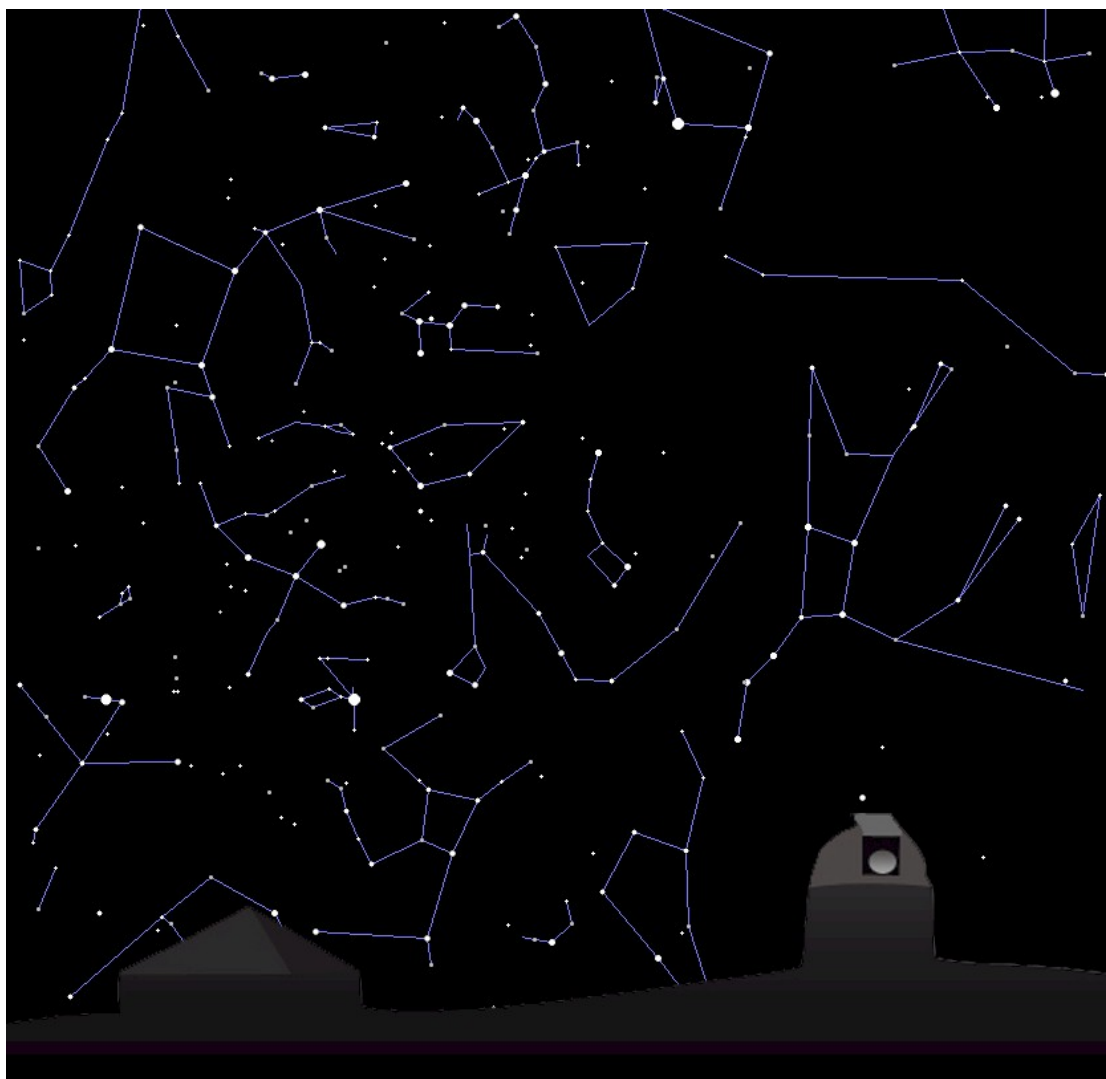




# Wynyard Planetarium & Observatory



## Autumn Observing Notes



Tour of the Sky with the Naked Eye

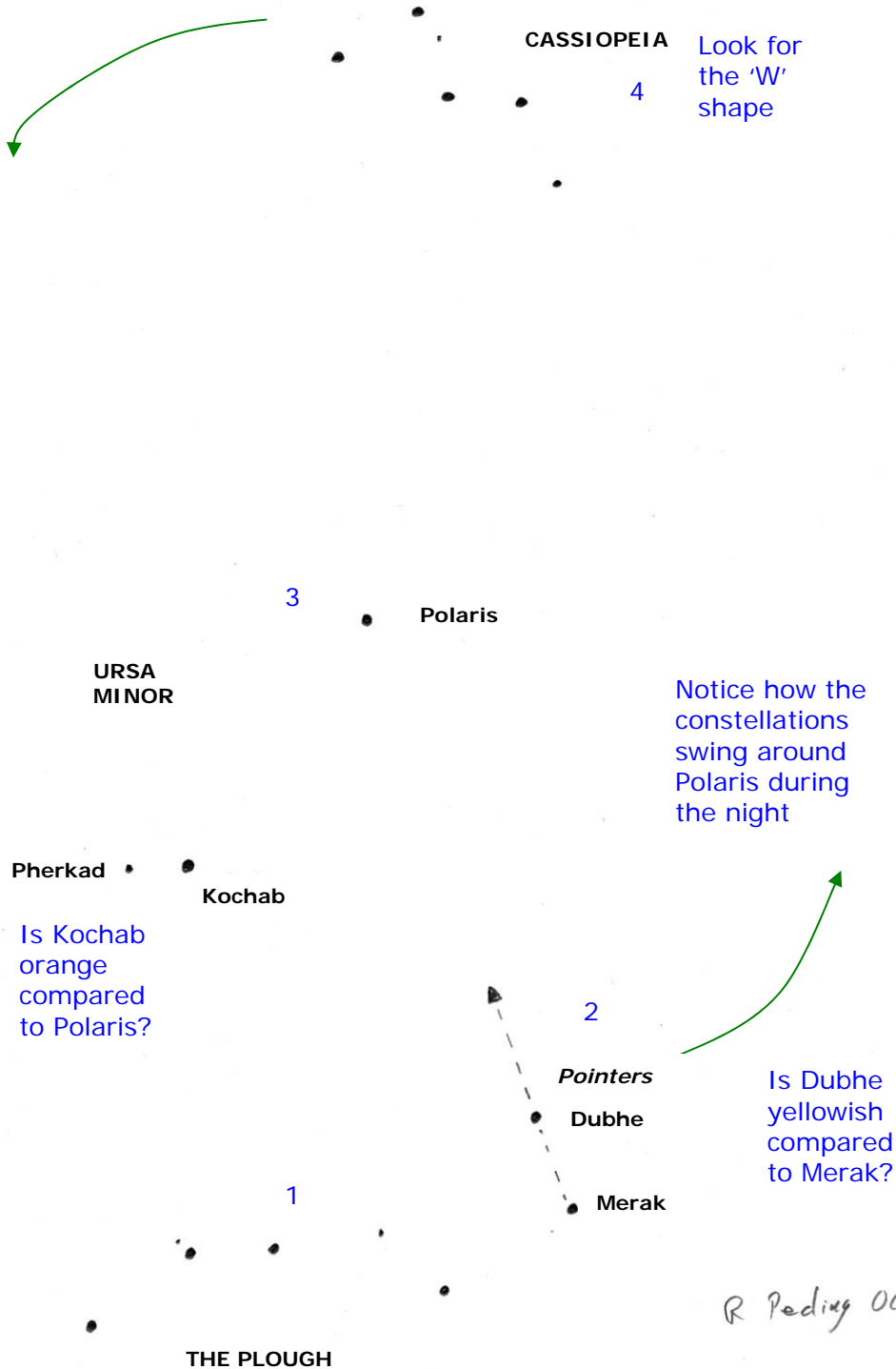


Figure 1: Sketch of the northern sky in autumn.





**North**

1. On leaving the planetarium, turn around and look northwards over the roof of the building. Close to the horizon is a group of stars like the outline of a saucepan with the handle stretching to your left. This is the Plough (also called the Big Dipper) and is part of the constellation Ursa Major, the Great Bear. The two right-hand stars are called the Pointers. Can you tell that the higher of the two, Dubhe is slightly yellowish compared to the lower, Merak? Check with binoculars. Not all stars are white. The colour shows that Dubhe is cooler than Merak in the same way that red-hot is cooler than white-hot.
2. Use the Pointers to guide you upwards to the next bright star. This is Polaris, the Pole (or North) Star. Note that it is not the brightest star in the sky, a common misconception. Below and to the left are two prominent but fainter stars. These are Kochab and Pherkad, the Guardians of the Pole. Look carefully and you will notice that Kochab is slightly orange when compared to Polaris. Polaris, Kochab and Pherkad mark the constellation Ursa Minor, the Little Bear.
3. Roughly continuing the line from the Pointers, through Polaris but swinging a little to the right is another bright group of stars high in the sky. They lie in a 'W' shape on its side. This is the constellation Cassiopeia. Continue the tour but look north again after at least 30 minutes and note how the Plough and Cassiopeia seem to have swung round Polaris slightly. This is caused by the Earth spinning on its axis to create day and night. Polaris lies on the axis (more or less directly above the north pole) and this is what makes it the Pole Star.

