

## Chapter 2

# The Stars

This chapter deals with those objects that are easily the most familiar to us all, whether astronomers or not – the stars. Stars are the first things you notice in the sky as soon as you step out on a clear night, and for most of us they are usually the initial target of any observing session, whether it be to align the telescope or judge the seeing conditions.

You may be forgiven in thinking that one star looks very like another, and to a casual observer this may well be true, whereas experienced amateurs will know that the stars differ from each other in many fascinating ways and are a rich source for study. This chapter looks at the brightest and nearest stars, along with double, triple and even quadruple star groupings. Also included are examples of the different spectral classification types of stars. There's even a section devoted to colored stars!

But before we start looking at the stars themselves, it is important that we cover some basic astrophysics, and it will be basic! From this point on, we will be mentioning such topics as luminosity, spectral classification, and so on, so let's begin by explaining in detail what is meant. It is no use, and indeed pointless, if certain details about a star are given without an explanation of what is meant by the information.

### Starlight

When you go out into the evening, the only immediate difference you notice between the stars is their brightness, or magnitude. Yet most amateur astronomers are aware that some stars are called white dwarfs, while others are red giants.

Some are old stars, while there are a few that are relatively young. How were these things discovered? Furthermore, even to the untrained naked eye a few stars have a perceptible color – Betelgeuse ( $\alpha$  Orionis)<sup>1</sup> is most definitely red, Capella ( $\alpha$  Aurigae) is yellow, and Vega ( $\alpha$  Lyrae) is steely blue. What causes stars to have such different colors, and why aren't all the stars visibly multicolored?

Well, stars can be classified into various groups, and these groups relate to the stars' temperature, size and color. In fact, the classification is so exact that in certain cases star masses and sizes can also be determined.

The history of stellar classification is a fascinating study in itself, but is not really important to us here. We will just explain the basic principles and how these are related to the stars that you observe. But before we go any further, it's probably worth discussing just what a star is!

A star is an immense ball of gas.<sup>2</sup>

It is as simple, or as complex, as that, whichever way you wish to look at it. Owing to its very large mass, and its concomitant strong gravitational field, conditions in the center of the ball of gas are such that the temperature can be about 10 million Kelvin. At this temperature the process of nuclear fusion occurs – and a star is born!

The gases composing the star are hydrogen, the most common element in the universe, along with some helium and then some other elements.<sup>3</sup> By and large, most stars are nearly all hydrogen (~75%),<sup>4</sup> with just a few percent helium (~24%), and very small amounts of everything else (~1%). As the star ages, it uses up more and more hydrogen in order to keep the nuclear reactions going. A by-product of this reaction is helium. Thus, as time passes, the amount of hydrogen decreases and the amount of helium increases. If conditions are right (these include a higher temperature and a large mass) then the helium itself will start to undergo nuclear fusion at the core of the star. This in turn will produce, as a by-product of the reaction,

---

<sup>1</sup> To explain how stars are named would take a book in itself. Suffice to say that many of the brighter stars were given Arabic names, for example, Betelgeuse, Rigel, and so on, for the simple reason that they were originally named by the ancient Arabian astronomers. The name in brackets signifies a star's listing in order of brightness in that particular constellation. Thus  $\alpha$  Orionis (Betelgeuse) is the brightest star in the constellation Orion,  $\beta$  Orionis (Rigel), the second brightest, and so on and so forth. When all the letters of the Greek alphabet are used up, numbers are then given to the stars; thus: 1 Orionis, 2, Orionis and so on. The use of the Greek alphabet for referencing stars is called the Bayer classification system, while using a number is the Flamsteed system.

<sup>2</sup> In fact, the gas in a star is more properly called a plasma. A plasma is a collection of electrons and ions – atoms that have had electrons stripped from them.

<sup>3</sup> Astronomers call every element other than hydrogen and helium, metals. It's odd, I agree, but don't worry about it – just accept it.

<sup>4</sup> These percentages will of course change slightly as the star ages and uses up its store of hydrogen, thus increasing the amount of helium, and other elements.

the element carbon, and again, if conditions are suitable, this too will start to begin nuclear fusion and produce more energy.

Note that each step requires a higher temperature to begin the nuclear reactions, and if a star does not have the conditions necessary to provide this high temperature then further reactions will not occur. Thus the “burning” of hydrogen and helium is the power source for nearly all the stars you can see, and the mass of the star determines how fast, and how far, the reaction will proceed.

To determine the classification of stars one needs a spectroscope. This is an instrument that utilizes either a prism or a diffraction grating to analyze the light. You’ll be aware that white light is in fact a mixture of many different colors, or wavelengths, so it’s safe to assume that the light from a star is also a mixture of colors. Indeed it is, but usually with an added component. Using a spectroscope mounted at the eyepiece end of the telescope,<sup>5</sup> light from the star can be collected and analyzed. The end result is something called a spectrum.

