD. A case of multiple (but very faint) Pole Star's perhaps?



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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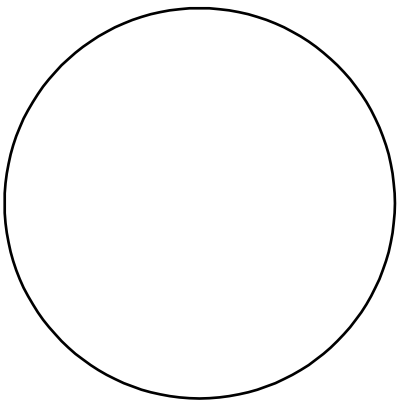
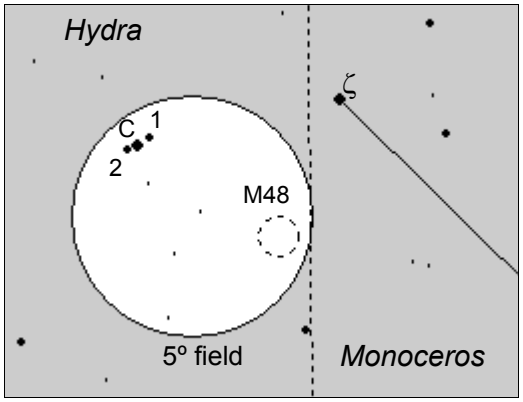


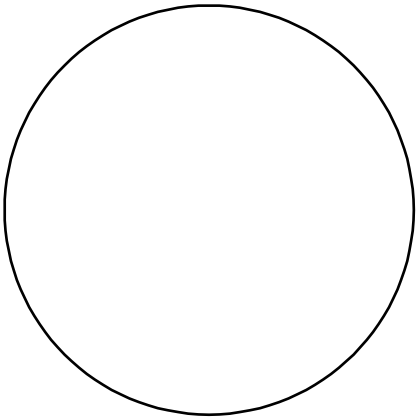
Hydra — M48 — *open cluster near the Solitary One* — easy

Hydra is so large a constellation that as the "head" of the Watersnake sinks in the western sky the "tail" is still rising in the east. A nice binocular cluster under the "head" is **M48**, a scattering of 80 or so stars set within a degree or so diameter field.

Look about eight degrees southwest of Sigma Hydrae, one of the stars of the "head" and you'll spy a tight group of three stars comprising 1, C, and 2 Hydrae. Continue your line 3½° further and this stellar swarm should slither into view. The cluster forms a triangle with the C Hydrae trio and Zeta Monocerotis.

What you should see is a slightly condensed sprinkling of ten or fifteen of the cluster's brighter suns. M48 is 1,500 light years distant and estimated to be about 300 million years old.





Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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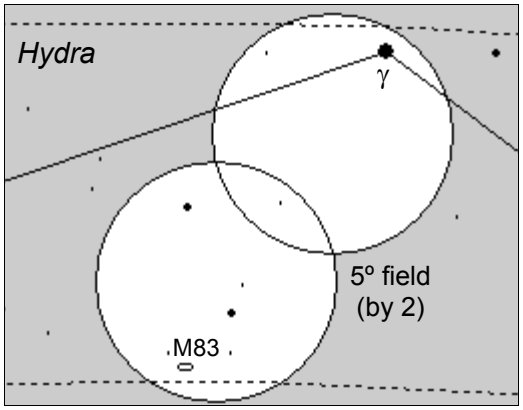
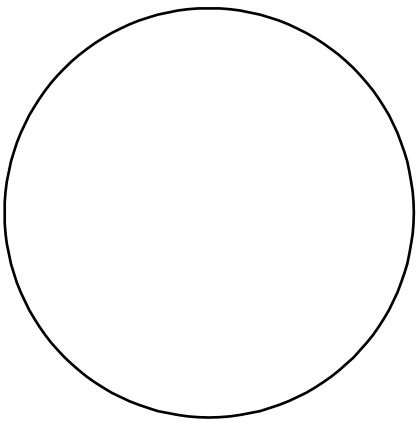
Hydra — M 83 — *Milky Way twin?* — moderate

Astronomers have often suggested that our view of **M83** most closely represents what our Milky Way would look like if seen from the same perspective.

Detailed photographs show the galaxy trailing beautifully defined spiral arms peppered with the pink-red glow of star formation regions. Hot blue-white stars stud the disk while the nucleus glows with the yellow light of ancient suns.

The galaxy is difficult enough to locate because of lack of suitably bright reference stars to star hop from. Taking Gamma Hydrae as point, look almost eight degrees to the southeast and you should find a large oval patch of light which is about all you'll really see of the galaxy in binoculars. A magnitude 5·8 star is off it's northeastern edge. M83 is 15 million light years distant.





Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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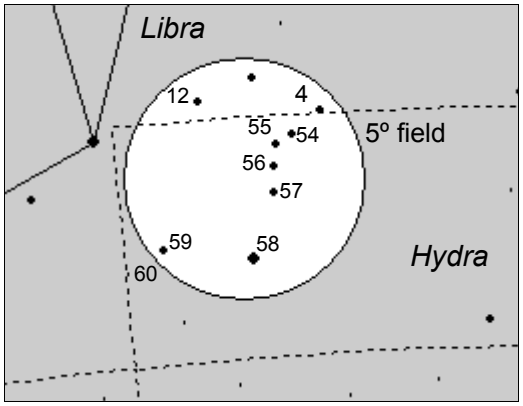
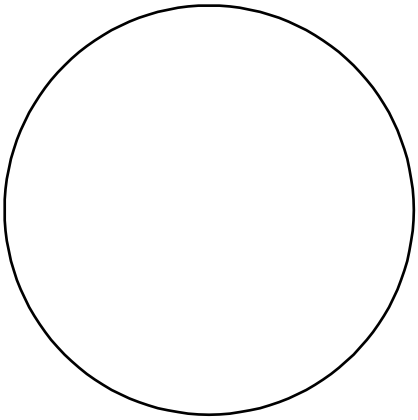
Hydra — 54 — *an asterism . . . and a defunct constellation* — easy



Just four degrees west of Sigma Librae is the fifth magnitude star **54 Hydrae**. It's highlighted here as to the author it's part of a pattern that looks for all the world like a miniature version of the constellation Scorpius.

54 through to 58 Hydrae form the body while a small curve of faint stars ends in the "stinger" marked by 59 Hydrae – with 60 Hydrae displacing the figure a little. The scorpion's claws are formed by 4 and 12 Librae with an unidentified sun in between. It is as if the celestial Scorpion has a baby sidekick! The group was once part of a now defunct constellation called Noctua (the Night Owl) and prior to that, a star pattern invented by Le Monnier that was known as the Solitaire Bird.

It's amazing what you find browsing the Internet too. One search turned up a site called "Encyclopedia Galactica" (www.orionsarm.com) with an entry stating that 54 Hydrae is home to jovibiota (manta ray and blimp-like creatures floating in a gaseous atmosphere) . . . o-kaaayyy . . .



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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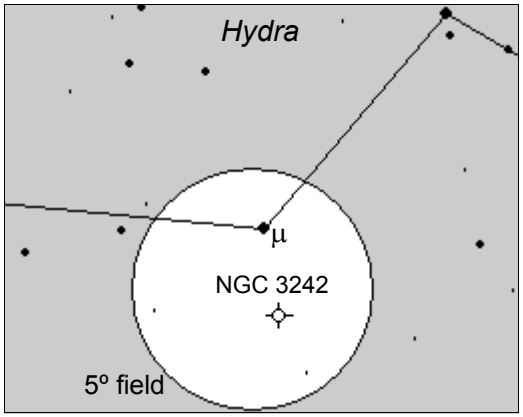
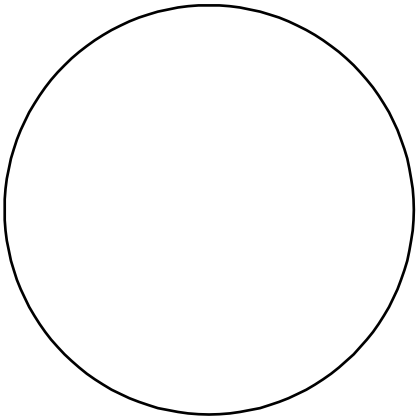
Hydra — NGC 3242 — *the "Ghost of Jupiter"* — challenge



Drop just under two degrees almost directly due south of magnitude 3·8 Mu Hydrae and you come to the planetary nebula **NGC 3242** that is more popularly known as the Ghost of Jupiter. Some observers have also likened its appearance in a telescope to an eye.

The planetary appears stellar-like in binoculars and the location in a star poor field makes identification a little easier. The eighth magnitude object seems to have a greenish tint to its light too. Phil Harrington, in his book *Touring the Universe through Binoculars*, suggests that larger instruments might show a tiny disk with a pronounced bulge.

Distances to planetary nebulae are difficult to gauge but this one is thought to lie about 2,500 light years away. The shells of gas visible in photos of NGC 3242 were probably ejected only a few thousand years ago.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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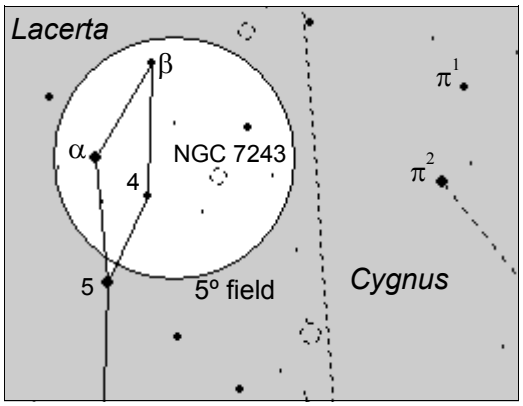
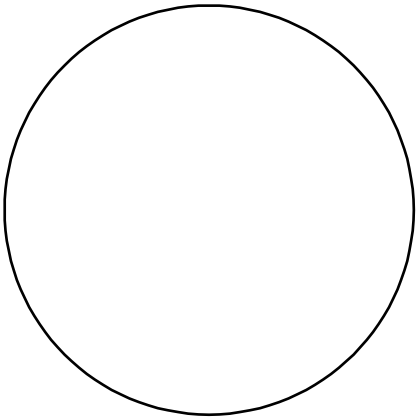
Lacerta — NGC 7243 — *scattered open cluster* — moderate



Nestled between Cygnus, Cepheus, and Andromeda is the small constellation of Lacerta, the Lizard. The brightest star is only just above fourth magnitude yet the pattern scuttles across a rich region of the Milky Way.

NGC 7243 is a lovely open cluster that has probably been seen by many people casually scanning our Galaxy's star fields north of Deneb but not recognised as such. To locate the object, first find the triangle of of Delta, Epsilon, and Zeta Cephei. The "head" of the Lizard is five degrees south of this trio. In fact, the diamond-shaped head just about fits in the field of 10x50mm binoculars along with NGC 7243 a little to the west.

The group shows as a small patch in lower power instruments while higher magnification resolves a few glints of starlight. About 40 stars are members of this cluster. See if you can spot another binocular cluster, **NGC 7209**, that also lies within the boundaries of Lacerta.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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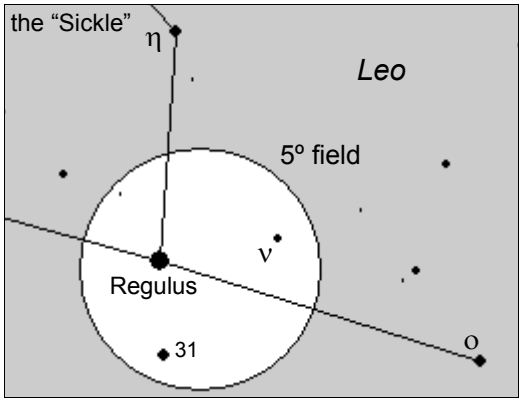
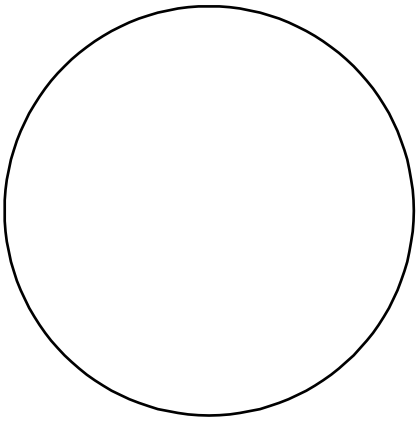
Leo — Regulus — *a study in contrasts* — challenge



Leo is one of the few constellations that actually looks like what it is supposed to represent. The bright star of the group is **Regulus**, a magnitude 1·3 luminary that lies just 77 light years away.

The star is a triple system with the lesser components orbiting each other in a period of a thousand years with the duo taking over 130,000 years to orbit Regulus itself.

The orange-dwarf sun of this minor pair is an 8th magnitude star found 177 arcseconds from Regulus. A generous separation you might think for binoculars but a notoriously difficult split in reality. The reason lies in the great difference in magnitudes between Regulus and its companion — a factor of more than four hundred times. Steadily mounted instruments carefully focussed will let you succeed though.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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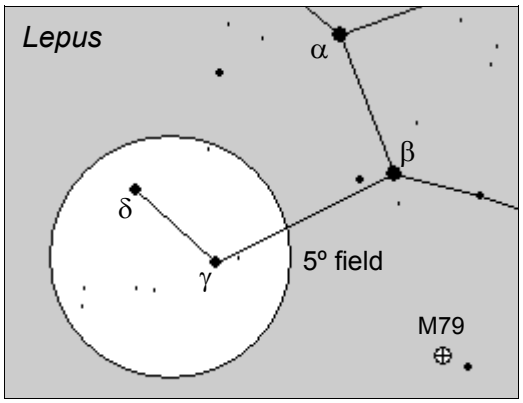
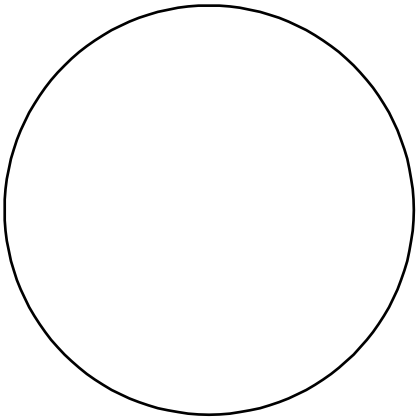
Lepus — Gamma — *double star* — easy



Gamma Leporis is a delightful double star for binocular observers. Gamma itself shines at magnitude 3·6 but in binoculars it is resolved into a beautiful yellowish and orange pairing separated by 96 arcseconds. The primary is a magnitude 3·6 F-type star while the secondary shines at magnitude 6·1. The sixth magnitude star 12 Leporis is seen half a degree to the northwest.

The brace are 29 light years away and are 20 times the distance of Pluto from the Sun apart so the period must be on a scale of thousands of years. No orbital motion has been detected in the system though they are known to be a genuine binary.

Burnham's *Celestial Handbook* notes that Gamma shares the same proper motion in the sky as Sirius and a number of other stars.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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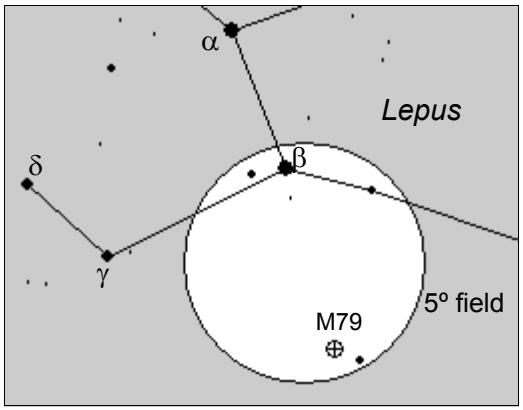
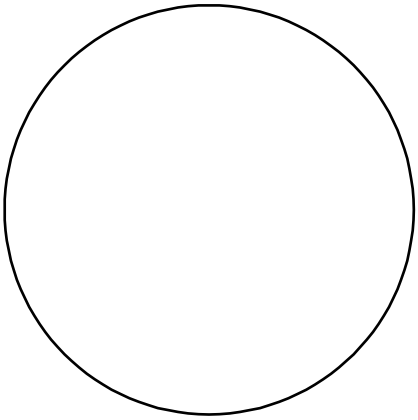
Lepus — M 79 — *globular cluster of the Winter skies* — moderate



Just below Orion is Lepus, the Hare, a constellation often overlooked because of the luminaries contained within the Hunter. You are missing out on some delights though. Place magnitude 2·8 Beta Leporis, or Nihal, at the top of your 5º binocular field and you'll find one treat, the globular cluster **M79**, positioned towards the lower part.

The cluster might be harder to see in lower power glasses but higher magnification instruments will reveal a hazy spot with a magnitude 5·3 star just a half degree to the southwest.

H.A. Rey, in his classic book "The Stars: A New Way to See Them", controversially redrew the join-the-dot system of constellation lines so that star patterns actually looked liked what they were supposed to represent. The style has its pros and cons but is ideal for the beginner to learn the constellations; Lepus, in Rey's system, is so obviously like a crouched Hare.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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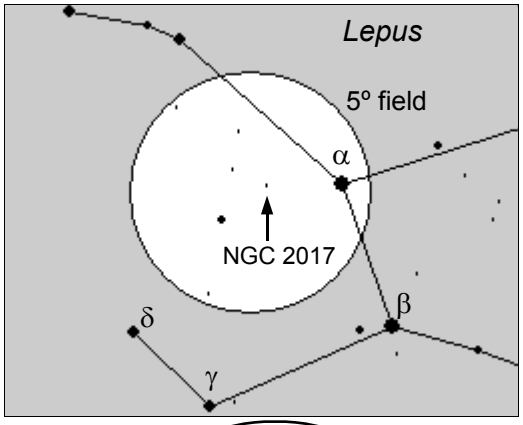
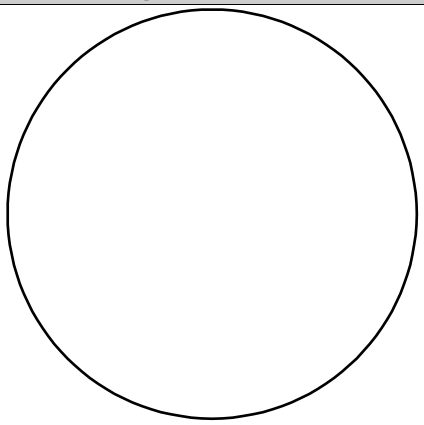
Lepus — NGC 2017 — *apparent multiple star* — moderate



This particular object is one of those non-existent star clusters that found itself with an NGC designation. Mis-identification with other objects, defects on photographic plates, poor resolution in a telescope, and other problems led to many spurious deep sky objects making their way on to the initial New General Catalogue drawn up by Dreyer. Some groups though have been working for some time to clean up these defects.

NGC 2017 itself is an apparent multiple system though we now know the stars are completely unrelated and a chance alignment. Look for it 1½° east of Alpha Leporis where you can spot four of its members in binoculars.

Since NGC 2017 is a bogus deep sky cluster your star charting software may not actually show it. The author noted this in Sky Map Pro (v. 6) although the object name is in the software's database and will be centred unlabelled on screen when you do a name search.



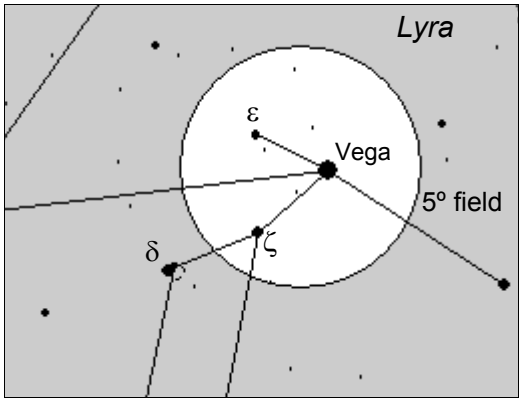
Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

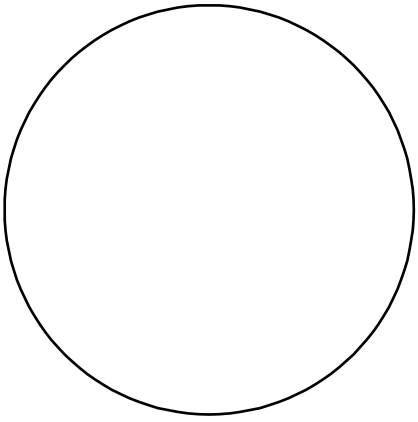
Notes _____

Lyra — Epsilon — *the "Double-Double"* — easy



One of the most celebrated multiple star systems in the sky is the reknowned "Double-Double", or **Epsilon Lyrae**. Located just 1¾° from brilliant, blue-white Vega, the two almost equal fifth-magnitude primaries are 208 arcseconds apart — wide enough for keen eyesight to split. Each is a double in its own right though a telescope is required to show the sum total of four members. The whole field is quite rich and the inclusion of Vega enhances the view.