**West**

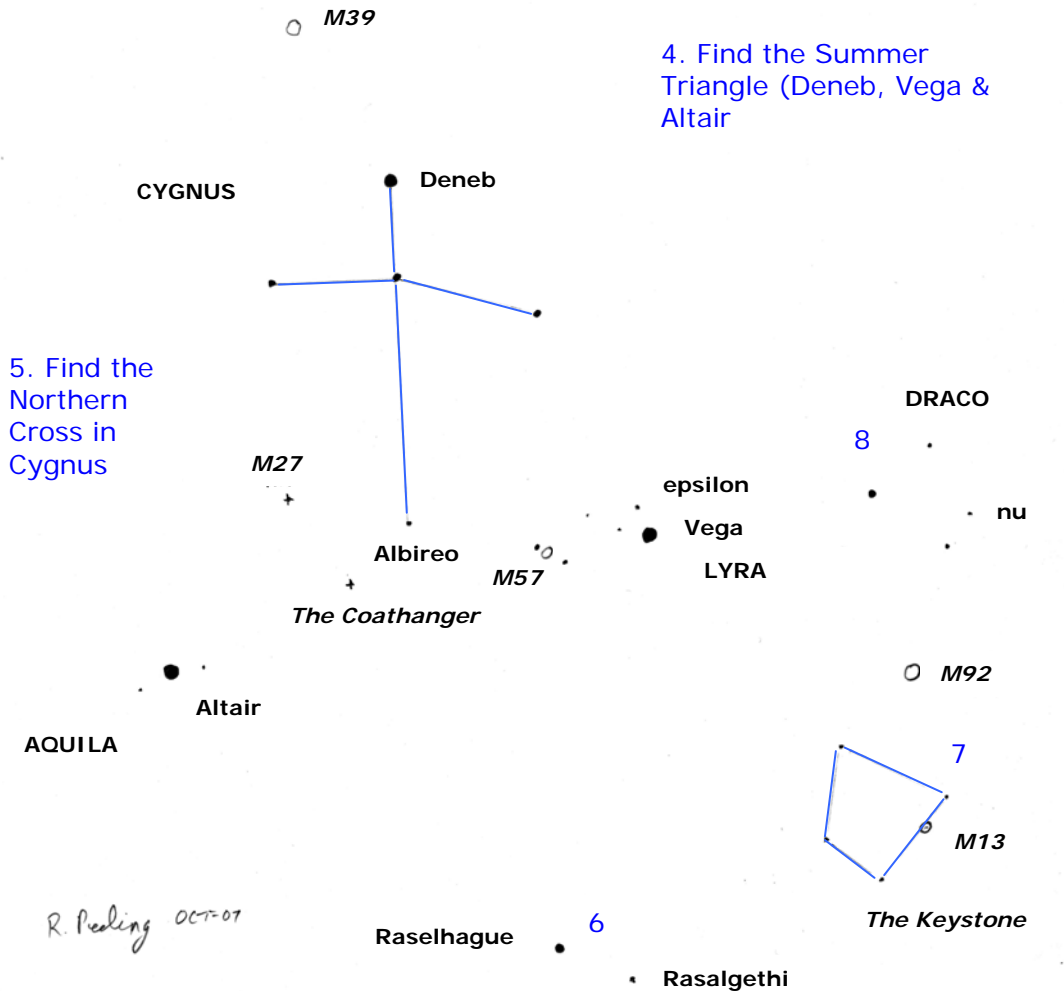
4. Turn to the left (west) and look for the three brightest stars. This is the Summer Triangle. The highest star is Deneb and it marks the tail of Cygnus, the Swan. Lower down to the left is Altair, bracketed by two fainter stars. This marks the constellation Aquila, the Eagle. Higher up and to the right is Vega in the constellation Lyra. In reality Deneb is the brightest of the three stars but the other two are much closer to Earth and so appear brighter:

Vega	26 light-years
Altair	17 light-years
Deneb	1400 light-years





A light year is the distance that light travels in one year, roughly 6 Trillion miles.



*Figure 2: Sketch of the western sky in autumn.*

- Start from Deneb and try to trace the shape of the Northern Cross with Deneb at the top and the line of three stars beneath making the Swan's wings. Further down, to complete the long leg of the cross and fainter than the other stars in the cross is Albireo, the eye of the Swan. Albireo is one of the best-known double stars. Any telescope will split this star into a beautiful yellow and blue pair.
- Dropping down from Vega there is another fairly bright star. This is Rasalhague in the constellation Ophiuchus. A little lower and to the right is a slightly fainter star, which is Rasalgethi in Hercules. Can you see a colour difference between the two stars? Rasalgethi is distinctly orange and is

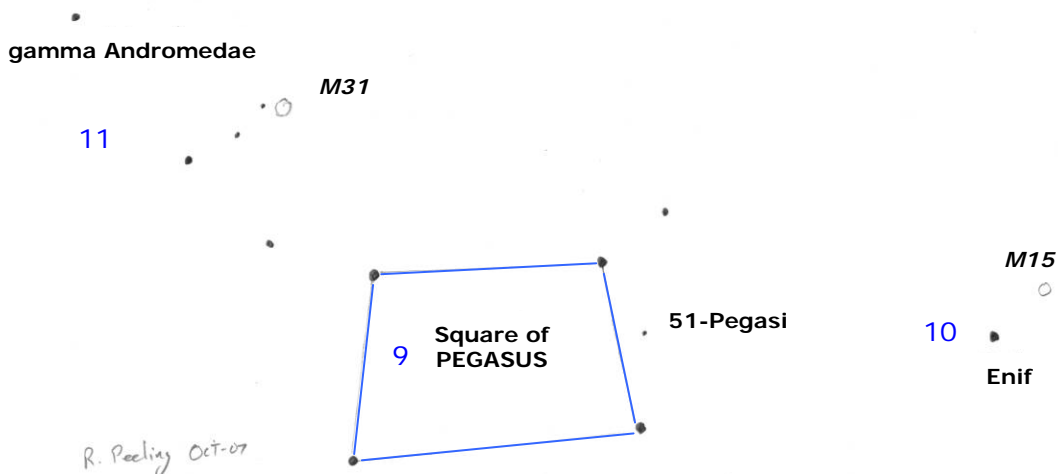




a 'red supergiant'. If Rasalgethi replaced our Sun in the Solar System then all the planets up to and including Mars would be *inside* this star. With a telescope Rasalgethi becomes a double. It can be slightly tricky to see but the orange star has a very close and much fainter blue/green companion. Many star names are Arabic in origin largely thanks to the Muslim astronomer Al Sufi who published his "Book of Fixed Stars" in the 10<sup>th</sup> Century.