Basically, a spectrum is a map of the light coming from the star. It consists of all of the light from the star, spread out according to wavelength (color) so that the different amounts of light at different wavelengths can be measured. Red stars have a lot of light at the red end of the spectrum, while blue stars have a correspondingly larger amount at the blue end. However, the important point here is that in addition to this light, there will be a series of dark lines superimposed upon this rainbow-like array of colors. These are called *absorption lines* and are formed in the atmosphere of the star. In a few rare cases, there are also bright lines, called *emission lines*. These lines, although comparatively rare in stars, are very important in nebulae.<sup>6</sup> The origins of the absorption lines are due to the differing amounts of elements in the cooler atmosphere of the stars absorbing the light at very specific wavelengths (recall that it was mentioned earlier that in addition to hydrogen and helium, there are also the other elements, or metals, present, although in minute quantities).

The factor that determines whether an absorption line will occur is the temperature of the atmosphere of a star. A hot star will have different absorption lines from a cool star – the classification of a star is determined by examining its spectrum and measuring aspects of the absorption lines. Thus the observational classification of a star is determined primarily by the temperature of the atmosphere and not the core temperature. The structure of the absorption lines themselves can also be examined, and this gives further information on pressure, rotation and even whether a companion star is present.

---

<sup>5</sup>Some spectroscopes place the prism or grating in front of the telescope, and thus the light from *every* star in the field of view is analysed simultaneously. This is called an *objective spectroscope*. The drawback is the considerable loss of detail about the stars, but does allow initial measurements to be made.

<sup>6</sup>See Chap. 4 for a discussion about the processes that make nebulae shine.

Star Classification

Having seen how stars are distinguished by their spectra (and thus temperature), let’s now think about the spectral type. For historical reasons a star’s classification is designated by a capital letter; thus, in order of *decreasing* temperature, you have:

O B A F G K M<sup>7</sup>

The sequence goes from hot blue stars types O and A to cool red stars K and M. In addition there are rare and hot stars called *Wolf-Rayet* stars, class WC and WN, exploding stars Q, and peculiar stars, P. Furthermore, the spectral types themselves are divided into ten spectral classes beginning with 0, 1, 2, 3 and so on up to 9. A class A1 star is thus hotter than a class A8 star, which in turn is hotter than a class F0 star. Further prefixes and suffixes can be used to illustrate additional features:

A star with emission lines (also called f in some O-type stars)	e
Metallic lines	m
A peculiar spectrum	p
A variable spectrum	v
A star with a blue or red shift in the line (for example P-Cygni stars)	q

And so forth. For historical reasons, the spectra of the hotter star types O, A and B are sometimes referred to as *early-type* stars, while the cooler ones, K, M, C and S, are *later-type*. Also, F and G stars are *intermediate-type* stars.

Finally, a star can also be additionally classified by its *luminosity*, which is related to the star’s intrinsic brightness, with the following system:

Hypergiants	O
Supergiants <sup>8</sup>	I
Bright giants	II
Giants	III
Subgiants	IV
Main sequence (dwarfs)	V
Subdwarfs	VI
White dwarfs	VII

<sup>7</sup>The full classification system is somewhat more complex (naturally!). It runs something like this; O B A F G M L T Y R N S. The L stars are dwarf stars, The T stars are brown dwarfs while the Y stars are sub-brown dwarfs. As of the time of writing, no Y objects have yet been discovered! The star types R, N and S actually overlap class M, and so R and N have been reclassified as C-type stars, the C standing for carbon stars. Complicated, isn’t it!

<sup>8</sup>These can be further subclassified into Ia and Ib, with Ia the brighter.

It’s evident that astronomers use a complex and seemingly confusing system! In fact several classes of spectral type are no longer in use, and the luminosity classification is also open to confusion. It will not surprise you to know that there is even disagreement among astronomers as to whether, for example, a star labeled F9 should be reclassified as G0. Nevertheless, it is the system used and so will be adhered to here. Examples of classification are:

$\alpha$ Boötes (Arcturus)	K2IIIp
$\beta$ Orionis (Rigel)	B8Ia
$\alpha$ Aurigae (Capella)	G8 III
P Cygni	B1Iapec
Sun	G2V

Let’s recap what has just been discussed. You will recall that the classification was based on the detection of absorption lines, which in turn depend on the temperature of the star’s atmosphere. Thus, the classification relies on the detection of certain elements in a star, giving rise to a temperature determination for that star.<sup>9</sup> The classification can be summarized best by Table 2.1.

Having now briefly discussed the various stellar parameters and classifications, let’s begin our exploration of the night sky.

Table 2.1 Star spectral classification				
Spectral-Type	Absorption lines	Temperature	Color	Notes
O	Ionized helium (HeII)	35,000 K+	Blue-white	Massive, short-lived
B	Neutral helium first appearance of hydrogen	20,000 K	Blue-white	Massive and luminous
A	Hydrogen lines singly ionized metals	10,000 K	White	Up to 100 times more luminous than Sun
F	Ionized calcium (CaII), weak hydrogen	7,000 K	Yellow-white	
G	CaII prominent, very weak hydrogen	6,000 K	Yellow	Sun is G-type
K	Neutral metals, faint hydrogen, hydrocarbon bands	4,000–4,700 K	Orange	
M	Molecular bands, titanium oxide (TiO)	2,500–3,000 K	Red	Most prolific stars in galaxy

<sup>9</sup>It usual for only the classes O, A, B, F, G, K and M to be listed. The other classes are used and defined as and when they are needed.