The two pairs are physically separated by 10,000 astronomical units (an astronomical unit, or AU, is roughly the mean Earth-Sun distance. The true definition of the unit is a little more elaborate though). If you resided on a planet orbiting one of the pairs then each star of the other system would appear as bright in that alien sky as the Quarter Moon does to us (but with their light concentrated into an almost point source!) They would also be separated by just one degree of arc — truely, a remarkable sight.



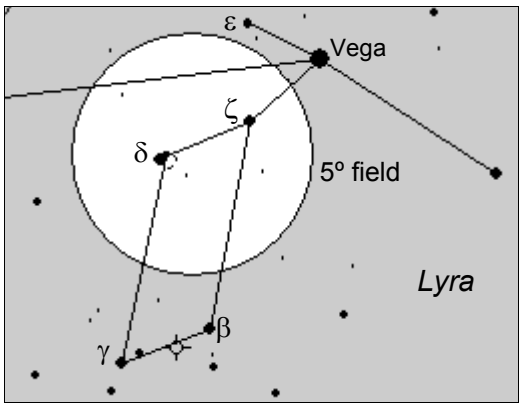
Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

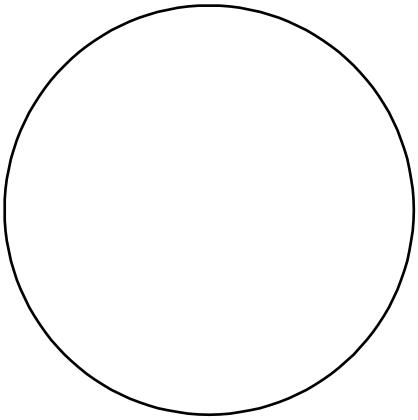
Lyra — Stephenson 1 — *scattered open cluster* — easy



Brilliant blue-white star Vega dominates the constellation Lyra. It anchors the corner of a parallelogram of four less bright stars, three of which, many observers are surprised to learn, are a binocular double star.

Stephenson 1 is a loose open cluster that counts orange Delta[1] and Delta[2] as members. The two stars are separated by 10½ arc minutes and a number of fainter suns are scattered across the field with the majority tending to congregate closer to Delta[1] in a vague triangular pattern.

Zeta is a nice with pair with magnitude 4·4 and 5·7 components. The fainter star is aquamarine in colour. **Beta**, a famous eclipsing variable, is a tight spectroscopic binary where the two components are so close they can only be seen by virtue of variations in the lines of the system's spectrum. A third, visible member glimmers at magnitude 8 but is difficult to resolve in smaller glasses as the glare from 3rd magnitude Beta almost overpowers it.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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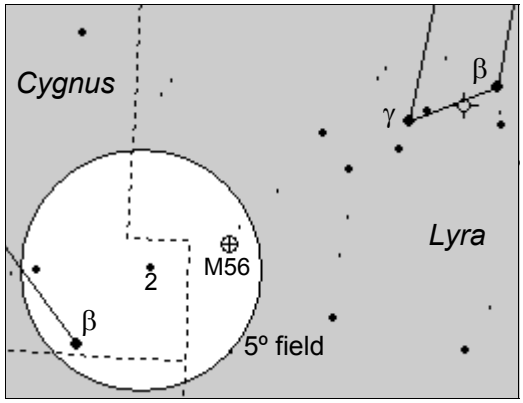
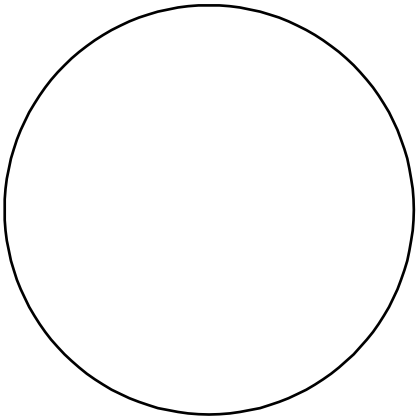
Lyra — M 56 — *globular cluster* — moderate



Half-way between Albireo (Beta Cygni) and Gamma Lyrae is a globular cluster that takes a little patience to tease out of the starry background. **M56** appears as a less condensed spot of hazy light than some of the other globulars highlighted in the handbook and under poor seeing conditions you might have a little trouble spying it in low power binoculars. A faint star is located at the western edge of the cluster but this is just in the foreground. The star doesn't appear to be marked in the older 1st volume of *Uranometria 2000.0* but is confirmed through checking the on-line Digital Sky Survey.

M56 is 32,900 light-years distant and estimated to be about 85 light years across. The surrounding field is peppered with many faint stars. Burnham's *Celestial Handbook* comments that Charles Messier himself found this cluster in January 1779 on the very same night that he discovered one of his comets. Messier's notes describe M56 as a "nebula without stars and having little light."



Observing Details

Date/Time _____ Instrument _____

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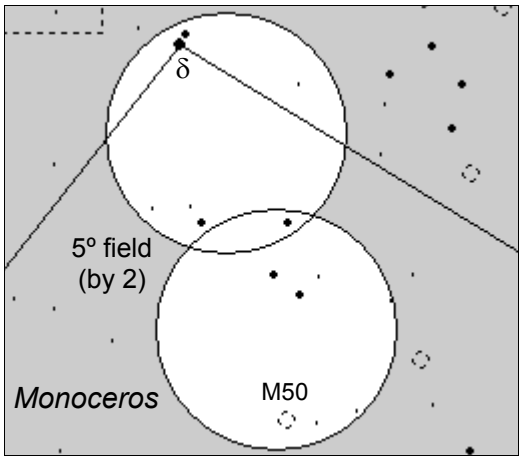
Monoceros — M 50 — *open cluster in the Unicorn* — easy

The oft overlooked constellation of Monoceros, the Unicorn, spans a particularly rich region of the winter Milky Way. Within its boundaries there are quite a few open clusters accessible to the binocular user. Only one though, **M50**, made it on to Messier's list of comet-like objects.

The cluster lies midway along a line joining magnitude 3·9 Alpha Monocerotis and magnitude 4·6 Beta. Look for a slight glow studded with a handful of the group's brighter suns. It forms a right-angled triangle with two sixth magnitude stars. M50 is about 3,000 light years away and contains some 200 members.

Dimming by interstellar dust means that the true brightness of the cluster is greater than what we see and adjusting for this factor allows us to estimate its age as being somewhere around 80 million years.



Observing Details

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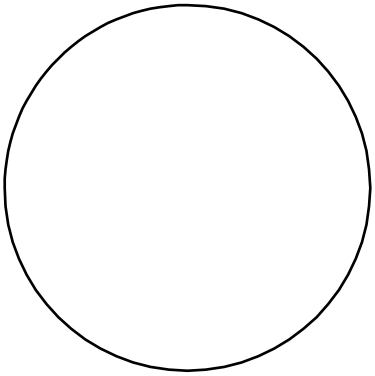
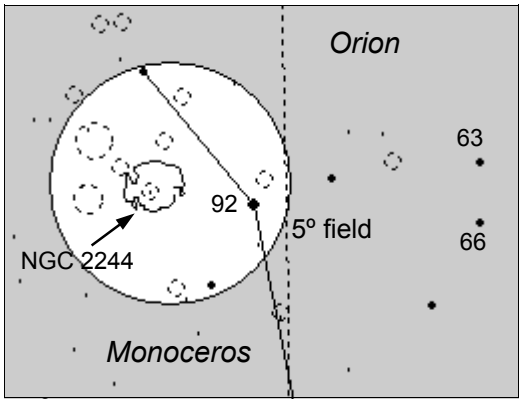


Monoceros — NGC 2244 — *open cluster in the Rosette* — easy

Long exposure photographs highlight the pinkish petals of the beautiful Rosette Nebula that wreathes this open cluster. **NGC 2244** is a particularly young swarm and star formation is still ongoing within the gas cloud in which it is embedded.

There are no bright reference stars nearby so the easiest way to find the cluster is to sweep 9½° south of east from Betelgeuse in Orion. What you should stumble across is a bouquet of sixth and seventh magnitude stars in a tight group. The brightest is 12 Monocerotis which is not actually a true cluster member but is in the foreground.

NGC 2244 is 5,500 light years away and the surrounding nebula extends over one degree of sky. Under very good conditions, large binoculars may detect the Rosette itself as a faint greyish patch of light.



Observing Details

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Location _____ Sky _____

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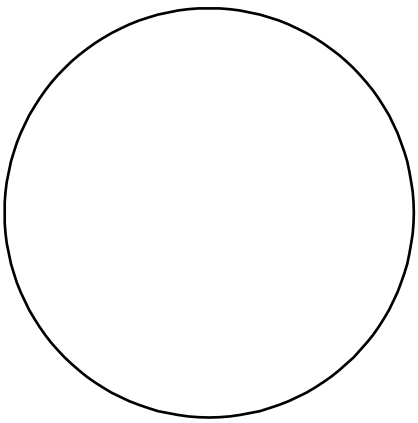
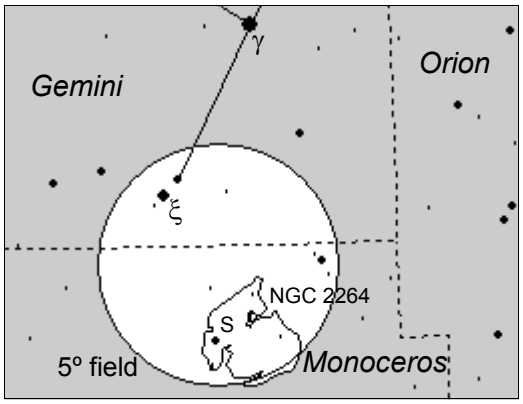


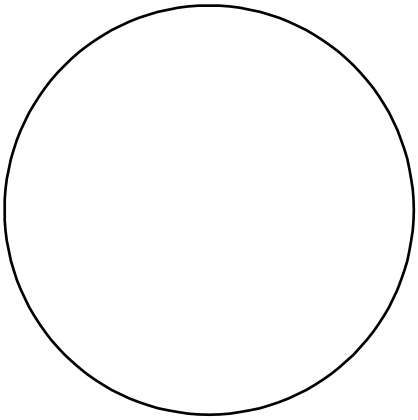
Monoceros — NGC 2264 — *the Christmas Tree cluster* — easy

Scan 3½° southwest of magnitude 3·3 Xi Geminorum to find **NGC 2264,** a sparse group of 15 or 20 bright stars arranged in an arrowhead shape — reminiscent of a Christmas tree which has become the moniker by which the group is better known.

Long exposure photographs show this area to be one of the most dramatic regions of the sky. The whole field in such detailed images is flocked with bright and dark nebulae.

The brightest star here is S (or 15) Monocerotis, an irregular variable star with a slight amplitude between magnitudes 4·5 and 5·0. William Herschel discovered the cluster in 1784 and the associated nebulosity in 1785. The gas clouds are too faint to be seen in binoculars however. NGC 2264 is 2,300 light years distant and is believed to be several million years old.





Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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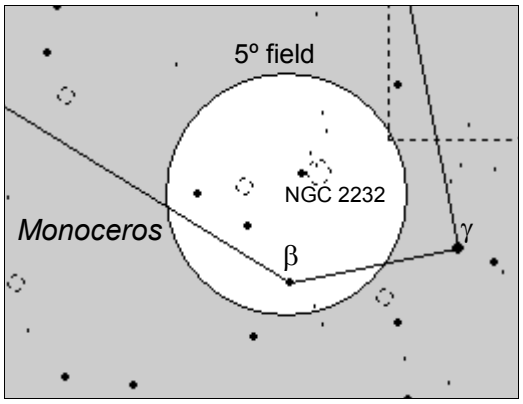
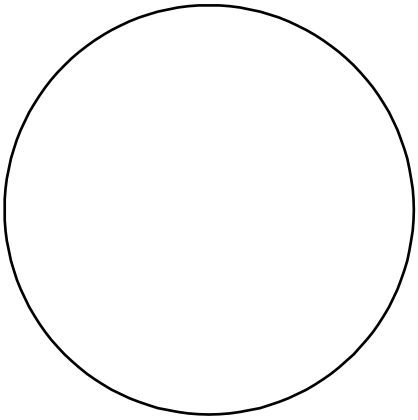
Monoceros — NGC 2232 — *open cluster* — easy

NGC 2232 is one of the minor clusters of Monoceros. The group is fairly sparse and can be found 2¼° almost due north of magnitude 4·6 Beta Monocerotis. Look for a number of stars set within a diameter equivalent to that of the Full Moon.

The brightest star is fifth magnitude 10 Monocerotis and the cluster lies 1,150 light years away. About 40 stars are classed as members and the age is given as 41 million years.

If you want to explore some of the other associations in this region of sky, an additional highlight is **NGC 2301**, a bright open cluster in a beautiful star field. The cluster is five degrees slightly north of west from Delta Monocerotis and binoculars show a short line of eighth magnitude stars. The brightest, almost in the the centre, has a slight orange tint.





Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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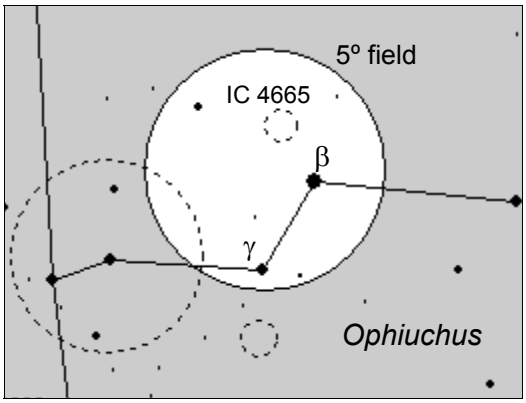
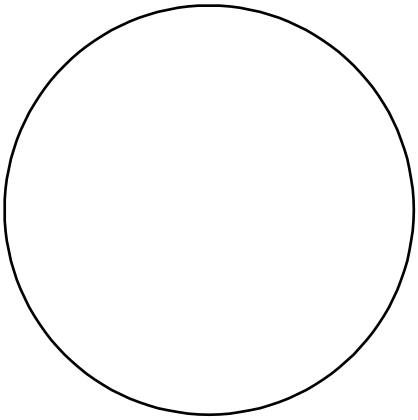
Ophiuchus — IC 4665 — *open cluster* — easy



Just 3° north of cream-coloured Beta Ophiuchi, or Cheleb, is the loose open cluster **IC 4665**. Use successively higher-power binoculars to see yet more of the numerous stars sprinkled across the scene.

The centre of the cluster has a nice chain of blue-white suns running across the field with a small arc of stars just below this. It gives the impression of a tiny celestial bridge spanning a tributary of the Milky Way. A small knot of stars at the southwestern edge of the cluster is reminiscent of a comet — a close pair of stars is seen embedded in a faint haze.

Nudge your binoculars slightly southeast of Beta and you come to Gamma Ophiuchi (magnitude 3·7) below which lies the sparse open cluster **Cr 350**. Larger instruments reveal a few eighth-magnitude members of the group. Indeed, the cluster is so loose that it is difficult to distinguish it from foreground stars randomly scattered across the field.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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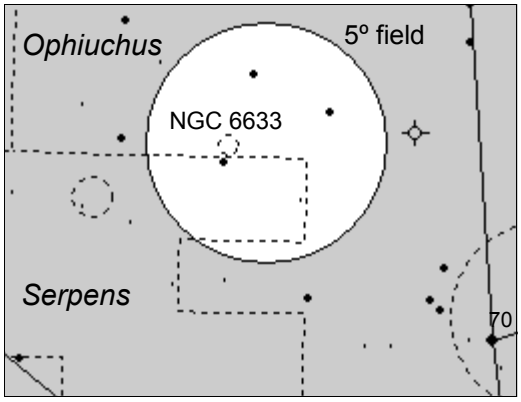
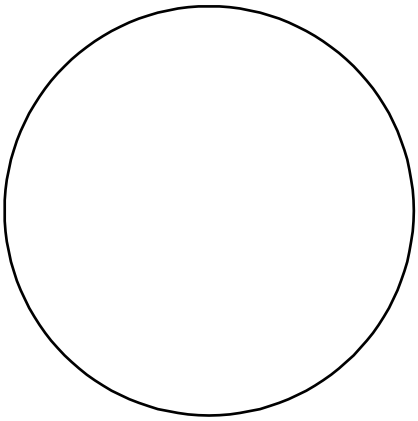
Ophiuchus — NGC 6633 — *open cluster* — easy



NGC 6633 is on the border of Ophiuchus and Serpens (Cauda) roughly halfway between 72 Ophiuchi and Theta Serpentis. A pair of 10x50mm binoculars resolves the cluster into numerous points of light all entangled in a misty haze – hinting at other members that lie just below visibility.

Linger a while and see if you can tease out various patterns in the way the cluster's stars are arranged. Fainter members will occasionally pop in to view when the seeing is less turbulent.

Some authors have commented on how could it be that Charles Messier overlooked NGC 6633 during the compilation of his catalogue of "nebulous" objects – though it was noted by Philippe Loys de Cheseaux in 1746. Indeed, it doesn't even rank a mention at all in Burnham's *Celestial Handbook* if that is one of your normal night sky references. It's a real shame because this is a gem of the Serpent Bearer.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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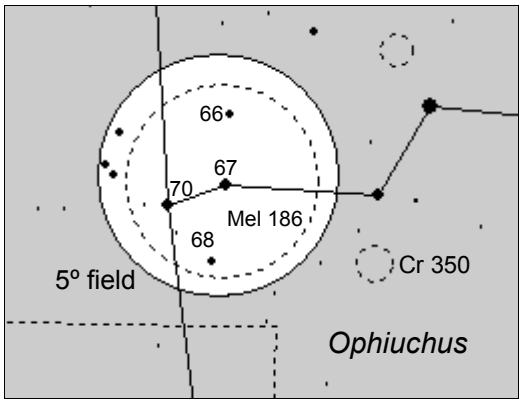
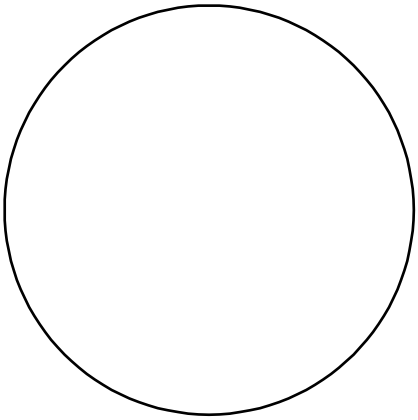
Ophiuchus — 70 — *in the region of a "lost" constellation* — easy



An arrowhead-shaped group of stars comprising of 67, 68 and 70 Ophiuchi with 66, slightly north of 67, ruining the symmetry, marks a defunct constellation known as **Taurus Poniatowski**. The pattern was devised by Bode in 1777 to honour Stanislaus Poniatowski, the then Polish king.

One of it's members, **70 Ophiuchi**, is a celebrated star in its own right. It was discovered to be a binary by Sir William Herschel in 1779 but a telescope is required to resolve the star into its components. It it also a relatively nearby star at a distance of only some 16.6 light-years and this makes it noteworthy as one of the few stars in the solar neighbourhood to be visible to the naked eye from our latitudes.

The whole extent of Taurus Poniatowski is part of a loose cluster known as **Mel 186** that measures 4° in diameter and is centred on 67 Ophiuchi. Numerous sparks are sprinkled liberally across the field.