7. Above and to the right of Rasalgethi, look for the faint but obvious pattern called the Keystone. This is part of the constellation Hercules. All these named shapes and patterns (which are not constellations) are termed asterisms. The stars in them are not necessarily near to each other in space, it is just how they look from Earth. The constellations were originally asterisms too. Nowadays the constellations are used more like labels for marking out 'estates' in the sky.
8. Above the Keystone and to the right of Vega is another faint but clear four-sided shape. This is the head of the rambling constellation of Draco.

## South



**Figure 3: Sketch of the southern sky in autumn.**

9. Turn to face south and look up. Can you pick out the Square of Pegasus? In the middle of the right-hand side lies the star 51-Pegasi which was the first sun-like star to be discovered to have a planet orbiting it. The planet is the size of Jupiter but much hotter because it is much closer to the star than Mercury is to our Sun.





10. Over to the right is a rather lonely yellowish star called Enif. It is still in the constellation of Pegasus.
11. The top left star of the square and a sweep of three more stars up to the left mark the constellation Andromeda.

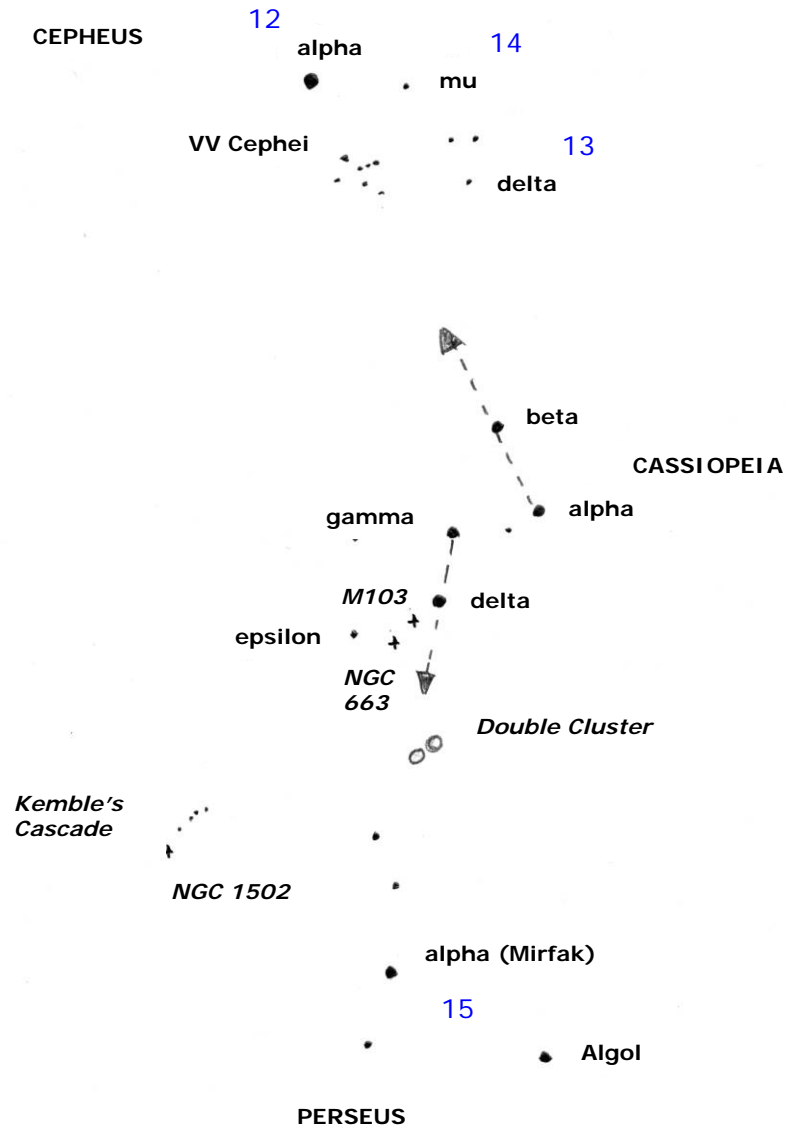
### **East**

12. Now face east and find Cassiopeia again and use the right-hand stars of the 'W', alpha and beta to point upwards to the next bright star, which will be almost overhead. This is alpha Cephei, the brightest star in the constellation Cepheus. Instead of using names, astronomers can also indicate a star by various numbering schemes or catalogues. Using Greek letters followed by the latin name of the constellation is a system originally devised by the German astronomer [Johann Bayer](#) in 1603, in his star atlas [Uranometria](#).
13. Look a little way back towards Cassiopeia and slightly off to your right to try and find a small, faint triangle of stars. At the tip of this triangle is delta Cephei. Watch this star every night for a week or two and compare its brightness to the other two stars in the triangle. You will notice that it varies in brightness to sometimes match the brighter and then the dimmer of the other two stars. The change is as regular as clockwork. This was discovered by John Goodricke in York in the 1780s. Variable stars of this particular type are called Cepheids after delta Cephei and are the essential tool for measuring the distances to other galaxies as shown by Edwin Hubble in 1925 using an understanding of the behaviour of Cepheids discovered by Henrietta Swan Leavitt in 1908. Through a telescope delta Cephei becomes a colourful double star. The yellow star is the variable together with a less bright blue companion.
14. Lying between the little triangle and alpha Cephei is the star mu Cephei – Herschel's Garnet Star. It is probably the reddest star visible to the naked eye. Mu Cephei is a red supergiant like Rasalgethi about 2000 light-years distant from Earth. It is even larger than Rasalgethi. If mu Cephei replaced our Sun in the Solar System then all the planets up to and including Jupiter would be inside it! The orange colour should be visible to the naked eye but check with binoculars if you like.





Wynyard Planetarium & Observatory  
**PUBLIC OBSERVING – Autumn**



R. Peeling. OCT-07

16

 Pleiades

**Figure 4: Sketch of the eastern sky in autumn.**

- Go back to Cassiopeia and use the stars gamma and delta to point downwards to the next bright star. This is alpha Persei, a hot young star in Perseus. To its right is another bright star called Algol, the Demon Star. If you watch at the right time (times can be found using the internet), the Demon will very slowly wink at you! It takes about 8 hours





from start to finish. This happens because a larger, fainter companion star is passing in front of the bright star usually seen. This type of system is called an eclipsing binary.

