The angular measurements of some objects

Your outstretched hand at arm's length	22°
Distance apart of the Pointers of the Plough	5°
Your forefinger at arm's length	1° (your Moon/Sun diameters)
Your little finger at arm's length	0.5°
The Sun	0.5°
The Moon	0.5°
Distance of Ganymede from Jupiter (the brightest of the Jovian planets)	6′
Resolution of the unaided eye	≥ 3′
Maximum size of Venus	1′
Biggest crater on the Moon	1′
Your eye can see objects as small as	≥ 1′

Greek alphabet

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

Starry Objects

Galactic cluster : lots of younger stars in a group

Globular cluster : lots of stars ($\sim 10^5$) in a spherical-shaped group.

Nebula : a cloud of dust and gas illuminated by stars.

Galaxy : an enormous number of stars ($\sim 10^{11}$) beyond our own Milky Way system (I like the old description "Island Universes")

Emission nebulae — the brightest — shine because of hot stars embedded in them.

Reflexion nebulae — visible because they reflect the light of nearby stars.

Dark nebulae — gas and dust with no nearby stars. They absorb the light of anything behind.

Planetary nebulae — some stars "puff" off their outer layers at the end of their processes, leaving a small, hot, energetic star. The layers expand outwards, shining with radiation from the central star.

Black hole

One type is the remains of a massive, "old", "dead" star. Fuel is the process of fusion, keeping the stellar object shining brightly. Once the nuclear transformations cease, the internal pressure begins to decrease. The force of gravity begins to dominate and the star collapses. Consequently, the gravitational field strength increases to such an extent that not even light can escape and it appears black, hence the name.

JF²

$$v_{escape} = \sqrt{\frac{2GM}{R}}$$

Use $M = M_{\odot} = 2.0 \times 10^{30}$ kg

$R = R_{\odot} = 6.9 \times 10^{8}$ m

$G = 6.67 \times 10^{-11}$ N m² kg⁻²

With its present mass, what must be the radius of the Sun for it to have a velocity of escape of c, that is, 3.0×10^{8} m s⁻¹ ?

Substituting:

$$3.0 \times 10^{8}\ m\ s^{-1} = \sqrt{\frac{2 \times 6.67 \times 10^{-11}\ N m^2 kg^{-2} \times 2.0 \times 10^{30}\ kg}{R}}$$

Squaring both sides and rearranging:

$$R = \frac{2 \times 6.67 \times 10^{-11}\ N m^2 kg^{-2} \times 2.0 \times 10^{30}\ kg}{9.0 \times 10^{16}\ m^2 s^{-2}}$$

$$= 3000\ m\ (3\ km)$$

Check that the units reduce to "m". Note that "N" can be rewritten as "kg m s⁻²"

What would be the density of this object?

$$d = \frac{m}{V} = \frac{2.0 \times 10^{30}\ kg}{\frac{4}{3}\pi \times (6.9 \times 10^{8}\ m)^3}$$

Glossary

Asterism Easy-to-remember group of stars generally, but not exclusively, within a constellation, eg the Plough.

Ecliptic A Greek word meaning "place of eclipses." This imaginary line is the path that the Sun takes around the sky over one year. The ecliptic passes through twelve constellations (out of a total of eighty-eight), giving rise to our "signs of the Zodiac." The word "zodiac" means "line of animals," and our word "zoo" comes from the same source.