Observing Details

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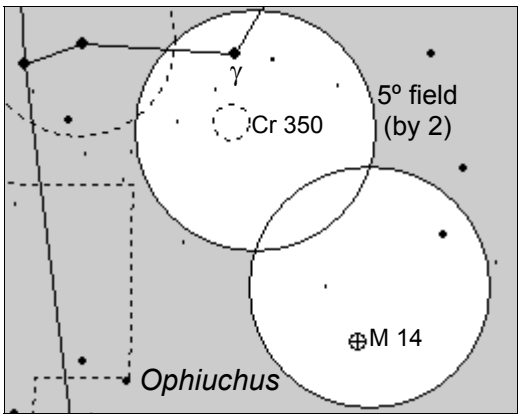
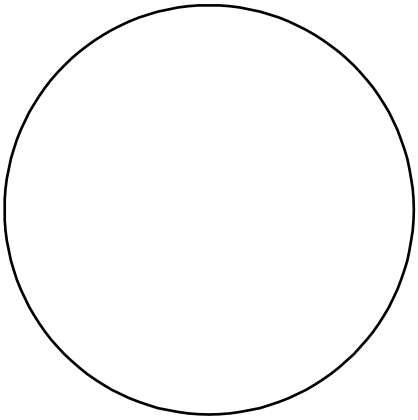
Ophiuchus — M 14 — *globular cluster* — moderate



If you've been successful in hunting down the M10/M12 pairing then you might like to try for **M14**, another Ophiuchus globular. It's not that hard to find; drop two 5 binocular field-widths down from Celabrai, or Beta Ophiuchi (also called Cheleb in some guides), and you should spot the subdued glow of the cluster a little off-centre of your field.

The cluster looks like a little ball of burnished steel wool and the harsher glow of the suns concentrated at the centre tapers towards the edges. It's roughly the same apparent size as M10 and M12 but not as bright. Look for a short line of faint suns immediately to the west while there appears to be a little knot of light just below the cluster but this a star near the limit of visibility.

M14 is the most distant of the Messier globulars in Ophiuchus at 45,000 light years or more than twice the distance from us to the galactic centre



Observing Details

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Location _____ Sky _____

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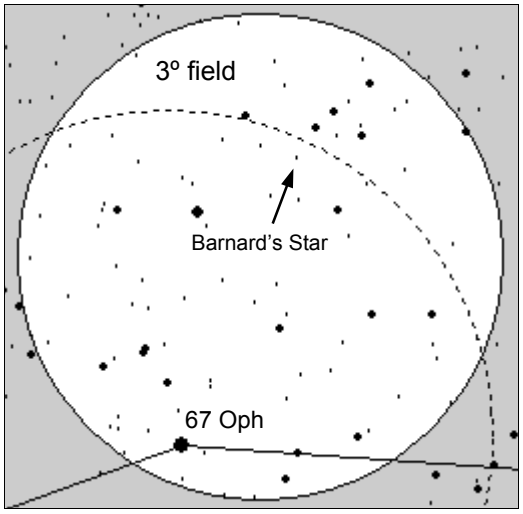
Ophiuchus — Barnard's Star — *stellar speedster* — challenge

Barnard's Star is a dim magnitude 9·5 red dwarf that has the highest proper motion (or apparent motion across the sky) of any charted star in the heavens. The famous American astronomer E.E. Barnard first noticed its character in 1916 when comparing plates made in 1894 and 1916.

He found that its annual motion is 10.29 arcseconds in a direction almost due north – meaning it covers a distance equivalent to the diameter of the Full Moon in only 175 years! Barnard's Star is also the second closest star to the Solar System (if you take Alpha Centauri as a single system).

One of the better chart's to help you locate the star can be found in the small pocket *Stars* book from the Collins Gem series (great value with a price tag of only about 8 euro). The Gem chart shows an arrowhead asterism in the field and the star is located a short distance southeast of this. Barnard's Star is surprisingly easy to see in larger binoculars.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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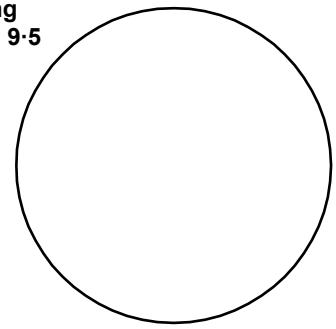
Limiting mag. = 9·5

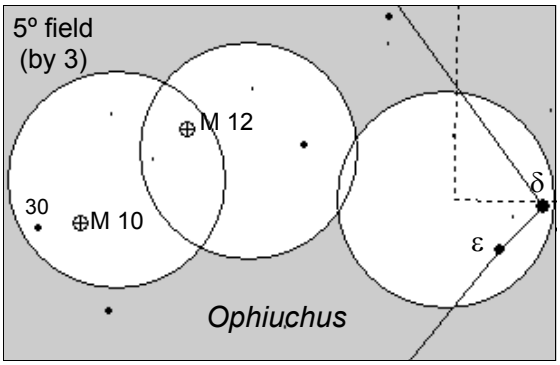


Ophiuchus — M 10/M 12 — *globular cluster duo* — moderate

Seven Messier globulars are in Ophiuchus — M9, M10, M12, M14, M19, M62, and M107. All are visible in binoculars but the easiest are the nice pairing of **M10** and **M12** in the torso of the Serpent Bearer.

There is no useful bright reference stars nearby to let you quickly spot the two but slowly scan about 10º east of the magnitude 3 pair of Delta and Epsilon Ophiuchi (known as Yed Prior and Yed Posterior respectively) and you should spot both globulars looking like fuzzy stars.

Although both appear similar in size, M12 is marginally brighter. Spend a little time studying the appearance of each though. Is our estimate of which is brightest correct? A faint pair of stars lies between both and you'll also see 30 Ophiuchi a little southeast of M10. The closer of the two globulars is M10 which is 14,000 light years away while M12 lies 19,000 light years distant.



Observing Details

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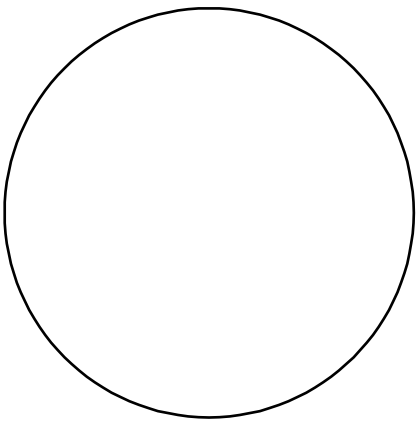
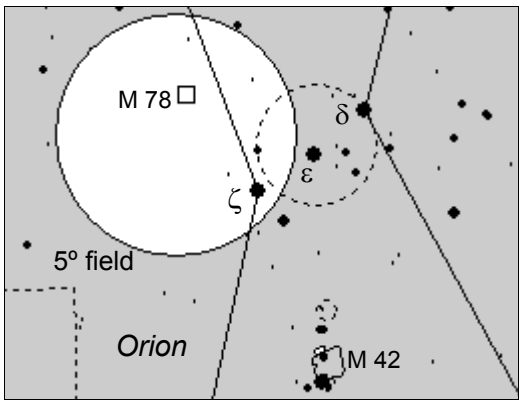


Orion — M 78 — *faint reflection nebula* — moderate

M78 in Orion is not on many casual observers' lists due to the proximity of the more illustrious M42, the Great Nebula. Phil Harrington mentions that it is a diffuse nebula and indeed it appears as an amorphorus glow through binoculars. Giant instruments may show two faint stars embedded within the threads of gas.

The nebula lies 2° northeast of Zeta Orionis, the easternmost of the Belt stars, and is one of the few reflection nebulae that is visible in binoculars. These nebulae shine by reflecting or scattering starlight.

The object came under intense scrutiny in February 2004 when Jay McNeil, a US amateur, discovered a new nebula nearby to M78. Astronomers found that this was a small reflection nebula associated with a very young star that underwent periodic changes in its light output.



Observing Details

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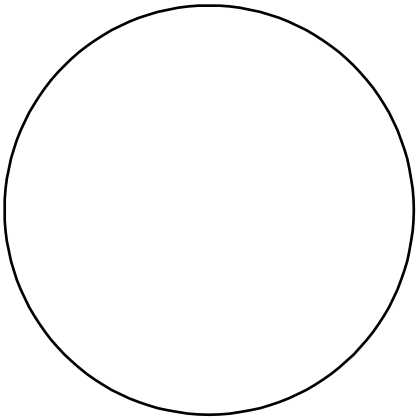
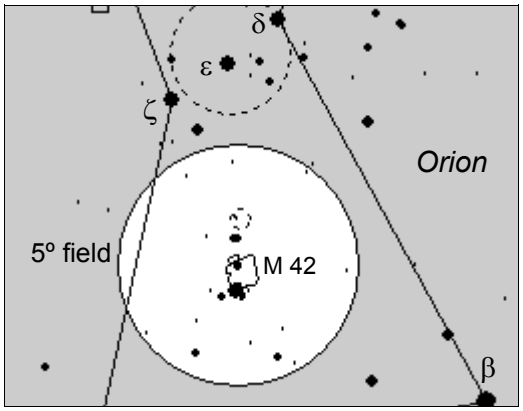


Orion — M 42 — *the Great Nebula* — easy

M42 never fails to elict a gasp of wonder. It's visible to the naked eye as a large amorphorus glow in Orion's Sword. In binoculars, beautiful tendrils reach out across the field and the fiery heart of the nebula in which the Trapezium stars are embedded hint at the birthplace of new suns. A tongue of dark material intruding, the so-called "Fishes Mouth", shows some detail.

It's a fine example, to quote Phil Harrington, that "even as an observer gains experience over the years, there will always be some aspect of M42 that has not been noticed before." Using the technique of averted vision, where you glance a little away from looking directly at the object, thus allowing the more sensitive part of you eye to be used, will let you tease out even more detail.

M43 appears a tiny detached portion of the Great Nebula almost immediately to the north.



Observing Details

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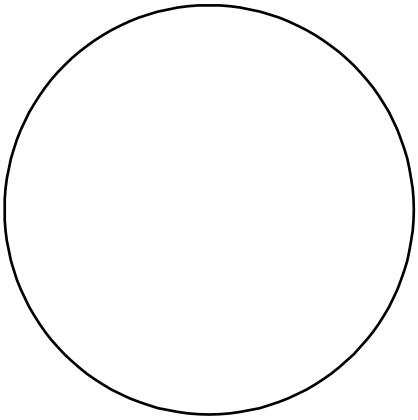
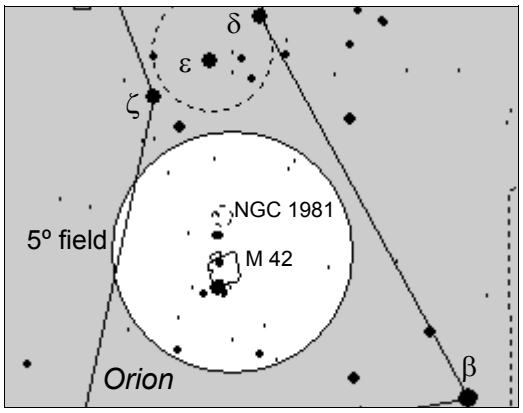


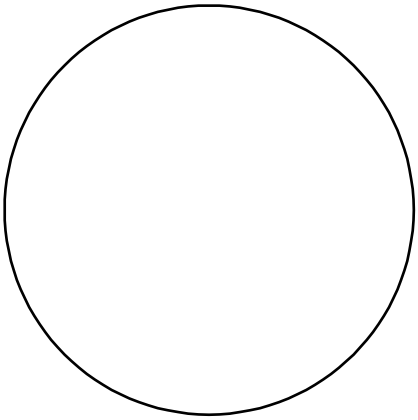
Orion — NGC 1981 — *cluster in the Sword* — easy

Just north of the Orion Nebula is a sprinking of stars making up the cluster **NGC 1981** — the two actually fit in the same field. Many of us have probably seen the cluster before but failed to recognize its true nature. Low power binoculars give a great impression. The group appears as a zig-zag of stars across the field with about a dozen or so seen in all. The cluster lies about 1,500 light years from Earth.



Just to digress a little, many of the stars in this region, and indeed most of those in Orion, are all part of a larger feature called **Gould's Belt**. This is a "spur" of the Milky Way inclined 20° to the galactic plane.

The belt comprises many of the bright stars of Canis Major, Carina, Perseus, and other constellations too and is a region of starbirth that started about 30 million years ago centred on the Alpha Persei Association.



Observing Details

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Location _____ Sky _____

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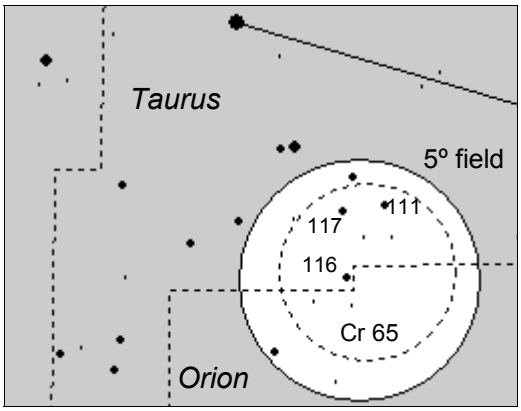
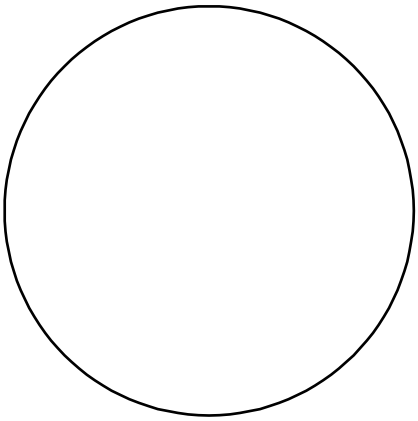
Orion — Cr 65 — *open cluster* — easy

On the edge of the boundary between Orion and Taurus is the open cluster **Cr 65** — it is in fact centred on the star 116 Tauri and spans about 2°. Its looseness means that lower power binoculars are needed to confirm its true nature as a cluster rather than a chance smattering of stars. Scan the area 5½° southwest of Zeta Tauri and you should spot this sparse group.



With the winter Milky Way flowing past eastern Orion there are a handful of other open clusters within that you can hunt. A good star atlas will help you identify many more than that highlighted here.

Nudge your binoculars eastwards towards the upraised "club" of Orion and you will find **NGC 2169**. Large binoculars reveal it as a dim patch with a couple of brighter members of the cluster just visible. The cluster is just a little below a line joining Xi and Nu Orionis.



Observing Details

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Location _____ Sky _____

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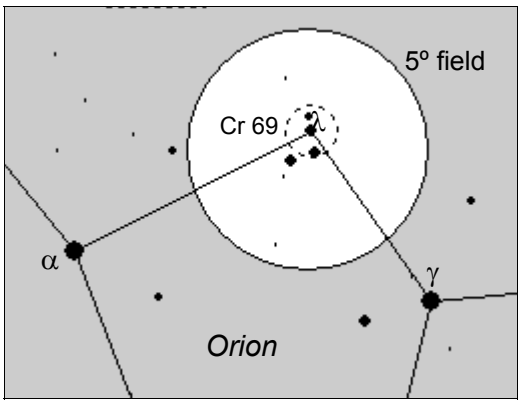
Orion — Cr 69 — *mistiness in Orion's head* — easy



In the northern part of the constellation, marking the "head" of Orion, is the star Lambda Orionis which is the brightest member of a loose grouping of fainter points of light. Catalogued as **Cr 69**, long exposure photographs highlight puffs of gas surrounding this patch of sky.

Binoculars will show a number of fainter suns clustered around magnitude 3·5 Lambda which itself is nested in a shell of gas 150 light years across. All told, some 20 stars are part of Cr 69, also dubbed the Lambda Orionis Association.

Lambda is a tight double consisting of a brilliant O-type sun separated by 4" from a magnitude six B-type star. The primary has a surface temperature of 35,000ºK and radiates more than 65,000 times the energy of the Sun. The Lambda pair will eventually end their short lives as supernovae.

Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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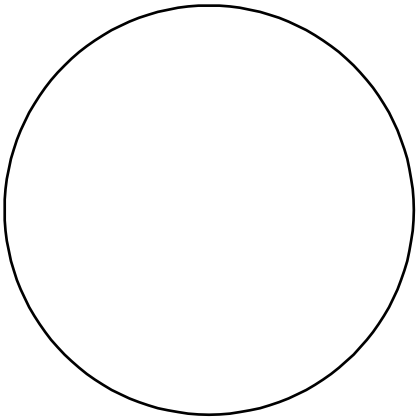
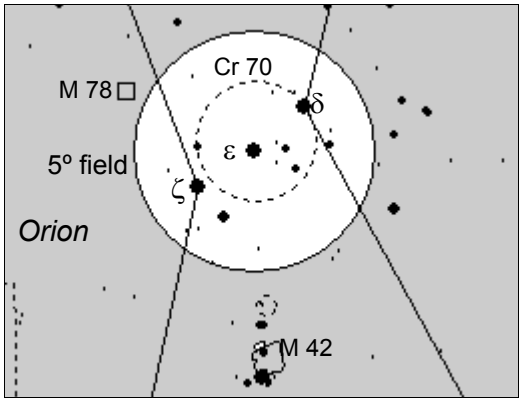


Orion — Cr 70 — *stars of Orion's Belt* — easy



The cluster **Cr 70**, many are surprised to learn, comprises the three Belt stars in Orion and the surrounding star field.

Cr 70 spans a diameter of three degrees so binoculars are a must to be able to take in the full view. In all, some 100 stars are in the cluster with most brighter than tenth magnitude. It's a magnificent sight.

Look for some double stars are are members of the group including the multiple star system Sigma Orionis which has five components in all. The sixth magnitude E component is separated by 42 arcseconds from the primary.

Sigma itself is 5,000 times as luminous as our Sun and even the visible companion is 600 times as bright.

Observing Details

Date/Time _____ Instrument _____

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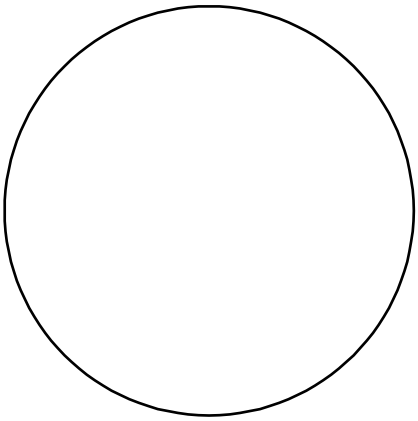
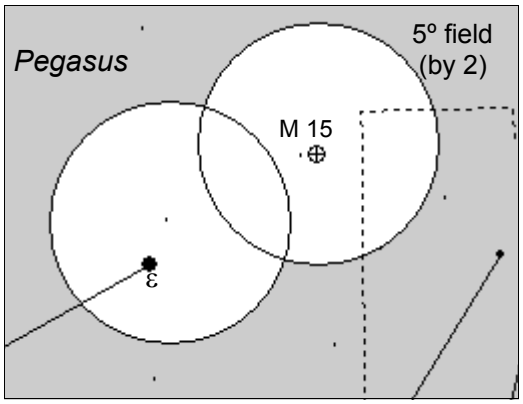


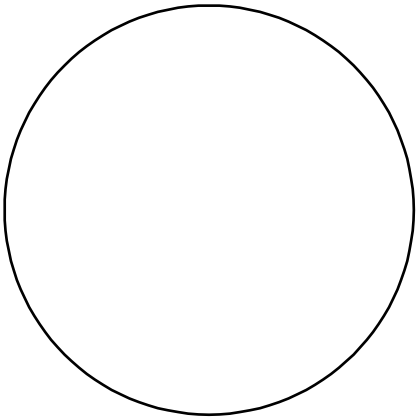
Pegasus — M 15 — *a globular cluster to rival M 13* — easy



M15 is a bright globular that rivals the better known M13 in Hercules. The cluster appears as a fluffy 6th magnitude spot of light in binoculars set within a field of three relatively bright stars forming an isoceles triangle. Make a note of which one M15 appears closest to in your sketch of the scene.

To find this delightful object you just need to wing your way less than four degrees northwest of magnitude 2·4 Epsilion Pegasi, or Enif (itself a binocular double with an 8·4m companion 143 arc-seconds distant.) Lower power binoculars will let you fit Enif and the cluster in the same field.

The cluster is 33,600 light years distant and about 175 light years across. It was also the first shown to harbour a planetary nebulae, Pease 1, recorded on photographic plates taken in 1927. There are strong hints too that a black hole resides at the core. Half the mass of M15 is packed into a sphere 10 light years across so close encounters between stars there must be common.