16. Later in the evening or later on in autumn, you will be able to see the Pleiades or Seven Sisters following Perseus up into the sky. How many stars can you see? Most people report six. They are arranged in a pattern like a mini version of the Plough. Now try binoculars and then a telescope. How many stars now? The Pleiades is a fairly typical open cluster that happens to be fairly close to Earth (378 light years away) which makes it big, bright and easy to see. The cluster contains several hundred stars.

### **Observing With Binoculars**

Some objects have already been mentioned which repay more detailed inspection with either binoculars or telescopes. The list is now expanded to include some more objects that can be seen using binoculars. Note that they are also all worth looking at with telescopes.

### **West (refer to figure 2)**

#### Epsilon Lyrae – the Double-Double

Look at Vega using binoculars and move slightly above Vega but still keep this star just in view. You will see two bright, blue-white stars close together. This is epsilon Lyrae the Double-Double. The stars you see are orbiting each other but at a great distance. To understand the name you will need to use high power with a telescope to find that each star splits again into a close double. Double-double systems are actually quite frequent and this fact must be telling us something about how stars form.

#### Nu Draconis – a double star

Find the head of Draco as described before. With binoculars, examine the faintest of the four stars to reveal it as a double.

#### M13 – the Great Hercules Cluster

Find the Keystone asterism in Hercules and look  $\frac{2}{3}$ <sup>rd</sup> of the way up the right-hand side of the shape. You will see something looking like a fuzzy star. This is a compact ball containing 300,000 to 500,000 stars lying 23,400 light-years away discovered in 1714 by Edmond Halley. This is one of the best and largest globular clusters. There are perhaps 200 of these orbiting our galaxy and







they contain the oldest stars in the galaxy – about 10 billion years old. M13 is the Messier number of this object. The Messier catalogue was compiled by Frenchman Charles Messier in ~1780 as a list of 110 fuzzy objects he didn't want to mistake for the comets he was searching for. Ironically his list of reject objects is now the most used reference to some of the most beautiful and interesting objects in the sky for modern observers. With a telescope, M13 starts to split apart into individual stars as magnifying power is increased. On a good night it will appear to glisten and pulsate – beautiful!

### M92 – another globular cluster in Hercules

After M13, sweep along to the middle of the top edge of the Keystone and find a little row of 3 stars pointing upwards. Follow their guide a sweep upwards to look for another fuzzy star. It is a bit of a challenge, so you will need to search patiently. This globular cluster is at a similar distance to M13 and therefore must be smaller. It too responds well to high power with a telescope.

### M39 – an open cluster in Cygnus

Starting from Deneb, scan up and to the left through the swarms of stars in this region of the Milky Way. A knot of perhaps a dozen stars should stand out. This is M39 which is an open cluster of stars which formed together. Open clusters are very common and roam the galaxy until the passage of time disrupts them as the stars are not strongly held in the cluster. The result is solitary stars like our Sun.

### Collinder 399 – the Coathanger

The Coathanger is an asterism. Start from the head of Cygnus with the star Albireo and sweep slowly over towards Altair (see figure 6). Figure 5 shows what you are looking for, a line of stars with a hook underneath. Turn the figure upside down and the name of this cluster makes sense. This is how the Coathanger appears in most telescopes because the design of the optics inverts the image. Collinder is another example of the many catalogues of objects that astronomers have compiled over the years. Collinder is a list of open clusters. For many years Collinder 399 was thought to be an open cluster, however research in 1998 showed that it is not.