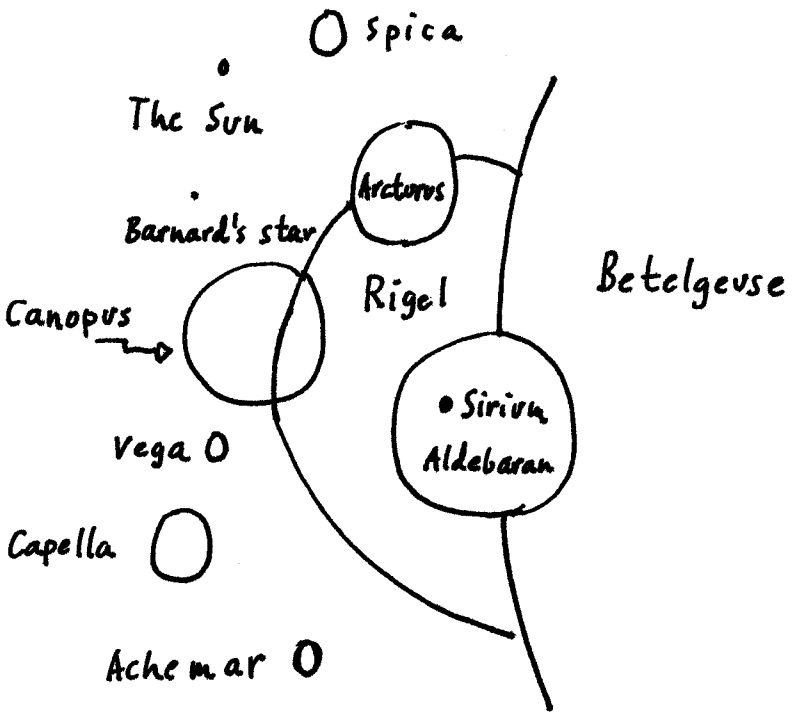
Incidentally, "zoology" is pronounced "zo-ology" and "zoologist" is pronounced "zo-ologist".

Pole star The name given to any bright star that happens to be above the Earth's North (or South) pole.

At present, Polaris is the Northern Pole star. Because of Precession ($T_p \sim 25,800$ years), the axis of the Earth points to different parts of the sky, and so different stars can become the Pole star.

In the Northern hemisphere, we find that the bright star Vega (in Lyra) and Thuban (in Draco) will be, and already have been, the Pole star.

Some stellar sizes and visual (apparent) magnitudes



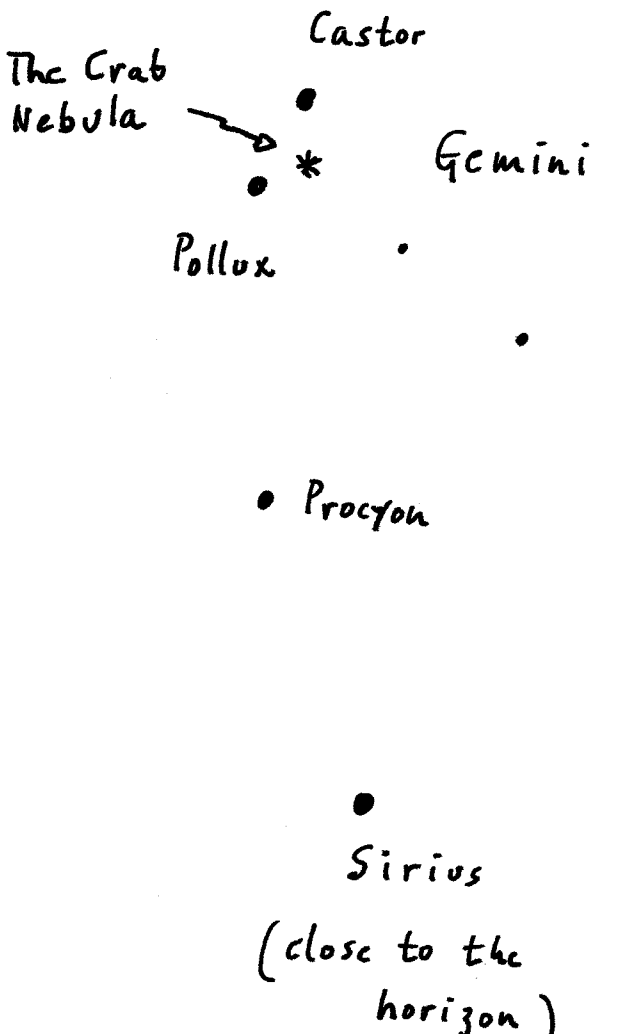
If Betelgeuse were located where the Sun is, its "surface" would be out near to the orbit of Jupiter.