Observing Details

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Location _____ Sky _____

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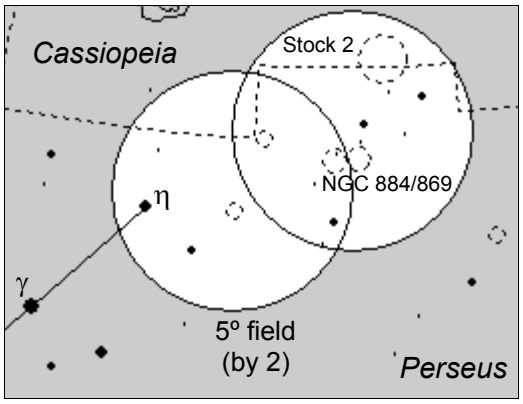
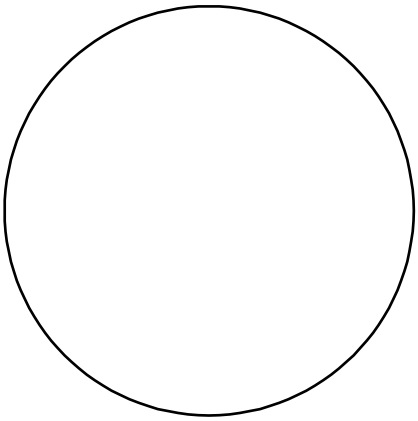
Perseus — NGC 884/NGC 869 — *the Double Cluster* — easy



An object, or rather, a dual object, visible to the naked eye is the famed **Double Cluster**. Also cataloged as NGC 884 and NGC 869, they were first noted by the Greek astronomer Hipparchus.

It is worth lingering awhile to savour the view of the duo in binoculars. NGC 869, the westernmost of the pair, is more concentrated and a nice long chain of bright stars sweeps away to the northwestern edge of the field.

You'll find conflicting information on whether the two are genuinely associated. Current thinking places NGC 869 at a distance of 7,100 light years while NGC 884 lies at about 7,500 light years. Both are very young with ages measured at only 5.6 million years for NGC 869 and 3.2 million years for NGC 884. They may have formed in the same giant interstellar gas cloud because of an apparently similar proper motion through space but over time have dispersed slightly from their stellar nursery.



Observing Details

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Location _____ Sky _____

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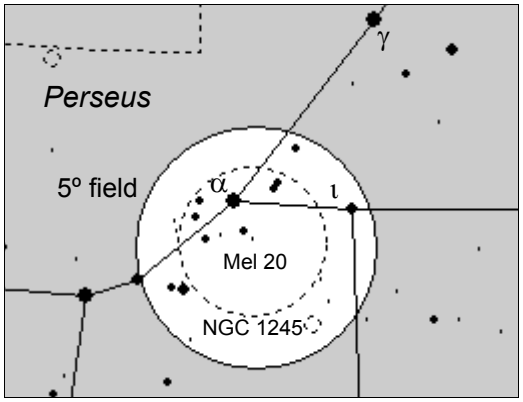
Perseus — Mel 20 — *star lights, burning bright* — easy

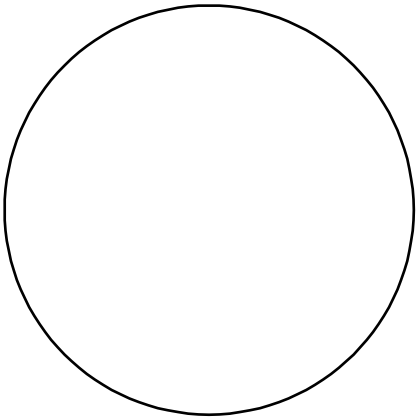
Sprinkled around magnitude 1·8 Alpha Persei, or Mirphak, are the brillant blue-white suns of **Mel 20**. Mirphak is an orange supergiant marking the heart of this association also known as the Alpha Persei Moving Cluster.

The cluster marks a region of space where an intense burst of star formation is believed to have been triggered some 30 million years ago.

Many of the stars of the Alpha Persei group are powerful hot blue-white suns classified as types O and B in the spectral sequence and burning their nuclear fuel at a prodigious rate. Other stars of the constellation are also part of this association – including Delta, Psi, 29, 30, 31 and 34 Persei.

Almost lost in the swarm of the Alpha Persei group is **NGC 1245**. It appears as a big squashed circle of stars with a prominent yellowish sun marking one edge. NGC 1245 can be found about 3° southwest of Mirphak.





Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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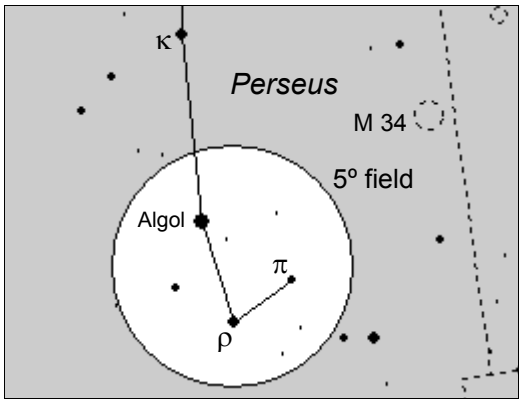
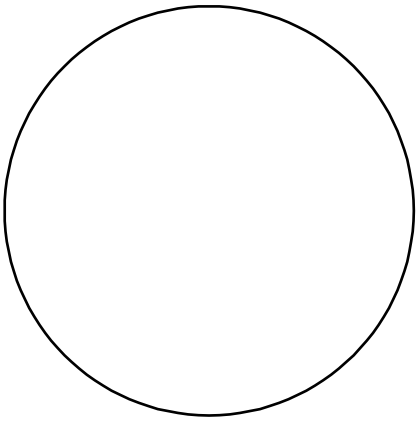
Perseus — Algol — *an eclipsing binary* — easy

Algol, or Beta Persei, is one of the most famous variable stars in the sky. The term is used to describe stars that vary in brightness over time. There are two causes; either the star changes in actual output of energy or the star itself may remain unchanged but some other material or body gets between us and the star. The latter are called eclipsing variables.

Although Algol appears as a single star in any Earth-based telescope it is known to consist of two stars of unequal brightness quite close to and revolving around each other. The faint one eclipses the bright one once in every orbit and so we see the light drop. This happens every 68 hours and 49 minutes. During most of the time Algol remains bright but then over a period of about ten hours it loses and then regains three quarters of its light.

Your challenge? Track the variations with the naked-eye or binoculars. Use the AAVSO web site at www.aavso.org to pick suitable comparison stars.





Observing Details

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Location _____ Sky _____

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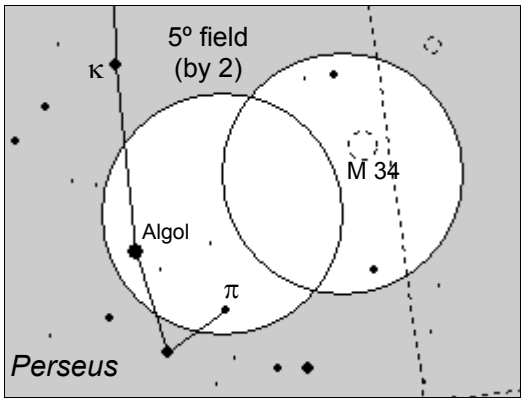
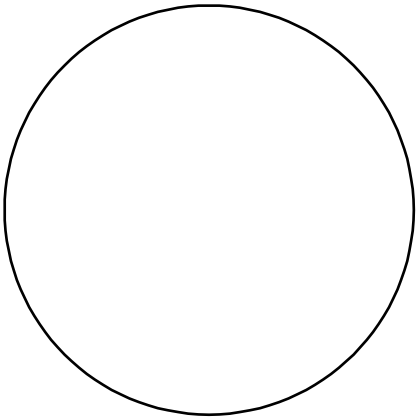
Perseus — M 34 — *splashy open cluster* — easy



M34 is a lovely galactic cluster found almost halfway along a line joining the variable star Algol and Gamma Andromedae. To be exact, it's a couple of degrees to the north of this line and there should be little difficulty in finding it.

Larger binoculars show a central glow boxed in by a rectangular arrangement of a few bright stars with this then surrounded by a heart-shaped (or pear-shaped) group of more brilliant suns. It's a delightful object that repays careful study.

The cluster lies 1,400 light years away and is about 180 million years old. Interestingly, M34 shares the same spatial motion with the Pleiades, the Alpha Persei group, Stephenson 1, and some other clusters. This has led some astronomers to class these groups as part of a "local association".



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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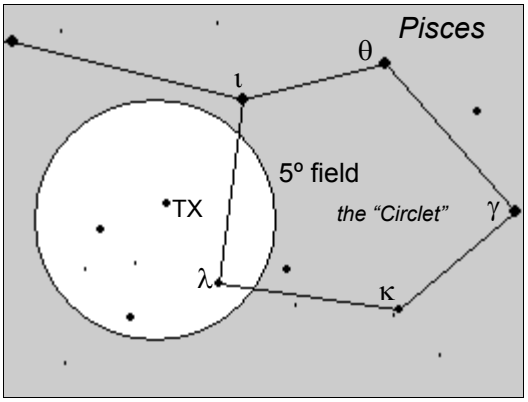
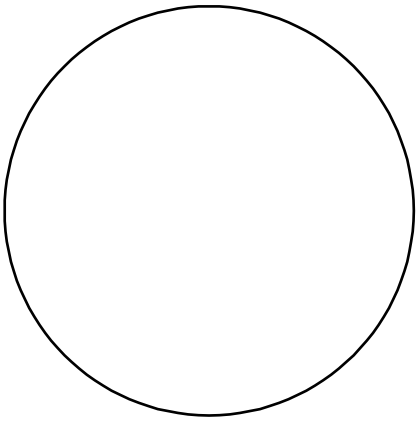
Pisces — TX Psc — *Carbon star in the "Circlet"* — easy



Although not as red as other Carbon stars – appearing more "yellow-orange" to the binocular user – this is one of the easier such suns to find because of it's location in the "circlet" of stars of the easternmost celestial fish.

Also catalogued as 19 Piscium, this fifth magnitude star is slightly variable and lies at a distance of 760 light years. Like other Carbon stars, it is a giant and the radius is twenty percent larger than that of the Earth's orbit. The surface temperature is 3050°K.

Nearing the end of its life, 19 Piscium is converting helium at its core into carbon. Convection currents dredge the carbon up from the centre where it enriches the outer layers of the star and, in various molecular forms, proves to be efficient at absorbing blue wavelengths of light.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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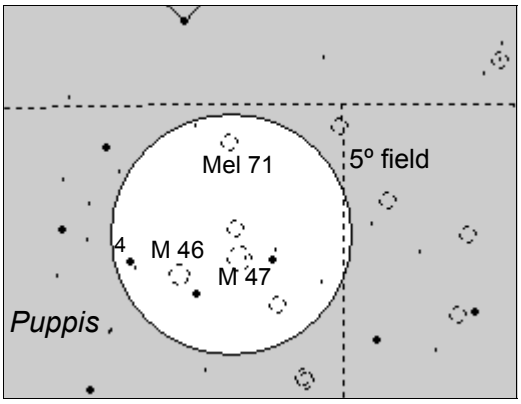
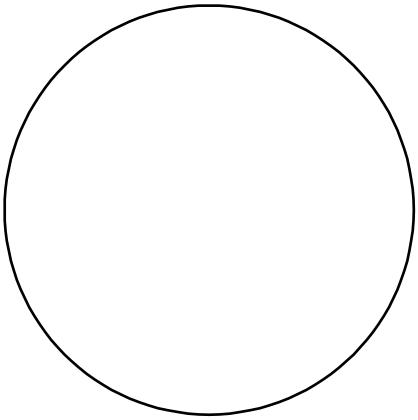
Puppis — M 46/M 47 — *delightful cluster pairing* — easy



You'll never tire of the pairing of the two open clusters **M46** and **M47**. The duo are in northern Puppis, set in a rich winter Milky Way field. The easiest way to find them is probably to scan three binocular field widths east from brilliant Sirius and just nudge your instruments a little north after the final "hop".

The sight is dramatic with M46, to the east (left), showing as a milky blur of light studded with the brighter members of the group. M47 on the other hand is much looser and beautifully resolved. It's one of the finest deep sky sights for binoculars and well worth spending a little time absorbing the view. Just 2½º above the pair is **Melotte 71**, a much more distant cluster that appears as an indistinct smear of light.

The two clusters are not physically associated though; M46 is 5,400 lights years away while M47 is a little closer at 5,200 light years.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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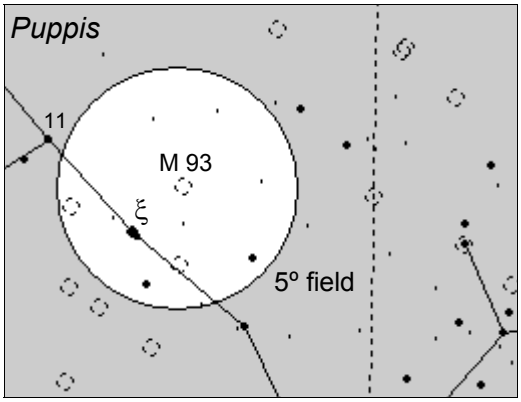
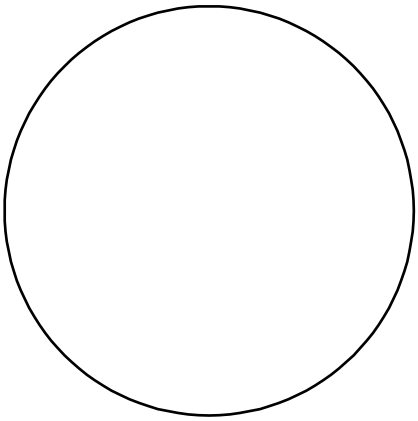
Puppis — M 93 — *comet-like open cluster* — easy



M93 is a beautiful telescopic cluster showing two lovely chains of stars tapering almost to a point with a smaller thread of suns pointing away from one of the curves.

The lower powers afforded by binoculars show those converging chains blurring into a ghostly comma with some of the more brilliant stars speckling the foreground. The cluster can be found 1½º northwest of magnitude 3·3 Xi Puppis, a yellow supergiant with a luminosity of 5,800 suns. The whole field is peppered with many faint stars.

M93 lies 3,600 light years away and contains about 80 members with the brightest classed as blue giants of type B9 on the HR diagram. They are relatively youthful stars — 100 million years old with luminosities 10,000 times that of the Sun — racing through their life-cycle at a furious rate.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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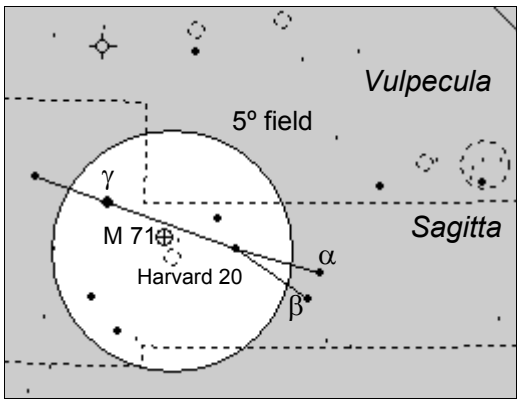
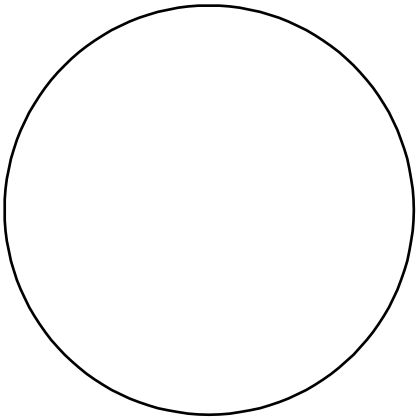
Sagitta — M 71 — *an identity crisis cluster* — moderate



For many years, **M71** in Sagitta was an object that defied classification though it was believed to be a very compact and rich open cluster.

Now, the general consensus is that it is a loose globular cluster. What makes it particularly difficult to pigeon-hole this object is that many sources differ in their surveys of M71. The most recent estimate is that it lies 13, 000 light years away which would make it extremely remote if it was an open cluster. As a globular, analysis of it's stars shows they differ in a number of ways from those making up the general population of such a class of object.

M71 is found in the same field of view as Gamma Sagittae. Look about 1¼° to the southwest of the star and you'll see the cluster as a broad glow of moderate brightness elongated in a north-south direction. A small triangle of suns lie just to the west with another brighter star capping the trio, making for an attractive field in this rich section of the Milky Way.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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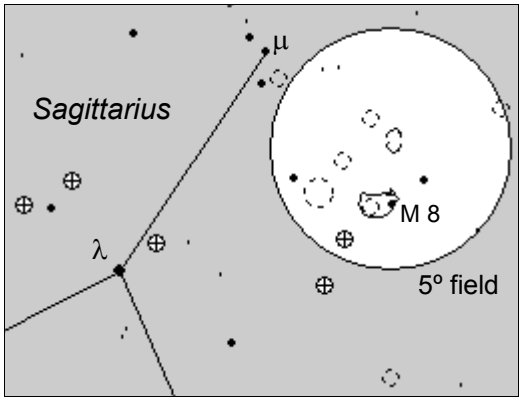
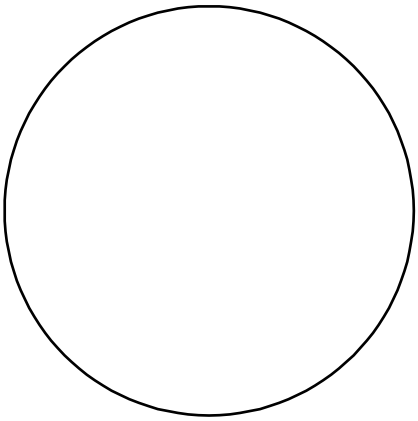
Sagittarius — M 8 — *the Lagoon Nebula* — easy



M8 is a wonderful complex of dark and light. This star-birth region is easily visible to the naked eye though its low altitude from Ireland means that you require the horizon reasonably haze-free.

Through binoculars, M8 appears as an elongated greenish-glow broken into segments by dark gas clouds that intrude across the front of the nebula. The great visual observer E.E. Barnard actually labelled each of these dark ribbons separately in his catalog. You'll also see the open cluster **NGC 6530** nested within the nebula These stars were physically born here and are classed as OB-type.

A sprinkling of brighter suns is seen towards the western edge. One of these, 9 Sagittarii, is believed to be one of the most luminous stars in the Galaxy and pumps out as much energy as 1·5 million Suns in just one second.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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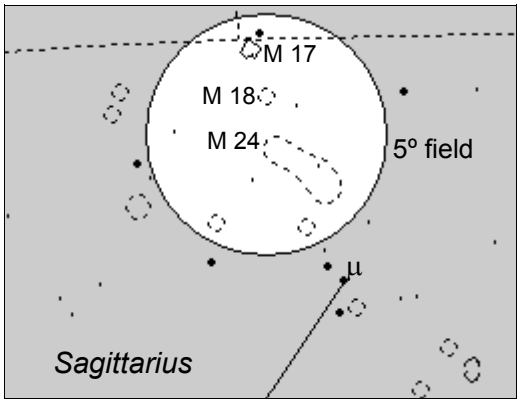
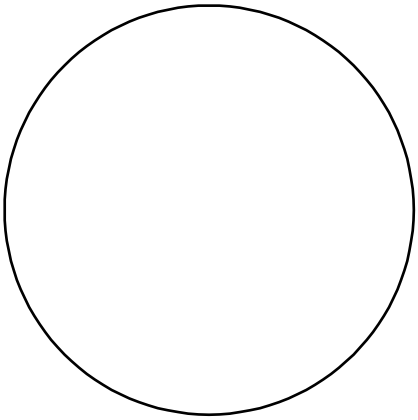
Sagittarius — M 17 — *the Swan Nebula* — easy

The **Swan, or Omega, Nebula** is a region of star birth 5,000 light years away that is lit by the hot, young suns forming within the gas cloud. Long exposure photographs show the typical pink-red glow of hydrogen gas excited to glow at a particular wavelength of light.

The nebula is in the same low power binocular field as magnitude 4·6 Gamma Scuti but a better bet might be just to train your binoculars on the M24 star cloud and you'll spot M17 towards the top of the field.

What you should see is an east-west orientated grey "bar" of light with a stubby extension on the southwestern edge. Deep field images show the classical slender curved "neck" and "body" shape that give this nebula it's nickname. A small group of stars is just off the northern edge while a magnitude 5·3 sun is just to the northwest.





Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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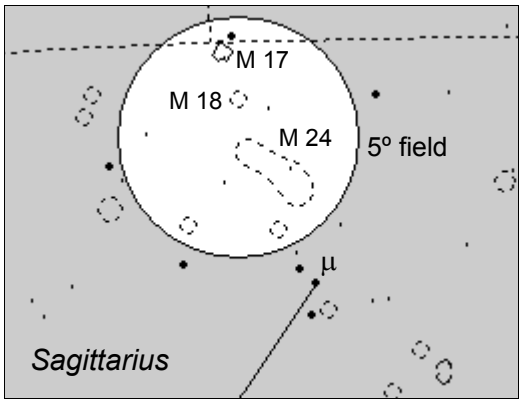
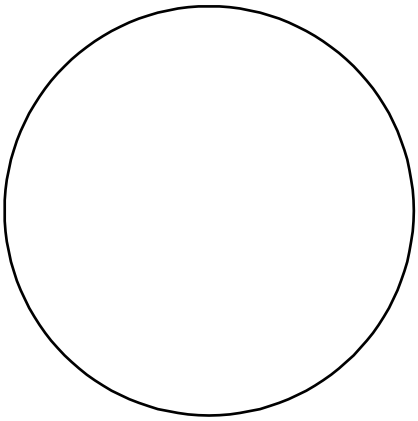
Sagittarius — M 18 — *open cluster* — easy

M18 is a lovely star cluster that lies in the same low power binocular field as the Swan Nebula and the Sagittarius Star Cloud — it's set about midway between the two objects. This is a lovely juxtaposition of a star cluster, nebula, and Milky Way star cloud.

A handful of bright stars is seen with the light from the rest of the members of the group combining as a faint background glow. To the west there is a particularly rich star field studded with a number of magnitude 6 suns.

M18 is quite a young group with an estimated age of 32 million years. The cluster lies 4,900 light years away. Deep field photographs of the region reveal some wisps of gas that may be some material left over from the formation of the cluster's stars.





Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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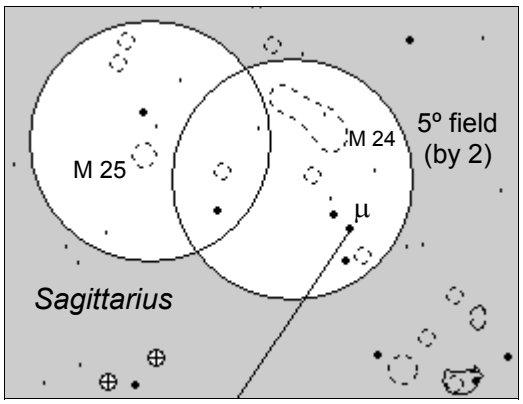
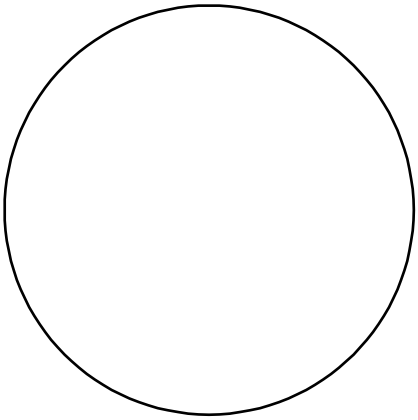
Sagittarius — M 25 — *open cluster* — easy



M25 is a beautiful loose open cluster for binoculars and can be found 3¼° almost due east of the Small Sagittarius Star Cloud, M24. Two bright stars will be seen at the top edge of the association with a fainter sun in between. The Cepheid variable star **U Sagittarii** lies at the heart of the group and fluctuates between magnitudes 6·3 and 7·1 over a period of 6·74 days.

A prominent feature of the cluster is the way the stars appear to be arranged in two curved chains backing each other – one observer commented to the author that they looked like two brackets back-to-back and indeed this is a very apt description. The stars in the upper chain are noticeably brighter than those of the lower.

The cluster was discovered in 1745-46 by Philippe Loys de Chéseaux and is about 2,000 light years distant. Although not a particularly rich group with only about 90 stars claiming membership, it's distinctive shape is appealing.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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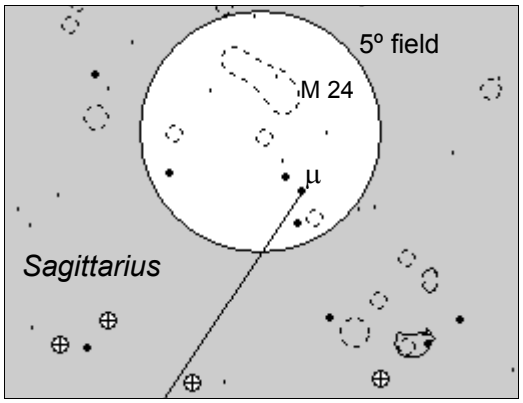
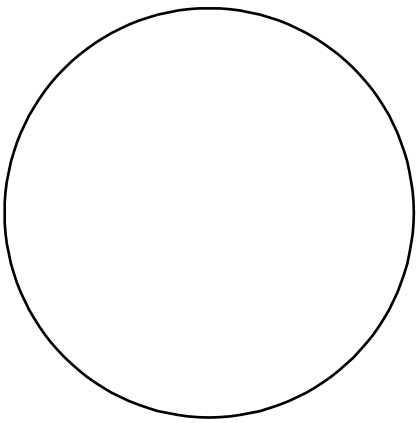
Sagittarius — M 24 — *the "Star Cloud"* — easy



M24 seems to be a bright detached wedge of the Milky Way in northern Sagittarius. There is almost a grainy texture to it's appearance and low power binoculars reveals a rich number of stars scattered across the field. The brighter suns can be connected to form a trellis garden fence shape orientated NE-SW with the southwestern edge rich in faint stars. The whole area constitutes a portion of the Sagittarius-Carina spiral arm that lies at a distance of 10,000 to 16,000 light-years.It's a stunning sight in any power binoculars.

A number of dark nebulae are easily visible as shadowy prongs intruding into the western and northwestern periphery of the star cloud. They appear as jet black ribbons against the faint glow of a multitude of unresolved Milky Way stars. The more prominent ink blot is known as **Barnard 92**. Tucked away in the star cloud is the condensed open cluster **NGC 6603**. Look for a small smudge of light northeast of the centre of M24.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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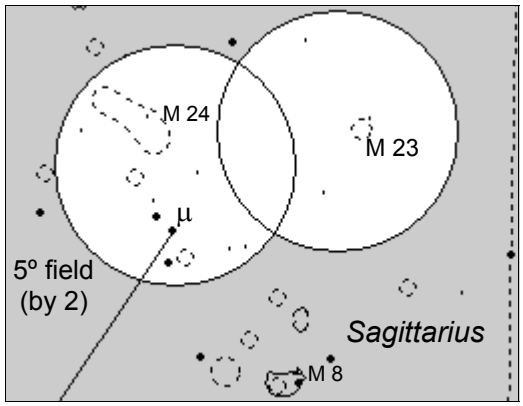
Sagittarius — M 23 — *open cluster* — easy



The scattered open cluster **M23** lies 4º to the northwest of the Lagoon Nebula/Trifid Nebula complex and is beautifully resolved in binoculars. If you are having a lot of trouble finding it then you just need to scan 5º to the right (west) of the M24 star cloud.

Numerous faint suns are arranged in winding chains while a magnitude 6·5 blue-white star a short distance off the northwestern edge is probably unrelated. The members are strewn over roughly a half-degree of sky — a scene that led C. E. Barns in 1929 to gush that it was "a blazing wilderness of starry jewels". Larger binoculars yield a superb view of this object.

M23 was discovered by Charles Messier on June 20, 1764 and has been found to lie at a distance of 2,150 light years. Burnham, in the third volume of his *Celestial Handbook*, writes that the majority of the group is made up of somewhat reddened main sequence stars.

Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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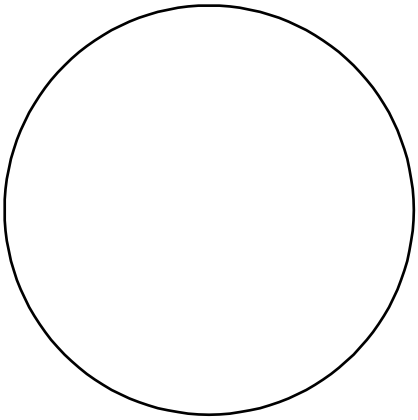
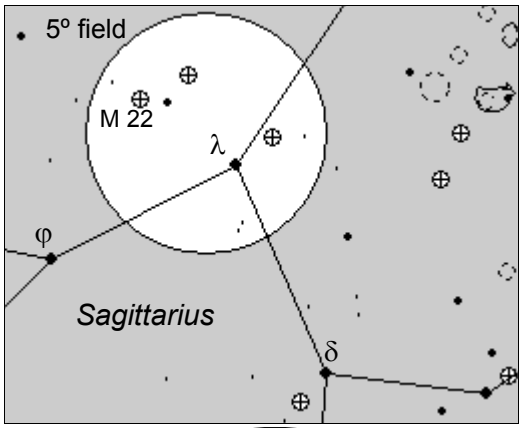


Sagittarius — M 22 — *a bright globular cluster* — easy



The premiere globular cluster of Sagittarius has to be **M22**. It's a magnificent object but few people have seen it from our latitude — maybe there is a suspicion it is just too low in the sky. Nothing could be further from the truth and once you see this huge starry globe you'll wonder aloud about whether M13 deserves the title of best globular in the Northern Hemisphere. It's an interesting point as each has their merits for visual observers.

M22 certainly has a greater apparent diameter than the Hercules cluster. It also appears uniformly bright across it's extent, appearing as a smudged out greyish glow. There is no obvious central condensation either and larger glasses will easily reveal it distinctly oblate in shape due to the rapid rotation of the cluster.

Keep Lambda Sagittarii (Kaus Borealis) at the bottom right edge of your binocular field and you should see M22 about 2½º to the northeast.

Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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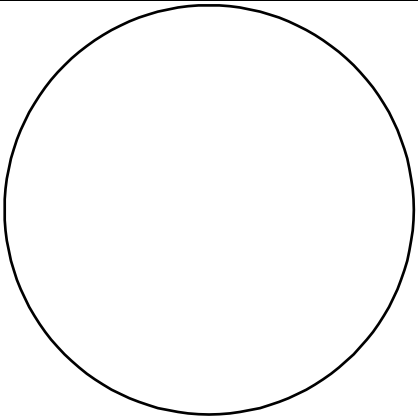
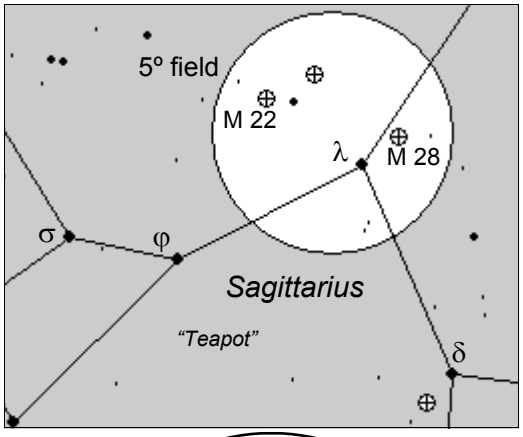


Sagittarius — M 28 — *globular cluster in the Archer* — moderate

The globular cluster **M28**, a degree to the northwest of Lambda Sagittaii (Kaus Borealis), is overshadowed somewhat by the more prominent M22 further east. Both are visible in the same medium to low-power binocular field and this will allow you make some comparisons between the two.

M28 appears as a dim hazy magnitude 6·8 spot condensed towards the centre. The visibility of the cluster is very much dependant on sky conditions and summer horizon haze can reduce it to a very feeble glow. It's worth observing the cluster more than once to get a feel for how atmospheric transparency can impact your views of this, and other, objects.

M28 was discovered by Charles Messier in July, 1764. It is heavily obscured by interstellar dust in, and near, the plane of the Milky Way with the most recent distance estimates placing it 18,300 light years away.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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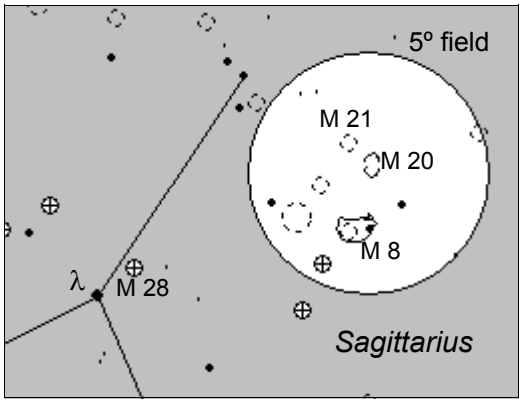
Sagittarius — M 20/M 21 — *nebula/open cluster* — moderate

A trio of Messier objects all fit in the same binocular field but we'll treat M20 and M21 as a "dual" object for the purposes of this highlight. The pair are slightly over 2½ ° southwest of the magnitude 3·8 star Mu Sagittarii.

M20, the Trifid Nebula, appears as a small ghostly glow centred on a seventh magnitude star that marks the one of the "fins" of a northeast pointing arrow-shaped group. It's a lovely sight but steadily mounted binoculars will be needed to gradually tease out the dim blur that is the gas cloud. The star that excites the nebula is ADS 10991, a triple system of extremely hot suns.

M21, a sparse open cluster, is a little easier and can be seen sprinkled around the star marking the tip of the aforementioned "arrow" pattern. Varying estimates exist for the distance to the cluster though it is believed to be about 4,250 light years away.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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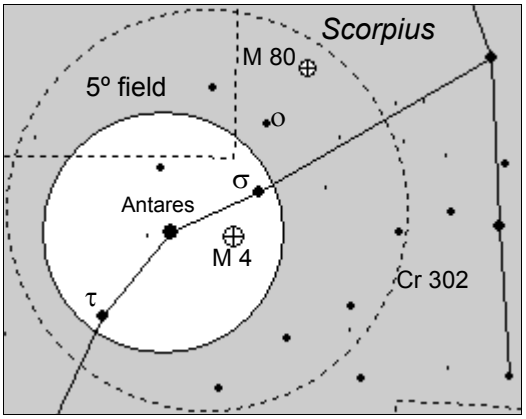
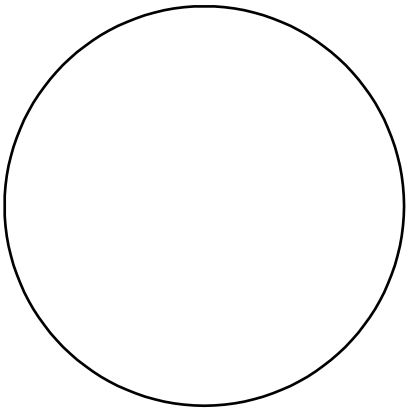
Scorpius — M 4 — *globular near Antares* — easy



Although the celestial scorpion never crawls far about the skyline from our latitude, there are a number of deep sky objects within for the binocular observer. Premier amongst these is **M4**, a globular cluster that sits within the same field of view as Antares.

Under ideal conditions, with the horizon free of summer haze, you'll easily see the object as a patch of light just over one degree west of Antares. Large binoculars hint at a grainy structure when the sky transparency is quite good.

M4 is considered one of the closest globular cluster to our Solar System, if not *the* closest. It lies 7,200 light years away — nearer than some of the open clusters highlighted in this handbook— and would be more prominent but for heavy obscuration by interstellar dust.



Observing Details

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Location _____ Sky _____

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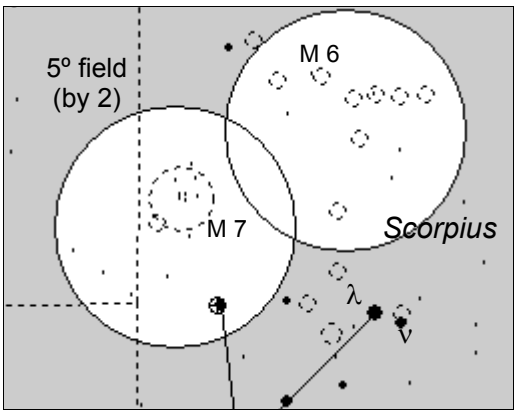
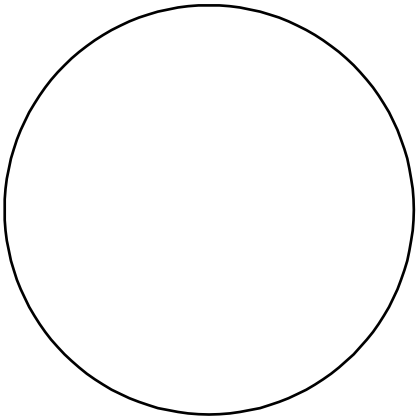
Scorpius — M 6 — *the Butterfly Cluster* — challenge — *due to low altitude from here*



This cluster, combined with M7 on the next page, are probably the ultimate challenge objects in the binocular handbook because of the rare opportunities you may get to snare each of the two. Their low altitude from Ireland may even necessitate a trip to our south coast where you'll also need very good sky conditions.

M6 appears as a compact group with two trails of stars leading from the centre — this pattern is what has given the group its nickname. The (sometimes) brightest star here is the semi-regular variable BM Scorpii which flickers between magnitudes 6·8 and 8·7 in a period of 850 days.

About 80 stars are members of M6 and the cluster is fairly close to us at only some 1,600 light years. It was first discovered by the Sicilian astronomer Giovanni Hodierna (1597-1660).



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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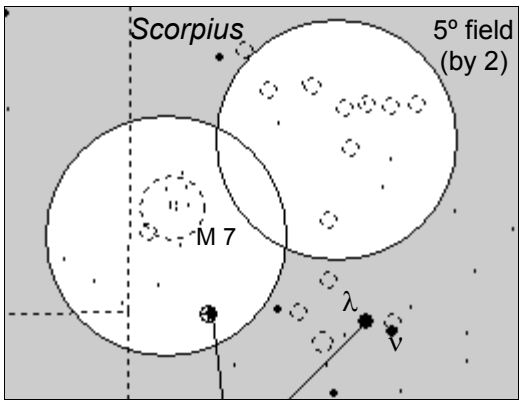
Scorpius **M 7 —** *Ptolemy's cluster* **challenge —** *due to low altitude from here*

Poised above the raised stinger of the celestial scorpion is **M7,** a star cluster that has been known since ancient times when the Greek astronomer Ptolemy called it the "nebula following the sting of Scorpius". Indeed, the ancient Arabs called M7 the "venom of the Scorpion" and the description is rather apt. The group is visible to the naked eye from temperate and more southerly latitudes.

The cluster is more loose than nearby M6 — the diameter of the group is over a degree in extent — and a little under half of its 80 member suns are visible in binoculars. The field in which it is located is quite rich in faint stars. The brightest star in M7 is a magnitude 5·6 G-type sun.

M7 lies about 800 light years away (though some sources quote 1,000 light years) with an estimated age of 220 million years.



Observing Details

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Location _____ Sky _____

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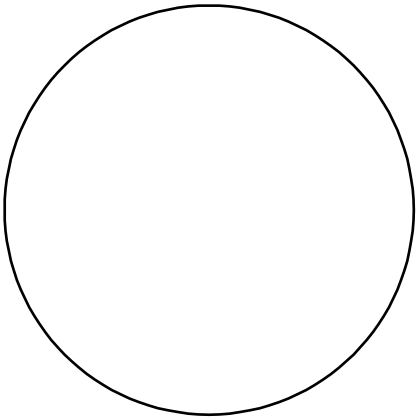
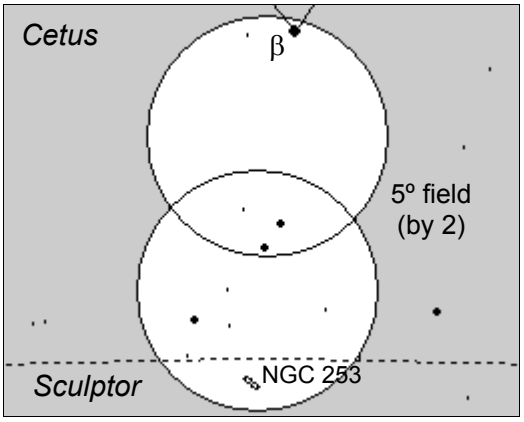


Sculptor **NGC 253 —** *Silver Coin galaxy* **moderate**

When the dim constellation of Sculptor crosses the meridian mid-evening during the dark nights of November we are looking towards the south pole of our galaxy. This gives us a window to peer deep into the Universe and see star systems far beyond our own.