*Figure 5: Collinder 399, the Coathanger. Sketch by R Peeling using 150mm Newtonian telescope with 25mm Plossl lens, 29-Aug-2005.*

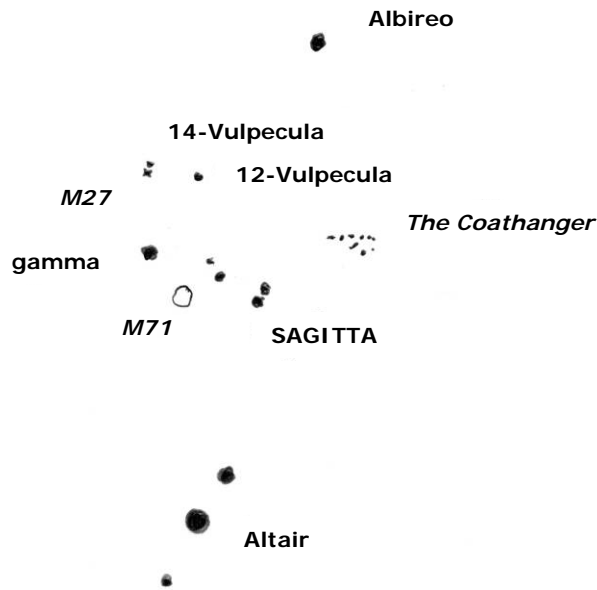
#### M27 - the Dumbbell Nebula in Vulpecula

Between Altair and Cygnus lies the small, faint constellation Sagitta, the Arrow. Find (figure 6) gamma at the arrow's point and look up and right towards Cygnus but staying fairly close to Sagitta. Two stars should stand out, 12 and 14 Vulpeculae. Pick the fainter one, 14 Vulpeculae and look just below it for a fuzzy patch. The Dumbbell Nebula was the first planetary nebula to be discovered (by Messier himself). It is glowing shell of gas thrown out by the dying star at the centre. All that's left of the star is the core, shrinking to become a white dwarf. It is incredibly hot and so mostly shines with ultra-violet light (which is why you can't easily see it). The ultra-violet makes the gas in the shell that originally the star's outer layers fluoresce, which is what we see. The central stars of planetary nebulae are the hottest stars known. This one is at 160,000 K. Compare it to the Sun's temperature of 5780 K.

#### M71 – a globular cluster in Sagitta

In the same region of the sky as M27, you can also find this loose but beautiful globular cluster. Go back to Sagitta and about half-way along the shaft of the arrow, and down a little, you should see another fuzzy star that through a telescope is easily resolved into a compressed mass of stars, with a bright centre, about 13,000 light years away.





*Figure 6: Finding Collinder 399 and M27.*

**South (refer to figure 3)**

M15 – globular cluster in Pegasus

Find Enif and move the binoculars until Enif is at about the 8 o'clock position on the edge of your view. Keep moving until what is a 2 o'clock is in the centre of your view. M15 should be visible as a fuzzy star. M15 is a little larger than M13 but at 30,600 light-years it is significantly further away and therefore less impressive. It responds well to high power in a telescope. M15 has the distinction of containing the first planetary nebula to be discovered in a globular cluster, Pease 1. Don't expect to be able to see it though.

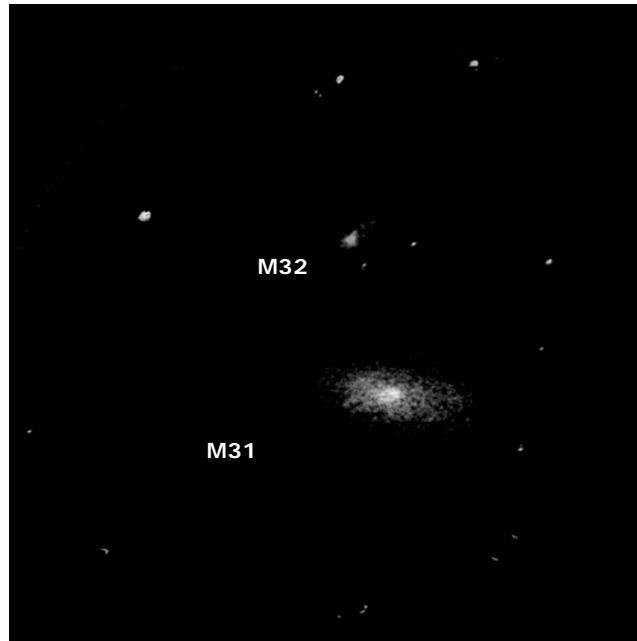
M31 – the Andromeda Galaxy

M31 is a spiral galaxy very similar but rather larger than our Milky Way. It is on collision course with us but don't worry, impact is in 2 billion years time. It is 2.9 million light-years away. This makes it the furthest object easily seen with the naked eye. However this isn't normally possible from the Planetarium because the sky is never dark enough but it can be seen by naked eye from up in the Cleveland Hills. To find it start with the top-left star of the Square of Pegasus and count two more stars along into Andromeda. Now count upwards another two stars and search for a milky patch close to the final star. In good conditions you will see that the brightness is concentrated in the middle but that it spreads outwards a surprising distance (figure 7). Don't miss an opportunity to view M31 with a telescope. On a good night with a wide field lens you





can see two more galaxies at the same time as M31. These are its satellite galaxies M32 and M110 which orbit the Andromeda galaxy just like the two Magellanic clouds orbit our galaxy (the Milkyway).