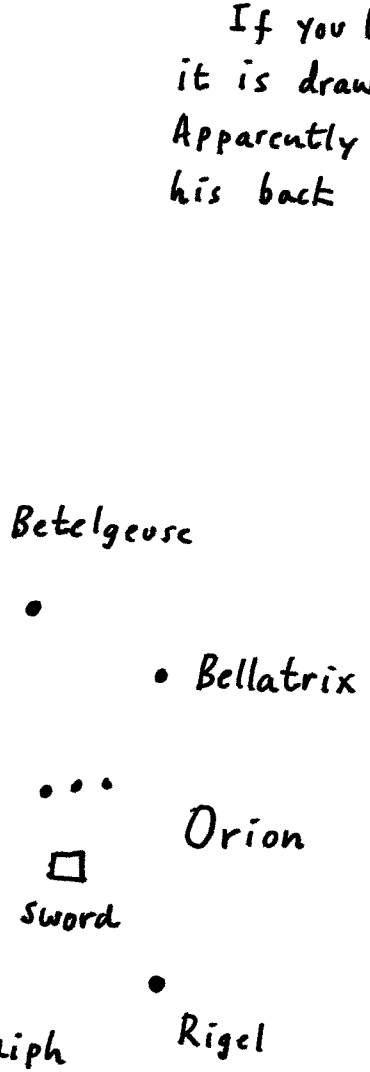
Star	Distance (light year)	Visual magnitude	Constellation
The Sun	Close	-26·7	
Proxima Centauri	4·27	11·0	Centaurus
Sirius A	8·6	-1·46	Canis Major
Arcturus	3·7	-0·04	Boötes
Vega	25	0·03	Lyra
Rigel	773	0·12	Orion
Procyon	11	0·38	Canis Minor
Betelgeuse	427	0·3 ⟶ 1·0	Orion
Sirius B (the "Pup")	8·6	8·44	Canis Major

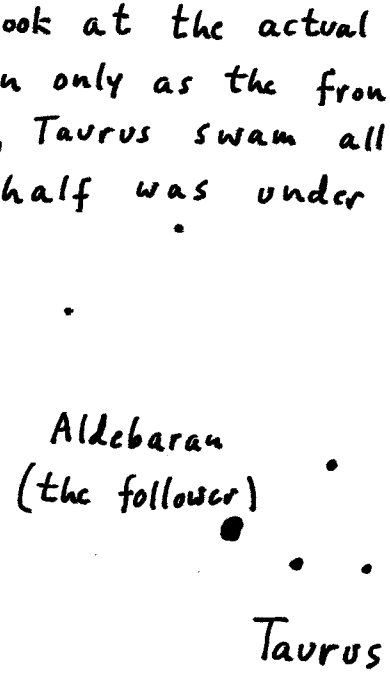
Note:

3·26 l.y. = 1 pc

Some important winter constellations







If you look at the actual design of Taurus, it is drawn only as the front half of a Bull. Apparently, Taurus swam all the way to Crete, so his back half was under water and invisible