The region here holds a swarm of at least fourteen galaxies known as the Sculptor, or South Polar, Group. The collection is about 10 million light years away and is the nearest such family to our own Local Group.

A member of the Sculptor Group visible in binoculars is **NGC 253**. You should be able to spot it as a spike of light roughly 20' long orientated northeast-southwest. The stars of the Sculptor's workshop are dim so your best bet is to drop 7½° directly south of second magnitude Beta Ceti. Midway along this line too is a small triange of equally bright magnitude 5·5 suns.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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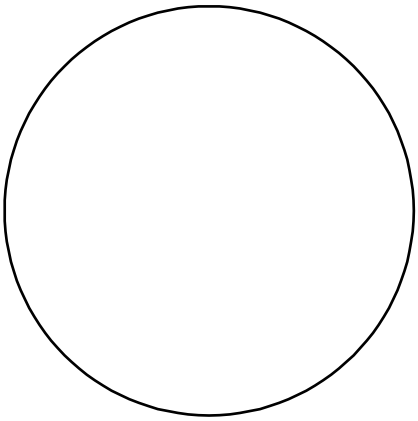
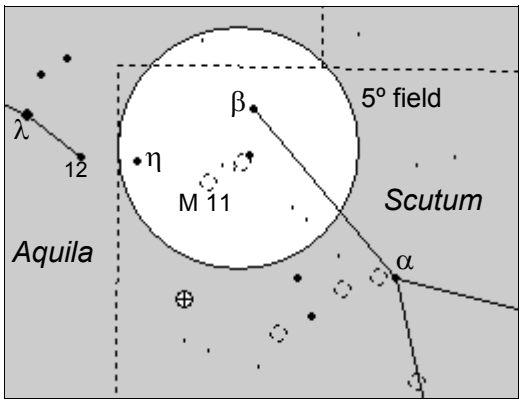


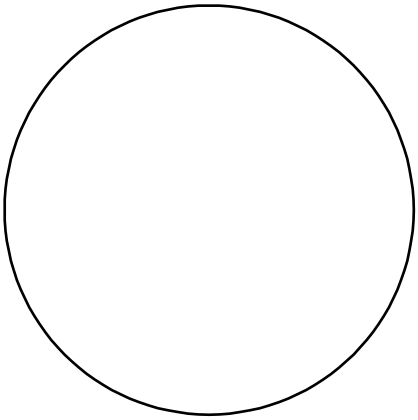
Scutum — M 11 — *the Wild Duck cluster* — easy



Within the same binocular field as fourth magnitude 12 Aquilae is the rich open cluster **M11**, also known as the Wild Duck. The moniker is derived from a description of M11 in the nineteenth century when Admiral Smyth wrote that it resembled "a flight of wild ducks". The group lies at the northern edge of the Scutum Star Cloud, a bright segment of the Milky Way that is visible to the naked eye.

Binoculars show a broad fan-shaped glow that appears more concentrated towards the eastern edge. A small "knot" to the southeast is the combined light of two unrelated ninth magnitude stars, one of which is the variable V369 Scuti. The unusual variable R Scuti is 1° to the northeast.

The cluster's stars are too faint to be resolved in binoculars but about 500 members are brighter than magnitude 14 with the majority classified as A- and F-type stars on the main sequence.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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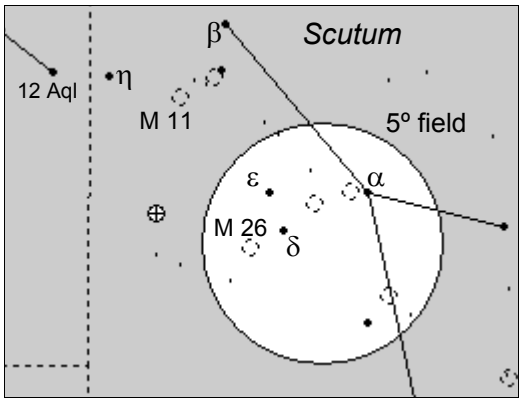
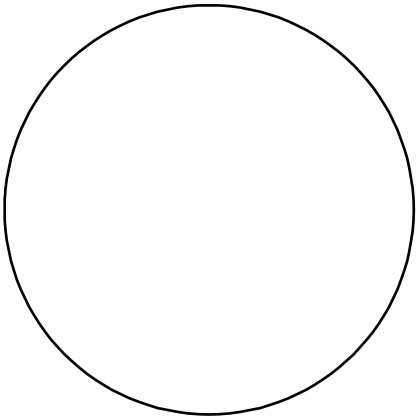
Scutum — M 26 — *elusive open cluster* — moderate



If you place the Wild Duck cluster at the top of your low power binocular field then you should be able to pick up the more diminutive **M26** as a small condensed patch of light ¾° southeast of Delta Scuti. A little time is needed to tease out the muted glow of this compact group.

It's worth drawing attention to a very pretty "fishhook" or "J"-shaped asterism that lies close to the two Messier clusters of Scutum. Place M11 at the top left of your binocular field and you should notice, towards the right, a ribbon of stars ending in a line of fainter suns that curl eastward.

M26 shines with the light of a magnitude 8 star and was discovered in June 1764 by Charles Messier who commented that it was "not distinguished in a 3½ foot (*focal length*) telescope and needed a better instrument." The cluster lies 5,000 light years distant as against 6,000 light years for M11.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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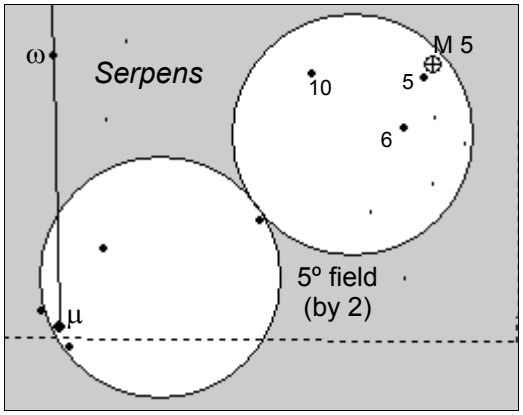
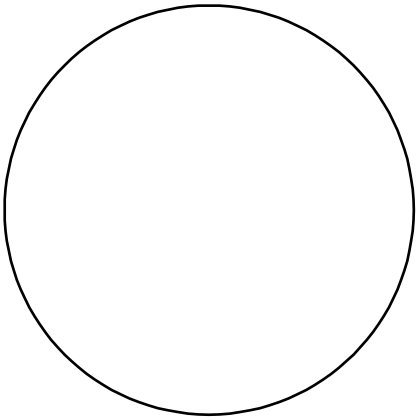
Serpens — M 5 — *globular cluster to delight* — moderate



This globular of the summer sky is a little hard to find but your reward for doing so is the sight of one of the more showy objects of the Serpent. **M5** can be found by sweeping ten degrees northwest of Mu Serpentis.

The cluster appears a little broader than M13 in Hercules though not as bright. It looks like a luminous ball of cotton wool, showing a lustre in the centre that gradually fades towards the outer edges. The star 5 Serpentis is just to the east in the same field of view.

M5 lies at a distance of 24,500 light years and is an extremely old globular cluster with an estimated age of 13 billion years. M5, as with all globulars, contains a number of RR Lyrae type variable stars. These are yellow giants with periods on the order of a day and are convenient yardsticks to determine the distances and distribution of the Milky Way's globular family.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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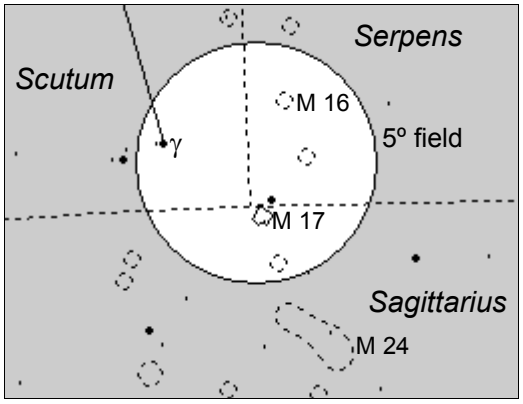
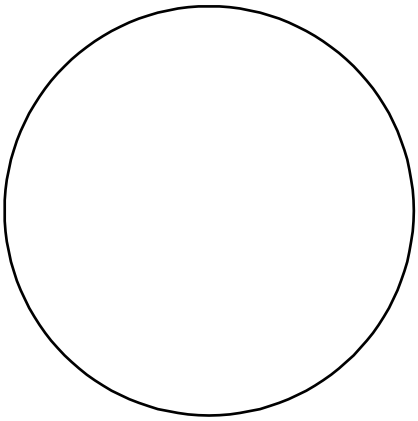
Serpens — M 16 — *the Eagle Nebula* — easy



The "Pillars of Creation" photograph of this region of sky by the *Hubble Space Telescope* is one of the most dramatic views of the Universe captured in recent years. Wider angle images show the dark filaments of gas that give **M16** its nickname of the Eagle Nebula.

M16 lies within the same field as M17, the Omega Nebula – scanning upwards along the Milky Way from M24 brings you through M18, then on to M17 and finally the Eagle. It's a rewarding sweep in binoculars.

The nebula is quite elusive in binoculars so what you will likely see is the embedded cluster **NGC 6611**. Look for a patch of light set towards the upper edge a parallelogram of four bright stars with the long axis aligned north-south. A few extra glints are seen in large binoculars. Most of the suns here were spawned within this vast stellar nursery with star-birth still ongoing.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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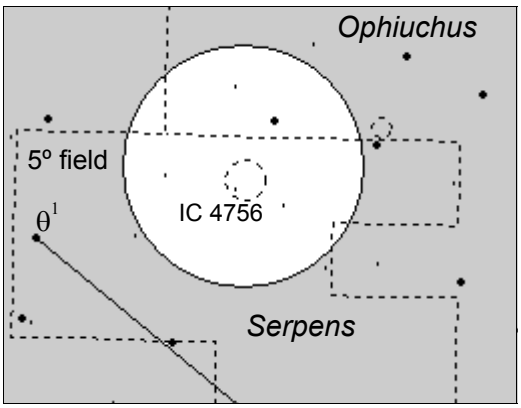
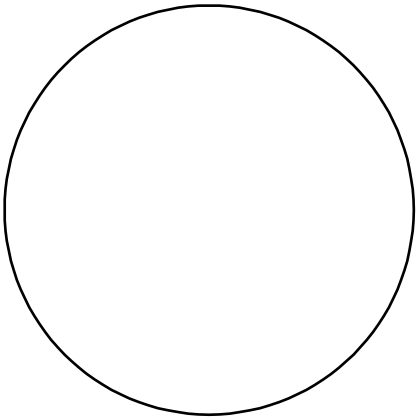
Serpens — IC 4756 — *open cluster in the Serpent's tail* — easy



IC 4756 is a fine binocular cluster just over the border from Ophiuchus. The whole group spans one degree of sky and lower power instruments give the best view. A magnitude 6·3 stars sits at the southeastern edge of the cluster. The richness of the Milky Way in this region rewards observers casually sweeping along its length.

IC 4756 lies just about within the same 5º binocular field as Theta Serpentis, or **Alya**, a fourth magnitude triple star system for small telescopes but also resolvable in binoculars. The B and C companions are of 5th and 8th magnitude respectively with the fainter C component 414 arcseconds away.

The two brighter members of the system lie 22 arcseconds apart and are a very good test of your observing skill. Giant binoculars, steadily mounted on a tripod, are a must. Both stars appear blue-white in colour.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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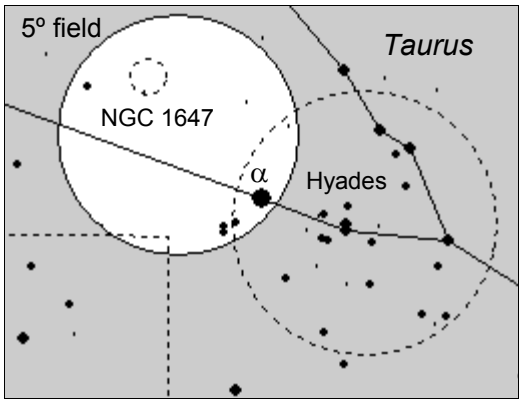
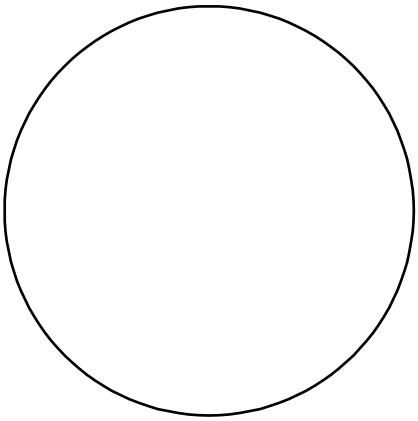
Taurus — NGC 1647 — *open cluster near Aldebaran* — easy



Hands up how many people know that Taurus hosts a number of other binocular open clusters besides the Pleiades and Hyades . . . yes, they are not as bold and brilliant as the well known aforementioned two but are well worth tracking down.

NGC 1647 is a lovely little group that lies 3½º northeast of orange Aldebaran, marking the eye of the charging Bull. It will easily fit in the same lower power binocular field as Aldebaran and you'll see a number of stellar pinpoints set in a clumpy whitish glow.

Higher powers show a handful more of the swarm's ninth magnitude and fainter stars. The cluster is 1,600 light years distant — more than 10 times as far from us as the Hyades. While you are here you might like to continue your sweep a further 6¼º northeast to **NGC 1746**, another binocular cluster.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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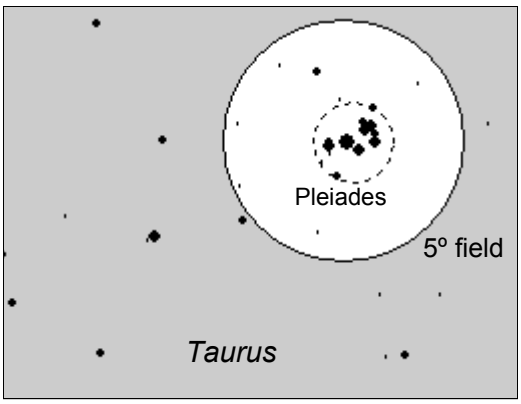
Taurus — M 45 — *the Pleiades* — easy



Poised above the rooftops during late-Autumn evenings is the beautiful **Pleiades** star cluster. Also known as the Seven Sisters star cluster or catalogued as number 45 in Messier's famous list, most people see the six brightest stars under a moderate sky. Binoculars show a stunning view with many steely-blue glints of light scattered across the field. At least five hundred stars are members of this swarm that lies 380 light years away.

Have you ever determined just how many Pleiads you can really see with the naked eye? From a dark location you should be able to see at least ten. Many observer's overlook the out-lying suns that are also part of the group — the whole cluster spans just under four Moon-diameters. Twenty-two stars are above magnitude 6·5 — the theoretical naked-eye limit — but in practice you won't see that many because the glare of the brighter stars overpowers the fainter members. Check out the following website — www.ras.ucalgary.ca/~gibson/pleiades/

Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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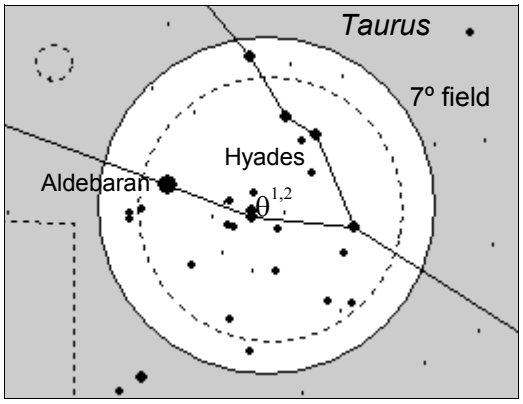
Taurus — Mel 25 — *the Hyades* — easy



The Hyades form the second closest open cluster to Earth at a distance of only about 150 light years. They appear as a distinctive V-shape arrowed away from Aldebaran, but this star is not a true member of the group being only half the cluster's distance from us.

With the naked eye, you can split the double star Theta Tauri which is a member while binoculars show a number more including the Delta^{1,2} pairing and much closer Sigma^{1,2} near Aldebaran. The whole group is spread over 6° of sky so even giant binoculars will have a little trouble fitting the Hyades in a single field of view.

The true diameter of the cluster is about 60 light years and some distant outlying members of the association are to be found up to 50° away on the sky from the Hyades pattern that we are most familiar with.

Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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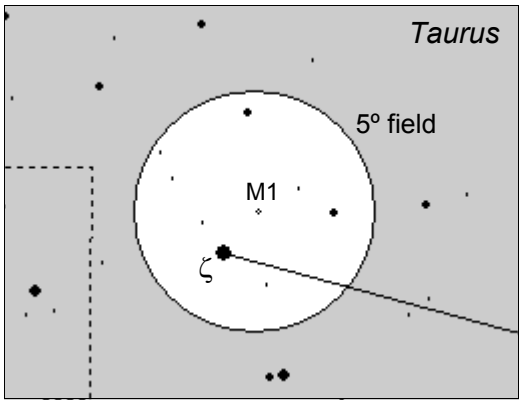
Taurus — M 1 — *the Crab Nebula* — challenge



A unique object in the handbook is the famous Crab Nebula supernova remnant which is listed as the first entry in Messier's catalogue. The nebula is the debris from a star that exploded near Zeta Tauri and was chronicled by Chinese astronomers as first appearing on July 4, 1054 AD. The "guest star" was visible to the naked eye during the day for many months, reaching magnitude -6, and remained on view for two years before fading from sight.

The supernova remnant itself was found by English astronomer John Bevis in 1731. The nickname was given by the Third Earl of Rosse who observed the object with the 72-inch telescope in Birr Castle.

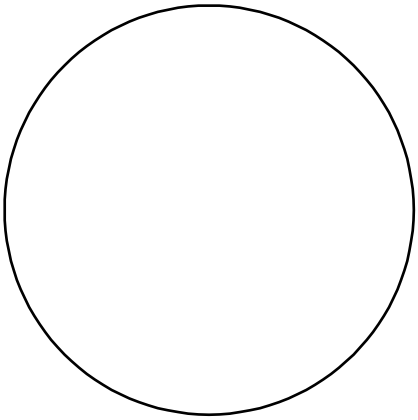
The nebula itself lies 1° northwest of Zeta Tauri, marking one of the horns of the Bull, but can prove elusive. Medium-to-giant binoculars will let you spot the Crab as a tiny patch of light — in lower powers it looks stellar.

Observing Details

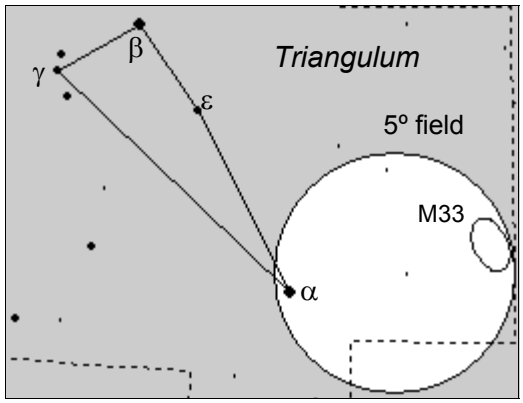
Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____



Triangulum — M 33 — *the Pinwheel Galaxy* — moderate



M33 is found roughly one-third of the way along a line joining Alpha Trianguli and Beta Andromedae. It's light is spread out over a large patch of sky about one degree in diameter and this low surface brightness makes it difficult to spot. You should be able to glimpse it's ghostly glow, given good clear conditions, with the naked eye or low-power binoculars though.

At a distance of 2·5 million light years it is a slightly more remote member of the Local Group of galaxies than M31. It is about half the size of the Milky Way and long exposure photographs bring out its loose spiral structure with the "arms" knotted with bright star-forming regions.