*Figure 7: Galaxies M31 & M32. Sketch by R Peeling using 150mm Newtonian telescope with 25mm Plossl lens, 07-Dec-2004.*

### Uranus

The planet Uranus can easily be seen with binoculars but it is a bit of a challenge because in binoculars it looks just like a star. It will be to the south in the autumn skies, at least until 2015. As it is a planet it moves noticeably week on week with respect to the background stars. You will need an up to date star chart to find it. The only way a telescope helps with this challenge is that Uranus shows as a planetary disk giving definite confirmation of success. It will take some effort but if you succeed then you will be improving your observing skills – good luck!

### East (refer to figure 4)

#### M103 & NGC 663 – open clusters in Cassiopeia

Scan with binoculars the are between delta and epsilon Cassiopeiae. You should see at least two small, fuzzy patches (on really clear, dark nights up to five patches may be visible). All the patches are open clusters. The one closest to delta is M103. NGC 663 is a bit off-line but halfway from delta to epsilon. Both clusters are well worth a look with a telescope. NGC 663 sports two bright doubles in its heart. M103 seems like a bright line of coloured stars surrounded by the cluster.



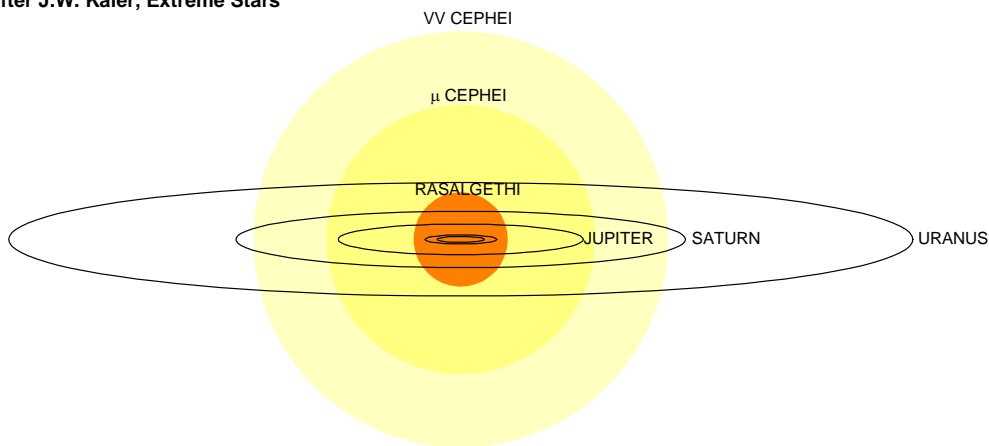


VV Cephei – the largest star known

Start from alpha Cephei and work a little way towards Cassiopeia (roughly parallel to the triangle containing delta Cephei). Look for what appears to be a funnel of two converging lines of three bright stars. Slightly away towards alpha Cephei from the narrow end of the funnel is the decidedly yellowish VV Cephei. Don't mistake it for the brighter xi Cephei slightly further away on the other side of the funnel. VV Cephei is another red supergiant and is the largest star known – see figure 8.

The size of the largest stars compared to the orbits of planets in the Solar System

Diagram after J.W. Kaler, *Extreme Stars*



**Figure 8: The largest stars known.**

Melotte 20 – Alpha Persei Moving Cluster

Turn your binoculars on alpha Persei. Many blue-white stars fill the sky around it. This is Melotte 20 or the Alpha Persei Moving Cluster. It is an association of young, hot stars located ~600 light-years away and moving at 16 km/s to the southeast. Don't forget to look at the Pleiades below alpha Persei before moving on.