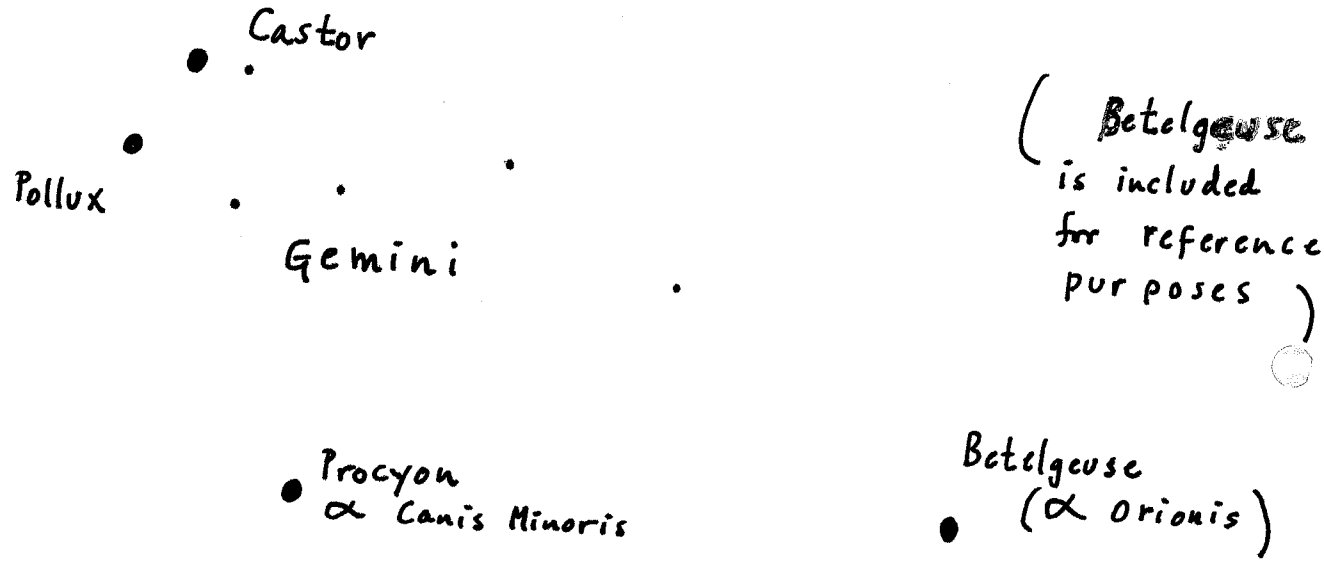
The Pleiades

Are one of the jewels of the skies. In a dark location you might be able to see ten stars. The group actually contains many hundreds. Binoculars will reveal the glories of the group. The Pleiades are moving through a nebulous cloud, which shines by reflecting the light. However, only a photograph reveals this aspect.

Gemini

Another one of the fine winter constellations, the two leading stars are the twins Castor ("the warrior") and Pollux ("the boxer"). They were Argonauts with Jason on the search for the Golden Fleece. Strangely, Pollux (β Gem.) is brighter than Castor (α Gem.), but according to legend Castor has faded over centuries.

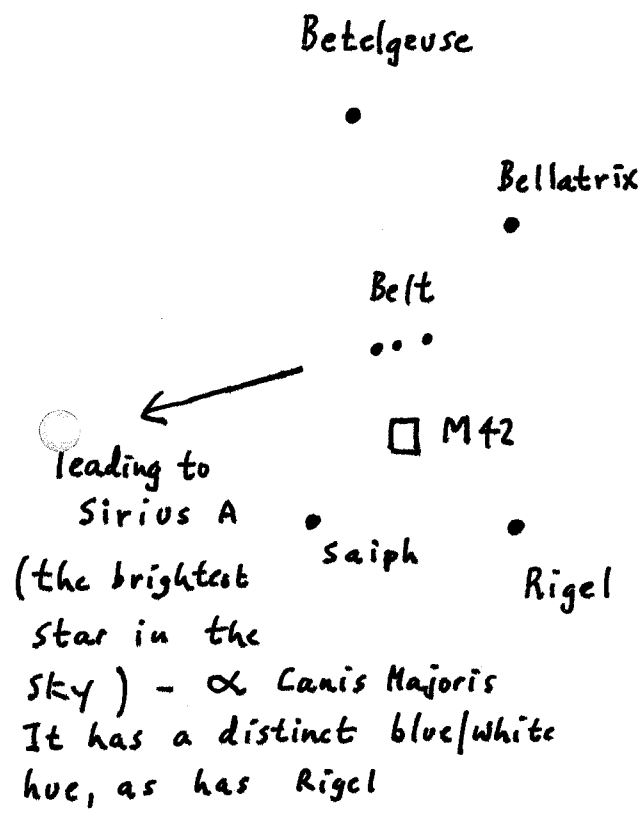
Castor is really a double star if you see it through a telescope. Even then, it is not that seems: there are doubles galore in the Castor system. A total of three doubles are orbiting around each other in times varying from nine days to ten thousand years (sic)



This is the constellation in which Pluto was observed on its discovery (1930)

Orion

This is the brightest of the constellations, because it contains more bright stars than any other. It dominates the winter sky.



Rigel has a bluish-white hue (high surface temperature) and is brighter than Betelgeuse for most of the time.

Betelgeuse is a truly enormous variable star, changing its brightness over about six years.

Between Rigel and Betelgeuse there are three stars in almost perfect alignment, making up the belt. However, they are not linked, apart from the line-of-sight effect.

Such an easily recognisable pattern is called an <u>asterism</u>.

M42, the Orion Nebula, is a famous fuzzy patch that can be seen with your unaided eye. Also known as the "Sword of Orion". It is an emission nebula, glowing because of the stars within it (notably θ Orionis). About one thousand stars are being formed here, a so-called stellar nursery.

Magnitude 4·0

Angular size 1° (about two Moon/Sun diameters)

Distance 490 pc (1600 l.y.)

DF

2013, April 2