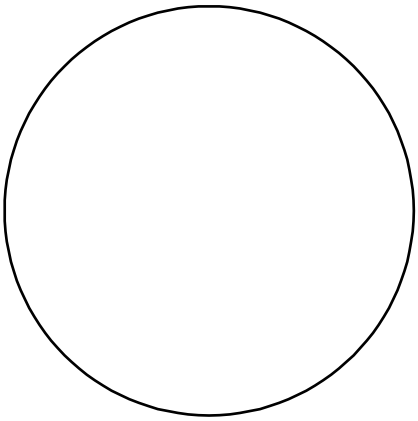
All told, the Local Group has just over 30 members and mostly consists of a rag-tag assortment of dwarf irregular and elliptical galaxies. M33 ranks as the third largest member after M31 and our own Milky Way.

Observing Details

Date/Time _____ Instrument _____

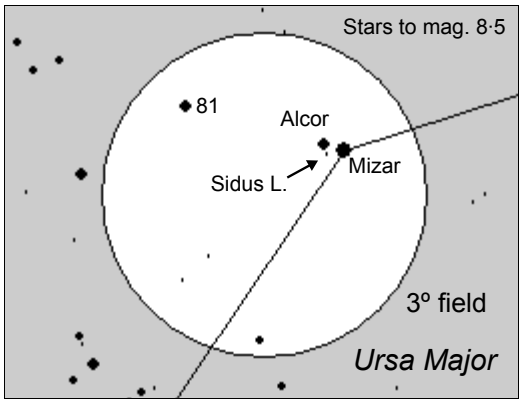
Location _____ Sky _____

Notes _____



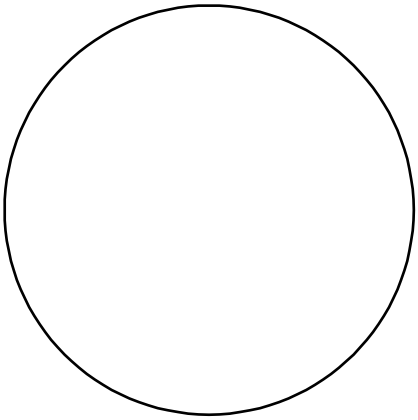
Ursa Major — Zeta — *a double in the Plough and an astronomical "wild goose" chase* — easy

Zeta Ursae Majoris, or Mizar, forms a wide double with Alcor but within the same field (8¼' east of Mizar) is an unrelated eighth magnitude mote that goes by the grand title of Sidus Ludoviciana. This star had a brief period of fame when it was mis-identified as a new planet in the early 1700s.



Johann Georg Liebknecht chanced upon the star in the same field as Mizar on December 2nd, 1722. Inaccurate positional measurements led him to believe he detected a slow motion against the stellar background. Convinced he had found a new planet, Liebknecht hastily named it Sidus Ludoviciana in honour of his monarch the Landgrave Ludwig of Hessen-Darmstadt.

However, far superior telescopes showed that Liebknecht's "planet" was nothing more than a fixed star. The episode briefly led to some rather unsavory and libellous exchanges between Liebkneckt and his detractors.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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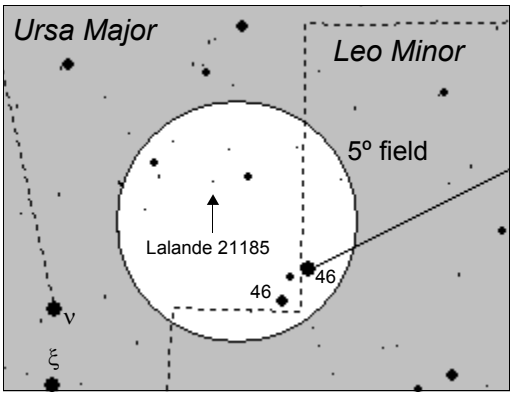
Ursa Major — Lalande 21185 — *near neighbour of the Sun* — moderate

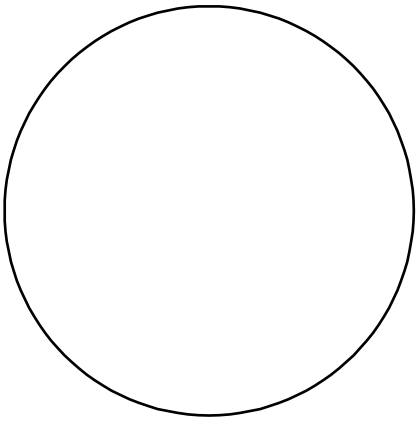
One of the few red dwarf stars visible in binoculars is magnitude 7·5 **Lalande 21185**, a near neighbour to our Solar System at only 8·3 light years.



It can be found by heading 2¼° northeast of the magnitude 3·7 star 46 Leo Minoris where you will find a magnitude 6 point at the head of a triangle of much fainter suns. The speck at the bottom left corner is Lalande 21185.

Lalande 21185 is a cool main-sequence M-type dwarf with 46% of the Sun's mass but only a 6/1000th of its brightness. In 1996 the star was found to possibly have two Jupiter-sized planets accompanying it.

The star has both a high radial velocity of 86 km/s toward the Sun and a high tangential velocity (proper motion) of 57 km/s. The former is bringing the star 0·028 light-year closer to us each century and to a closest approach of about 4·6 light-years in 22,000 AD.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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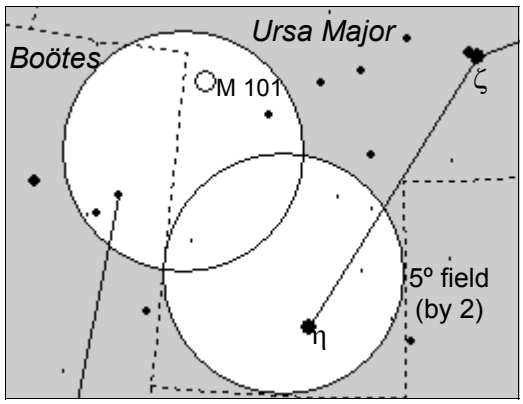
Ursa Major — M 101 — *face-on spiral galaxy* — moderate

M 101 is a beautiful face-on spiral galaxy that shows arms heavily dusted with star forming regions in detailed long exposure photographs. The binocular user though has to be content with admiring the combined light of its billions of stars as a pale grey smudge.

The galaxy is quite easy to find as it lies to the other side of Eta Ursae Majoris, the last star in the handle of the Plough, to the better known M51. Sweep 5 northeast of Eta and you should spot the tenuous glow of the galaxy as a large roundish patch. Because we are seeing M101 face-on the surface brightness is quite low so you may scan over it at first.

M 101 lies 27 million light years away and measures 170,000 light years across. It is the brightest of a small clutch of galaxies in this region of space that form their own local group.



Observing Details

Date/Time _____ Instrument _____

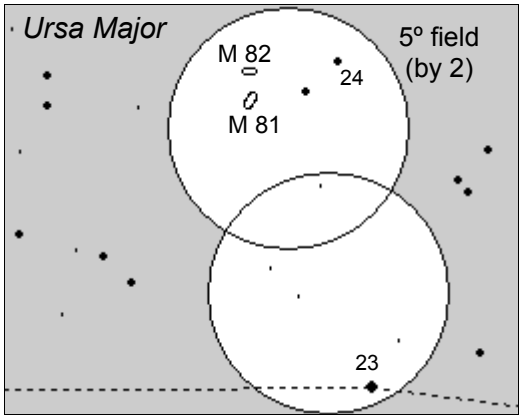
Location _____ Sky _____

Notes _____

Ursa Major — M 81/M 82 — *a galaxy pairing* — moderate

M81 and **M82** are part of one of the nearest groups of galaxies to our own Local Group at "only" 12 million light years away. One, M 81, is a large spiral tilted almost face-on to us and showing a brilliant nucleus with tightly wound arms. M 82 shows very unusual structure in detailed photographs and is now believed to be going through a huge phase of star formation. This is probably the result of a close encounter between the two galaxies — they presently lie just 150,000 light years from each other.

The handiest way to find the galaxies is to take-off from Alpha Ursae Majoris to 23 UMa, 10½° a little north of west. From here, go 6½° to the northeast and you'll be in the right region. M81 is probably easiest to spot as it appears like a magnitude 7 "star" in smaller binoculars. Pushing up the magnification will let you see it as a pale oval-shaped glow. Just half a degree to it's north, with larger binoculars, you should spot M82 as a thin spike of ghostly light.



Observing Details

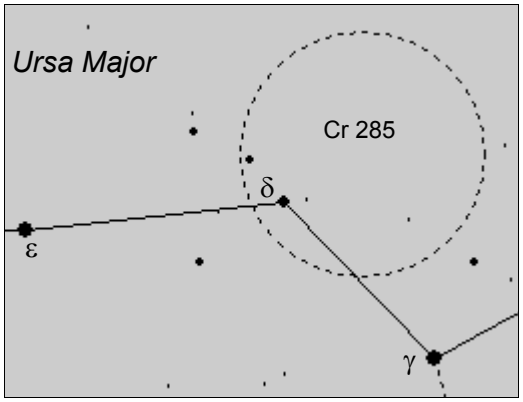
Date/Time _____ Instrument _____

Location _____ Sky _____

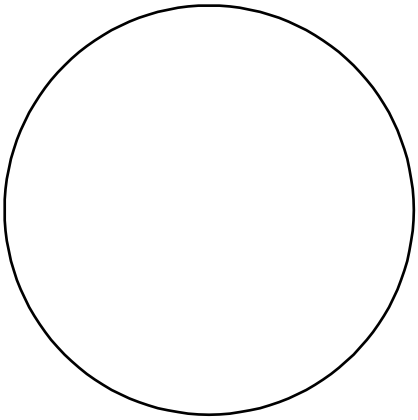
Notes _____

Ursa Major — Cr 285 — *the nearest open cluster* — easy

It's the closest open star cluster to Earth and you've probably seen it countless times since you first started enjoying the night sky. Want to guess what it is? If you said "the Plough" then you know your stuff! Yes, five of the seven stars making up the familiar asterism are all part of the nearest stellar association to us. A number of fainter stars near Zeta and Epsilon Ursae Majoris are also members of this intriguing cluster.



Catalogued as **Cr 285**, the fact that this group is so close means that the cluster's suns are scattered widely across the celestial sphere with even Sirius suggested as being an outlying member. Cr 285 is just 75 light years away and more than a hundred stars have been identifed as part of the group. Stars such as Sirius may have escaped the gravitational pull of the swarm at this stage though it still shows a similar proper motion as the cluster. Our own Sun is also located within the *Ursa Major Stream* but was never a member because it is far older than Cr 285's stars.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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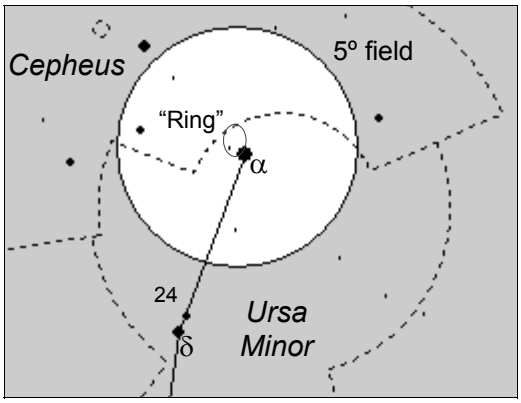
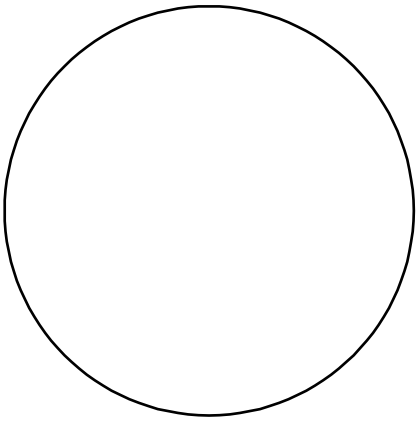
Ursa Minor — Polaris — *the Axis of the Heavens* — easy

Polaris has long held a position of eminence for skywatchers, navigators and others alike. It is not the sky's brightest star by a long shot — ranking only number 50 — but is the reference about which the heavens seem to pivot. Polaris is 2,200 times as luminous as the Sun and is also an unusual Cepheid variable in that it has almost ceased to fluctuate. The distance has been measured as 430 light years.



In binoculars, you might spot a slightly distorted circlet of suns known as the **Engagement Ring** with Polaris marking the diamond stone set in the band. The brightest of the rest, a magnitude 6·4 star, allows us see something quite interesting. Over the course of the night, it appears to revolve around Polaris in a period of hours rather than decades as we would expect in a binary system. However, the two are unrelated and what you are really witnessing is a consequence of the motion of the celestial sphere about the north celestial pole. Still, it's a fascinating demonstration.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

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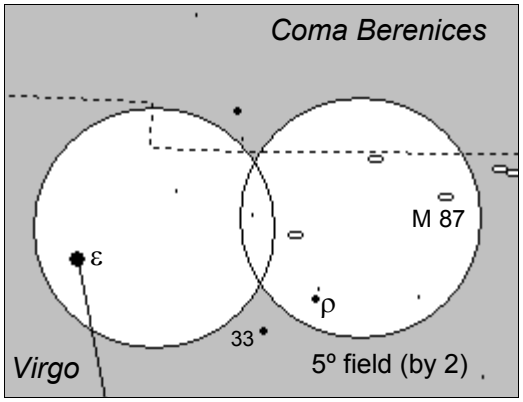
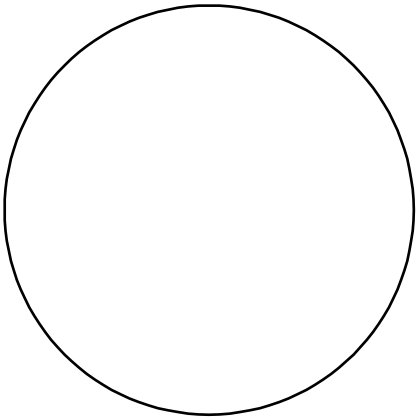
Virgo — M 87 — *a giant amongst galaxies* — challenge

M87 is a true giant and lies at the heart of the great Coma-Virgo galaxy throng. This huge elliptical measures some half a million light years across — considerably more than our own Milky Way — and is surrounded by a swarm of thousands of globular clusters. Very deep photographs show a curious jet of material being shot out from the core. In recent years, this feature has even been seen visually by some experienced observers using large telescopes under superb sky conditions. M87 lies 60 million light years away.



In binoculars, you'll need to carefully "star hop" to the location of the galaxy. First sweep 5º a little south of west of Epsilon Virginis to magnitude 4·8 Rho where you'll also see two slightly fainter stars either side of it. Then scan 3¼° to the northwest and you may spot the magnitude 9 galaxy as a tiny spot of light. Don't despair if you cannot find the galaxy because this is one of the real taxing objects of the handbook. As you gain in experience, it's a challenge you can tackle in time.



Observing Details

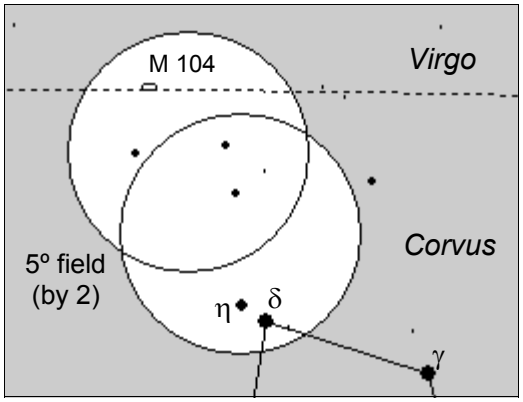
Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

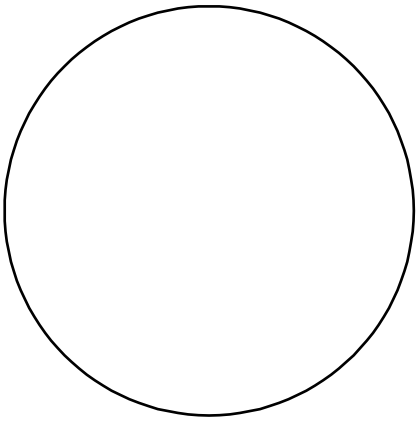
Virgo — M 104 — *the Sombrero galaxy* — moderate

M 104 really suggests a likeness to a Sombrero hat. Long exposure photographs of the galaxy show a bright bulging nucleus with the "brim" formed by a ring of dark material silhouetted against the stars of the broad disk.



While the grandeur is beyond the capabilities of binoculars you will be able to see M 104 as a tiny ellipse while larger instruments will show the core of the galaxy as a more concentrated spot at the centre. It has been suggested that giant binoculars will even let you glimpse the dark dust lane under excellent conditions.

To find M 104 you need to sweep 5½° northeast of Delta Corvi. You'll spot a small triangle of roughly sixth magnitude stars just to the west the midpoint along this line. It's probably one of the most distant objects that you will see with binoculars as the galaxy is believed to lie almost 50 million light years away.



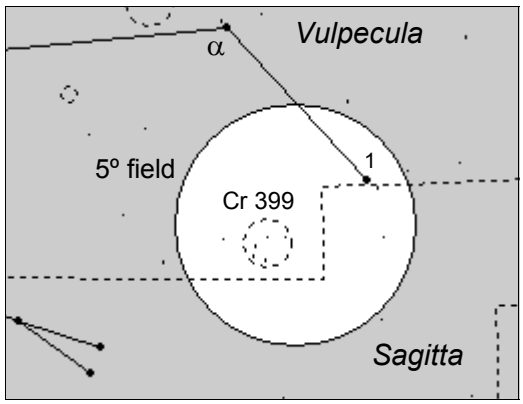
Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

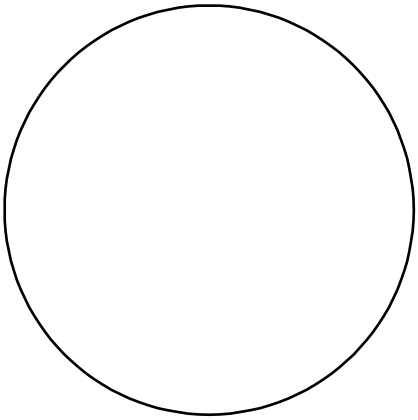
Vulpecula — Cr 399 — *The celestial Coathanger* — easy



Vulpecula harbours one of the most enchanting sights in the sky for binocular users. This is the asterism called the "Coathanger" or Brocchi's Cluster. A glance through low-power binoculars reveals the origin of the nickname and it is sure to become one of your summer sky favourites.

Catalogued as **Cr 399**, the cluster looks remarkably like a wardrobe hanger with six stars aligned in a straight line forming the cross bar while four other points of light curve away to form the hook. The group is centred on the star 4 Vulpeculae and under good conditions far from lights you may see the brighter members with the naked eye.

The arrangement is pure chance as these stars lie at different distances and are moving in different directions in space. Look for Cr 399 just about a 10x binocular field-width northwest of the star Alpha Sagittae that marks the vane of the little *flêche* flying high across our summer Milky Way.



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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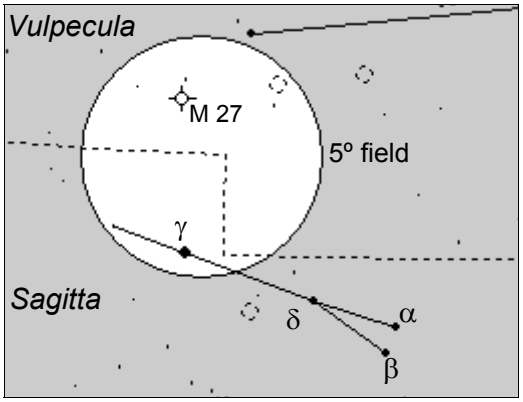
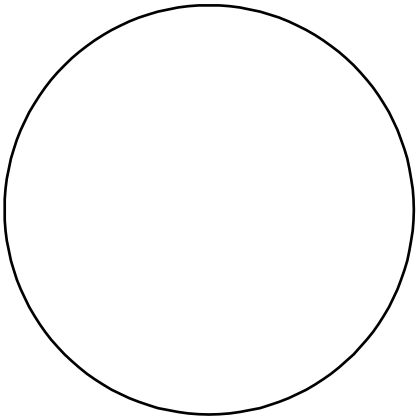
Vulpecula — M27 — *The Dumbbell Nebula* — easy



The Dumbbell nebula, or **M27**, is considered to be one of the best planetary nebulae for binocular observers. Planetary nebulae are the outer layers shed by stars near the end of their life cycle. At this phase in their life, such stars may lose up to half their original mass. Strong stellar winds blowing from their surface shock previously ejected material and the high-energy radiation causes these shells to glow.