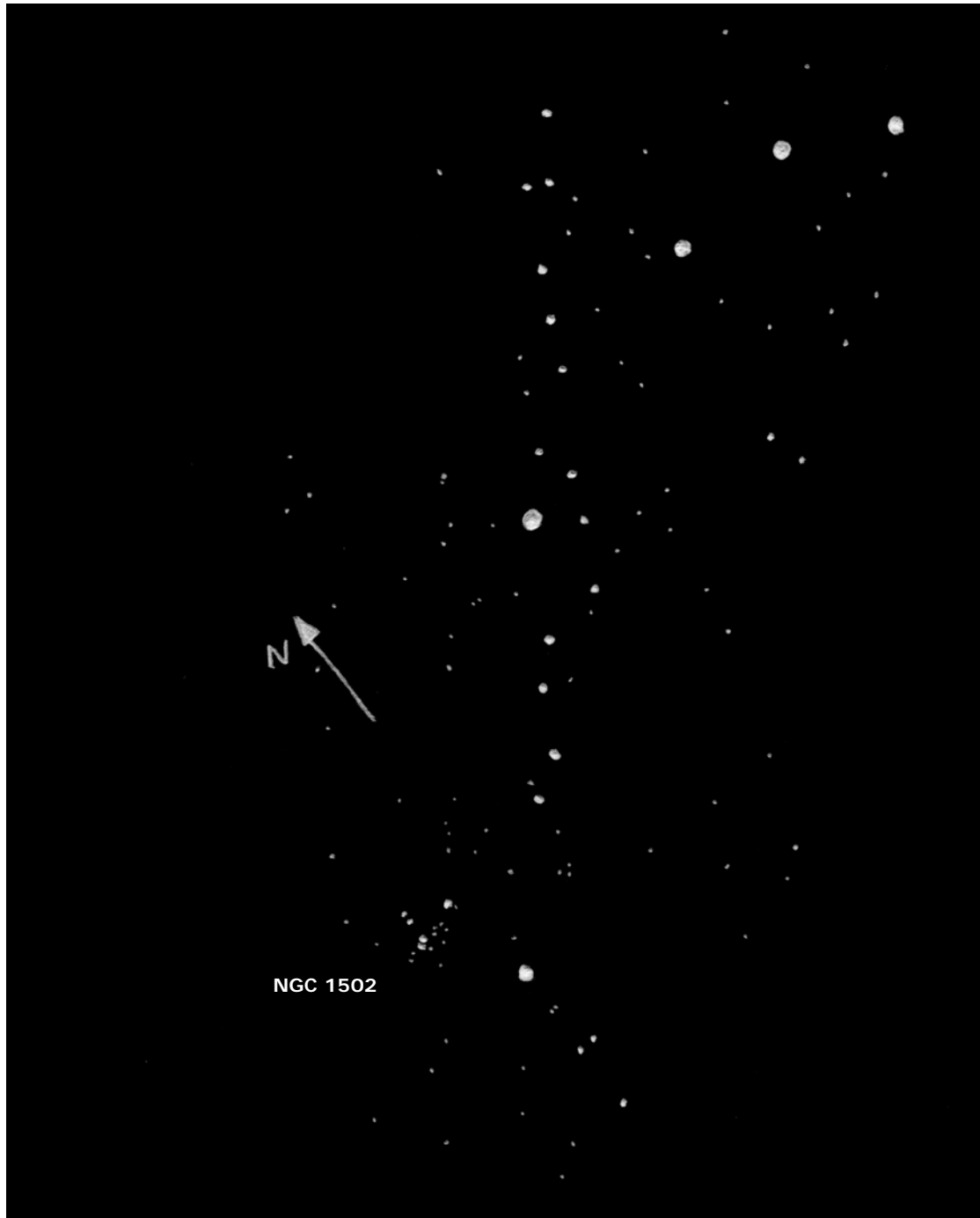
Kemble's Cascade & open cluster NGC 1502

Using alpha Persei and Algol to point the direction, sweep slowly out to the east. Look for a gentle curve of four stars consisting of three evenly spaced with the last further east and slightly lower. Look very carefully above and below the separated star to see the faint glimmer of a long straight line of faint stars. It stretches upwards past the curve of three stars and downwards to another star with the glimmer of a cluster to the left of it. The open cluster is NGC 1502 and the faint line of stars is an asterism called Kemble's Cascade (figure 9). Looking at it, it is hard to believe that this is chance arrangement of stars. They all lie at a range of distances





and in reality have nothing to do with each other. Try scanning up and down the cascade and take a close look at NGC 1502. There is a good double star embedded in it.



*Figure 9: Kemble's Cascade. Sketch built up from 4 fields by R Peeling using 150mm Newtonian telescope with 25mm Plossl lens, 28-Aug-2005.*





## Observing With a Telescope

Where appropriate, comments have been made on viewing the objects described with a telescope throughout the preceding notes and so only a few additional objects are suggested here.

### M57 - Ring Nebula in Lyra (figure 2)

Below and to the left of Vega are two fainter stars. Further down and to the left are two more. These stars define the lyre shape of the constellation. Fit a low power eyepiece and aim the telescope mid-way between the lower pair. A tiny ring of smoke should appear in your field of view. Centre the Ring Nebula and increase power. This is one of the most viewed objects in the sky. It is a planetary nebula and was first reported by Antoine Darquier de Pellepoix in 1779. The central star's temperature is 145,000 Kelvin, not quite as hot as M27. Can you see that the ring is filled with a faint glow and there is a faint star lying just outside the ring?

### Gamma Andromedae – colour contrasting double (figure 3)

Start from the top-left star in the Square of Pegasus. Count out an 3 stars along Andromeda to well over towards Perseus and Cassiopeia. Through the telescope it should split into a pair. The brighter star is yellow-orange and the other is white.

### NGC 864 & 889 – the Double Cluster

The Double Cluster marks the hilt of Perseus's sword as he decapitates Medusa. It is visible with binoculars but not particularly impressive but this means you can spot it with a finder telescope. Through a telescope it is superb. It consists of two large open clusters that are separate but located close together in space. You will see hundreds of stars in each cluster. To find the Double Cluster sweep the finder scope down from delta Cassiopeia about a third of the way to alpha Persei. Gamma and delta Cassiopeiae indicate the direction. You should spot two faint concentrations of stars. After examining the Double Cluster, fit a low power lens and move the telescope gently north (towards Cassiopeia). Just after the Double Cluster drops out of the field of view, another larger but fainter open cluster will appear. This is Stock 2, nicknamed the 'Strong Man'. Look for a stick-man made of lines of stars with his hands clasped over his head.





[Hwww.wynyard-planetarium.netH](http://www.wynyard-planetarium.net)  
[Hdirector@wynyard-planetarium.netH](mailto:director@wynyard-planetarium.net)  
+ 44 (0) 1740 630544  
[Hwww.negas.org.ukH](http://www.negas.org.uk)