M27 is in the same binocular field as Gamma Sagittae and shows as a lovely puff of light set in an attractive star field. With larger binoculars you may see a hint of the "applecore" shape of the nebula — certainly, the centre appears a little more "pinched".

Scan about 4º west of M27 and you'll spy a chain of stars more than 5º long running northeast to the southwest — broken in places but the eye still sees it as a continuous thread. Has anyone noticed this asterism before?



Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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Uranus — *snaring the outer planets* **easy**

Binoculars, surprisingly enough, are sufficent to snare two additional Solar System members to the five known to the ancients. Uranus and Neptune are both relatively easy to see in low power instruments. All you need is a current chart of their positions. Check out the Sky and Telescope web site at skyandtelescope.com/observing/objects/planets/article_1221_1.asp

These two ponderous outer-Solar System giants are currently in the region of the sky often dubbed the Celestial Sea; Uranus is slowly moving through Aquarius and does not cross in to Pisces until late-March 2009, while Neptune does not move from Capricornus (where it is at present) into Aquarius until late-2010.

Uranus is just visible to the naked-eye when at opposition — provided you know where to find it — and looks like a greenish "star" in binoculars. The planet was at opposition on August 27th in 2004.

Neptune is fainter (and farther) and is normally just above 8th magnitude at opposition. It appears a more subtle bluish hue. The gas giant reached opposition on August 5th in 2004 and is close to the magnitude 4·1 star Theta Capricorni for the remainder of 2004.

Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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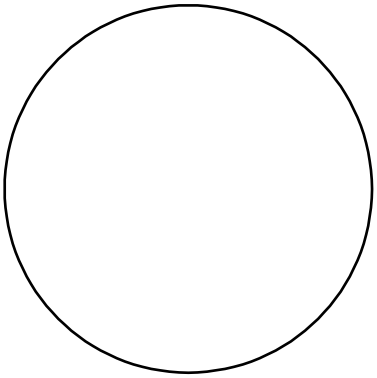

Vesta — *the brightest asteroid* **easy**

Of all the known asteroids, only one, **4 Vesta**, regularly becomes bright enough to be visible to the naked eye. It shines at magnitude 6·1 when at opposition on September 13th, 2004 and lies within 1° of ω^2 Aquarii.

The *Hubble Space Telescope* observed Vesta in late-1994 and a diameter of 525 kilometres was derived. The *HST* images also revealed a giant impact basin and showed that the surface is varied with light and dark terrain — an indication of basaltic outflows at some point in its history.

This particular challenge requires a little pre-planning. Vesta will be past opposition by the time you get this booklet so you will have to source an almanac or an Internet reference to get the most up-to-date positions. A good technique to known you've seen it is to sketch what you see in the binocular field on successive nights. The "star" that's moved will be Vesta.

A finder chart for Vesta is currently (as of September 2004) on the www.astronomy.com web site. Minor planet 9 Metis is also presently in the same low power field; the asteroid is the only one to have been found from Ireland (in 1848).

Observing Details

Date/Time _____ Instrument _____

Location _____ Sky _____

Notes _____

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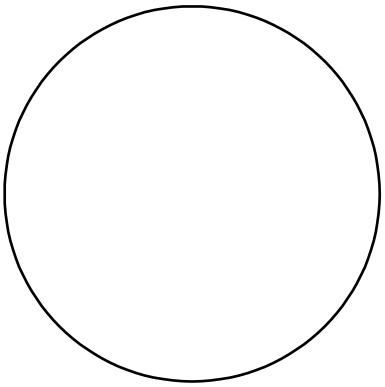

Highlighted Objects

THE TABLE HERE lists all the objects that are part of the binocular challenge. However, it does not include the additional deep sky sights mentioned throughout the text. We have quoted the magnitude at maximum for variable stars.

Use the table as a means of charting your progress towards completion of each level of the binocular certificate. By their very nature, we've omitted the Solar System objects whose position on the celestial sphere, naturally, changes on a scale of days or months rather than millennia.

The various catalogues mentioned here include the famous list drawn up by French astronomer Charles Messier between 1771 and 1781. It is often considered a guide to the best deep sky objects. Messier produced the list in order to chart objects that might be mistaken for the comets which he was more interested in (ironically, no-one remembers his comets!) Messier objects are labelled with an "**M**".

The **NGC** is the New General Catalogue compiled by J.L.E. Dreyer at Armagh Observatory and published in 1888.

Key to object types

******	*double star*	**Pln**	*planetary nebula*
Aster	*asterism*	**Neb**	*emission or reflection nebula*
Var	*variable star*	**OpC**	*open cluster*
Glx	*galaxy*	**Glb**	*globular cluster*

- and the unique M 1, keyed as a supernova remnant (SNR)

Some less well known catalogues referenced include;

Mel Philibert Jacques Melotte in "A catalogue of star clusters shown on the Franklin-Adams chart plates"

Cr Per Collinder in "On structured properties of open galactic clusters & their spatial distribution" (1931)

Stock Jürgen Stock in "A Catalogue of Star Clusters and Associations" (1958)

Object	Con	Type	R.A. hrs	R.A. mns	Dec °	Dec '	Mag.	Notes	Page	Level	Seen ✓
M 31	And	Glx	00	42.8	41	16	4.5	Andromeda Galaxy	6	Easy	○
NGC 752	And	OpC	01	57.8	37	41	5.7		6	Easy	○
M 2	Aqr	Glb	21	33.5	00	49	7.5		7	Moderate	○
NGC 7293	Aqr	Pln	22	29.6	-20	48	6.5	Helix Nebula	7	Challenge	○
M 36	Aur	OpC	05	36.3	34	08	6.0		8	Easy	○
M 37	Aur	OpC	05	52.4	32	33	5.6		8	Easy	○
M 38	Aur	OpC	05	28.7	35	51	6.4		8	Easy	○
Kemble's Cascade	Cam	Aster	03	58.0	63	06	4.0		9	Easy	○
Stock 23	Cam	Opc	03	16.3	60	02	6.8		9	Easy	○
NGC 2403	Cam	Glx	07	36.9	65	36	8.4		10	Moderate	○
M 44	Cnc	OpC	08	40.1	19	59	3.1	the Beehive	10	Easy	○
M 67	Cnc	OpC	08	50.4	11	49	7.5		11	Easy	○
Iota	Cnc	**	08	46.7	28	46		mags. 4.2 and 6.6 (31")	11	Moderate	○
M 3	CVn	Glb	13	42.2	28	23	6.4		12	Moderate	○
M 51	CVn	Glx	13	29.9	47	12	8.4	The Whirlpool Galaxy	12	Moderate	○
Y CVn	CVn	Var	12	45.1	45	26	7.4	La Superba -- red star	13	Moderate	○
M 41	CMa	OpC	06	47.0	-20	44	4.5		13	Easy	○
Alpha	Cap	**	20	18.1	-12	33		mags. 3.6 and 4.2 (378")	14	Easy	○
M 103	Cas	OpC	01	33.2	60	42	7.4		14	Easy	○
NGC 663	Cas	Opc	01	46.0	61	15	7.1		14	Easy	○
M 52	Cas	OpC	23	24.2	61	35	6.9		15	Easy	○
Stock 2	Cas	Opc	02	15.0	59	16	4.4		15	Easy	○
NGC 457	Cas	Opc	01	19.5	58	17	6.4		16	Easy	○
NGC 7789	Cas	Opc	23	57.4	56	43	6.7		16	Easy	○
Delta	Cep	Var	22	29.2	58	25	3.5	prototype Cepheid	17	Easy	○

Object	Con	Type	R.A. hrs	R.A. mns	Dec °	Dec '	Mag.	Notes	Page	Level	Seen ✓
Mu	Cep	Var	21	43.5	58	47	3.4	the Garnet Star	17	Easy	○
Mel 111	Com	OpC	12	25.0	26	00	1.8	Coma Star Cluster	18	Easy	○
M 64	Com	Glx	12	56.7	21	41	8.5	Black Eye galaxy	18	Challenge	○
NGC 4565	Com	Glx	12	36.3	25	59	9.6		19	Challenge	○
NGC 7000	Cyg	Neb	21	01.8	44	12	4.0	North American Nebula	19	Easy	○
M 39	Cyg	OpC	21	32.2	48	26	5.5		20	Easy	○
M 29	Cyg	OpC	20	23.9	38	32	6.6		20	Moderate	○
Beta	Cyg	**	19	30.7	27	58		mags. 3.1 and 5.1 (34")	21	Easy	○
Omicron	Cyg	**	20	13.6	46	44		mags. 4,7 & 5 (107", 338")	21	Easy	○
61	Cyg	**	21	06.9	38	45		mags. 5.2 and 6 (29")	22	Easy	○
HDE 226868	Cyg	Star	19	58.5	35	12	8.9v	black hole candidate?	22	Challenge	○
Nu	Dra	**	17	32.2	55	11		mags. 4.9 and 4.9 (62")	23	Easy	○
M 35	Gem	OpC	06	08.9	24	20	5.5		23	Easy	○
M 13	Her	Glb	16	41.7	36	28	5.9		24	Easy	○
M 92	Her	Glb	17	17.1	43	08	7.5		24	Moderate	○
M 48	Hya	OpC	08	13.8	-05	48	5.5		25	Easy	○
M 83	Hya	Glx	13	37.1	-29	52	8.5		25	Moderate	○
54 Hya	Hya	Aster	14	46.2	-25	27	5.0		26	Easy	○
NGC 3242	Hya	Pln	10	24.8	-18	39	8.6	Ghost of Jupiter	26	Challenge	○
NGC 7243	Lac	OpC	22	15.1	49	54	6.4		27	Moderate	○
Regulus	Leo	**	10	08.4	11	58		mags. 1.4 and 7.7 (177")	27	Challenge	○
Gamma	Lep	**	05	44.5	-22	27		mags. 3.7 and 6.3 (96")	28	Easy	○
M 79	Lep	Glb	05	24.2	-24	31	8.4		28	Moderate	○
NGC 2017	Lep	**	05	39.3	-17	51	7.0	multiple star	29	Moderate	○
Epsilon	Lyr	**	18	44.3	39	40		mags. 5 and 5.2 (208")	29	Easy	○
Stephenson 1	Lyr	OpC	18	53.5	36	55	3.8		30	Easy	○
M 56	Lyr	Glb	19	16.6	30	11	8.3		30	Moderate	○
M 50	Mon	OpC	07	03.2	-08	20	5.9		31	Easy	○
NGC 2244	Mon	OpC	06	32.4	04	52	4.8	wreathed by Rosette nebula	31	Easy	○
NGC 2264	Mon	OpC	06	41.0	09	54	3.9	the Christmas Tree cluster	32	Easy	○
NGC 2232	Mon	Opc	06	28.0	-04	51	3.9		32	Easy	○
IC 4665	Oph	OpC	17	46.3	05	43	4.2		33	Easy	○
NGC 6633	Oph	OpC	18	27.7	06	34	4.6		33	Easy	○
70	Oph	Star	18	05.7	02	29	4.0		34	Easy	○
M 14	Oph	Glb	17	37.6	-03	15	7.6		34	Moderate	○
Barnard's	Oph	Star	17	57.9	04	24	9.5		35	Challenge	○
M 10	Oph	Glb	16	57.1	-04	06	7.5		35	Moderate	○
M 12	Oph	Glb	16	47.2	-01	57	6.6		35	Moderate	○
M 78	Ori	Neb	05	46.7	00	03	8.0		36	Moderate	○
M 42	Ori	Neb	05	35.3	-05	23	4.0	Orion Nebula	36	Easy	○
NGC 1981	Ori	OpC	05	35.2	-04	26	4.2		37	Easy	○
Cr 65	Ori	OpC	05	26.0	16	00	3.0		37	Easy	○
Cr 69	Ori	OpC	05	35.1	09	56	2.8		38	Easy	○
Cr 70	Ori	Opc	05	36.0	-01	00	0.4	the Belt stars	38	Easy	○
M 15	Peg	Glb	21	30.0	12	10	7.5		39	Easy	○

Object	Con	Type	R.A. hrs	R.A. mns	Dec °	Dec '	Mag.	Notes	Page	Level	Seen ✓
NGC 869	Per	OpC	02	19.1	57	09	5.3	Double Cluster (& NGC 884)	39	Easy	O
NGC 884	Per	OpC	02	22.4	57	07	6.1		39	Easy	O
Mel 20	Per	OpC	03	22.0	49	00	1.2	Alpha Persei Association	40	Easy	O
Algol	Per	Var	03	08.2	40	57	2.1	eclipsing variable	40	Easy	O
M34	Per	OpC	02	42.1	42	47	5.2		41	Easy	O
TX	Psc	Var	23	46.6	03	30	5.0	Carbon star	41	Easy	O
M 46	Pup	OpC	07	41.8	-14	49	6.5		42	Easy	O
M 47	Pup	OpC	07	36.6	-14	30	4.5		42	Easy	O
M 93	Pup	OpC	07	44.6	-23	52	6.5		42	Easy	O
M 71	Sge	Glb	19	53.8	18	47	8.3		43	Moderate	O
M 8	Sgr	Neb	18	03.1	-24	23	5.0	Lagoon nebula	43	Easy	O
M 17	Sgr	Neb	18	20.8	-16	11	6.0	Swan, or Omega, nebula	44	Easy	O
M 18	Sgr	OpC	18	19.9	-17	08	6.9		44	Easy	O
M 25	Sgr	OpC	18	28.8	-19	17	4.9		45	Easy	O
M 24	Sgr	M/Way	18	18.4	-18	25	3.1	bright Milky Way patch	45	Easy	O
M 23	Sgr	OpC	17	56.8	-19	01	5.5		46	Easy	O
M 22	Sgr	Glb	18	36.4	-29	54	6.5		46	Easy	O
M 28	Sgr	Glb	18	24.5	-24	52	6.9		47	Moderate	O
M 20	Sgr	Neb	18	02.3	-23	02	6.3	Trifid nebula	47	Moderate	O
M 21	Sgr	OpC	18	04.6	-22	30	5.9		47	Moderate	O
M 4	Sco	Glb	16	23.6	-26	32	7.5		48	Easy	O
M 6	Sco	OpC	17	40.3	-32	15	4.2		48	Challenge	O
M 7	Sco	OpC	17	53.9	-34	48	3.3		49	Challenge	O
NGC 253	Scu	Glx	00	47.6	-25	18	7.2		49	Challenge	O
M 11	Sct	OpC	18	51.1	-06	16	5.8	the Wild Duck cluster	50	Easy	O
M 26	Sct	OpC	18	45.2	-09	24	8.0		50	Moderate	O
M 5	Ser	Glb	15	18.6	02	05	5.8		51	Moderate	O
M 16	Ser	OpC	18	18.8	-13	47	6.5	in the Eagle Nebula	51	Easy	O
IC 4756	Ser	OpC	18	39.0	05	27	4.6		52	Easy	O
NGC 1647	Tau	OpC	04	45.9	19	06	6.4		52	Easy	O
M 45	Tau	OpC	03	47.0	24	07	1.4	Pleiades or Seven Sisters	53	Easy	O
Mel 25	Tau	OpC	04	27.0	16	00	0.5	the Hyades	53	Easy	O
M 1	Tau	SNR	05	34.5	22	01	8.4	Crab Nebula	54	Challenge	O
M 33	Tri	Glx	01	33.9	30	40	5.7	Triangulum Galaxy	54	Moderate	O
Zeta	UMa	**	13	23.9	54	56		Mizar/Alcor - naked eye	55	Easy	O
Lalande 21185	UMa	Star	11	03.5	35	56	7.5	nearby star	55	Moderate	O
M 101	UMa	Glx	14	03.2	54	21	7.9		56	Moderate	O
M 81	UMa	Glx	09	55.6	69	04	6.9		56	Moderate	O
M 82	UMa	Glx	09	55.9	69	41	8.4		56	Moderate	O
Cr 285	UMa	OpC	12	03.0	58	00	0.4	most of the Plough stars	57	Easy	O
Polaris	UMi	Star	02	32.0	89	00	2.0	the Engagement Ring	57	Easy	O
M 87	Vir	Glx	12	30.8	12	23	8.6		58	Challenge	O
M 104	Vir	Glx	12	40.0	-11	37	8.0	the Sombrero	58	Moderate	O
Cr 399	Vul	Aster	19	25.4	20	11	3.6	Coathanger	59	Easy	O
M 27	Vul	Pln	19	59.6	22	43	7.5	the Dumbell Nebula	59	Easy	O

References and Resources

Binoculars Books — two classics

Touring the Universe through Binoculars
by Phil Harrington, John Wiley & Sons Inc. (1990)

What a great book. If you want a survey of all that you can see with binoculars then this is it. It's a constellation-by-constellation treatment of deep-sky highlights along with chapters on observing the Moon, planets, and variable stars. There's a good section on buying binoculars too. It lacks star charts but most sky mapping software should show almost all the highlights here. *Sky and Telescope* magazine sell a TUBA (as the book is known) CD-ROM that charts all the 1,100 objects listed in the tables in the book.

Binocular Astronomy
by Craig Crossen and Wil Tirion, Willmann Bell (1992)

This is a fine hardcover publication that you should have in conjunction with Harrington's book. Rather than reading as a summary of celestial sights as with the latter, Crossen and Tirion's book is a series of sky tours of the constellations with a lot of mythology and other information interwoven with the text. The book is complimented nicely by the all-sky Magnitude 6 Star Atlas drawn by Tirion.

Other Binocular Books

Astronomy with Binoculars
by James Muirden, Arco Publishing Inc., New York (1984)

Deep-Sky Objects for Binoculars
by John Kozak, Sky Publishing Corporation (1988)

Exploring the Moon through Binoculars & Small Telescopes
by Ernest H. Cherrington, Jr., Dover Inc. (1984)

Exploring the Night Sky with Binoculars
by David Chandler, David Chandler and Co

Exploring the Night Sky with Binoculars
by Patrick Moore, Cambridge University Press (1986)

Sky Vistas: Astronomy for Binoculars and Richest Field Telescopes
by Craig Crossen & Gerald Rhemann, Springer-Verlag (2003)

Star Gazing Through Binoculars
by Stephen Mensing, TAB Books, USA (1986)

The Binocular Stargazer
by Leslie C. Peltier, Kalmbach Publishing Company (1995)

Sky and Telescope magazine carries a monthly binocular highlight column and this has been running since the January 1993 issue. The current editor of the column is Canadian astronomer Gary Seronik. The UK-based *Astronomy Now* and, less frequently, *Astronomy*, also publish binocular articles and are always good monthlies to read too.

Atlases and General Books

365 Starry Nights
by Chet Raymo — Fireside Books

Advanced Skywatching
various authors — Collins Books

Burnham's Celestial Handbook *(3 volumes)*
by Robert Burnham, Jr — Dover Publications

Celestial Delights
by Francis Reddy and Greg Walz-Chojnacki — Celestial Arts

Deep Sky Wonders *by Walter Scott Houston (editted by Stephen J. O'Meara) — Sky Publishing Corp.*

Norton's Star Atlas
editor, Ian Ridpath — Longman Scientific

Stars (part of the Collins GEM series) — *diminutive book that packs a lot in and is very highly recommended*

The Messier Catalog
by Stephen James O'Meara — Sky Publishing Corp.

Websites

The advent of the world wide web has proved a real boon to astronomy. Chat forums allow people share observations about recent celestial happenings or discuss the latest piece of equipment to come on the market. There's plenty out there for the binocular observer.

www.allthesky.com — very useful wide-angle constellation photographs with the brightest deep sky objects labelled

www.messier45.com — comprehensive resource that hosts a bewildering array of deep sky object catalogues

www.carbonar.es/s33/33.html — the S-33 Project has a selection of easy binocular doubles

skyandtelescope.com/howto/scopes/ — articles on choosing and using binoculars

www.hawastsoc.org/deepsky/constellations.html — constellation lore and what to see in each

www.seds.org/messier/ — in depth information on the Messier objects plus links to NGC data

freespace.virgin.net/m.poxon/hba-home.htm — Michael Poxon's online guide to the binocular deep-sky

www.cloudynights.com — very active discussion forums with one dedicated to all aspects of binoculars

www.aavso.org — a valuable repository of variable star observations, finder charts, and introductory guides