## The Brightest Stars

This section describes in detail the 20 brightest stars in the sky, as seen with the naked eye. Some stars, for instance Alpha Centauri, will be visible only from the southern hemisphere, while others can be observed only from a northerly location. The stars are listed in Table 2.2, going from the brightest to the faintest, but, as you will see from the detailed descriptions, the stars (and all other objects mentioned in the book) are cataloged in such a way as to allow you to observe objects at different times of the year, from January to December. All the stars in this section are easily visible with the naked eye, even from the most heavily light-polluted areas.

Throughout the rest of the book we'll use the following nomenclature: first is the common or popular name for the object (if it has one), followed by its scientific

**Table 2.2** The 20 brightest stars in the sky

	Star	Apparent magnitude (m)	Constellation
1	Sirius	-1.46 <sub>v</sub> <sup>a,b,c</sup>	Canis Major
2	Canopus	-0.72 <sub>v</sub>	Carina
3	Alpha Centauri A	-0.01	Centaurus
4	Arcturus	-0.04 <sub>v</sub>	Boötes
5	Vega	0.03 <sub>v</sub>	Lyra
6	Capella	0.08 <sub>v</sub>	Auriga
7	Rigel	0.12 <sub>v</sub>	Orion
8	Procyon	0.34	Canis Minor
9	Achernar	0.50 <sub>v</sub>	Eridanus
10	Betelgeuse	0.58 <sub>v</sub>	Orion
11	Hadar	0.60 <sub>v</sub>	Centaurus
12	Altair	0.77 <sub>v</sub>	Aquila
13	Acrux	0.8	Crux
14	Aldebaran	0.85	Taurus
15	Spica	1.04 <sub>v</sub>	Virgo
16	Antares	1.09 <sub>v</sub>	Scorpius
17	Pollux	1.15	Gemini
18	Formalhaut	1.16	Piscis Austrinus
19	Deneb	1.25	Cygnus
20	Mimosa	1.30	Crux

<sup>a</sup>Many stars are variable so the value for the apparent magnitude will change. Any variable will have the suffix <sub>v</sub>, and the value given will be the mean value.

<sup>b</sup>The data for the magnitude is from the SIMBAD database.

<sup>c</sup>In some instances the star will actually be a double or triple star system. The magnitude quoted is for the complete system and not an individual star.

designation. The next item is its position in right ascension and declination, and the final term is the date of transit at midnight (at Greenwich<sup>10</sup>) – this is the time when the object is at its highest in the sky<sup>11</sup> and so will be the best time to observe.<sup>12</sup>

The next line will then present information pertinent to the type of object. Thus, if it is a star, it will give its magnitudes, stellar classification and distance in light-years. If a double star is being described, then information about both components will be given, if a star cluster, its size, and so on. The positions quoted are for epoch 2000.0 and the source of data is the Hipparcos Catalogue or the SIMBAD database.

Some objects will be *circumpolar*, that is, they never set below the horizon, and thus are observable on every night of the year (weather permitting). However, this is a double-edged sword because it also means that at certain times of the year the object, be it a star, nebula or galaxy, will be so close to the horizon that it would be a waste of time trying to observe it. Use your own judgement to decide. In later sections, circumpolar<sup>13</sup> objects will be indicated by the symbol ©, which will be placed after the ease-of-observation designation. So for the brightest stars it will look something like this:

Popular name	Scientific designation	RA	Dec.	Date of midnight transit
Apparent magnitude	Absolute magnitude <sup>14</sup>	Stellar classification		Distance

You will also notice that the listings present data in two forms. If an object is at its best time to observe, i.e., the month during which it transits, then a full description will be given; however, usually lots of other similar objects will also be visible, but they may not be at their best position to be observed. In that instance, a brief reference to the month at which the object will transit is given and thus be at an acceptable position to be observed.

<sup>10</sup>There will be several instances when an object is not visible from northern latitudes. In such cases the transit time will be for an observer at 0° latitude and longitude.

<sup>11</sup>It will be due south for northern observers and due north for southern observers.

<sup>12</sup>Any object can of course be observed earlier or later than this date. Remember that a star or any astronomical object (except the Moon!) rises about 4 min earlier each night, nearly ½h each week, and thus about 2 h a month. To observe any object earlier than its transit date, you will have to get up in (or stay up to) the early hours of the morning. To observe a star later than the transit date will mean looking for the object earlier in the evening. As an example, Sirius transits on January 1 at midnight, but will transit on December 1 at about 2.00 a.m., and at around 4.00 a.m. on November 1. Similarly, it will transit on February 1 at approximately 10.00 p.m., and on March 1 at about 8.00 p.m.

<sup>13</sup>The circumpolar objects will be those that are visible from around a latitude of 40° North.

<sup>14</sup>The absolute magnitude (M) is the apparent magnitude (m) an object would have if it were 10 pc distant. One parsec is 3.26 light-years.

There is one caveat however. There are several disparate lists of the 20 brightest stars that can be found on the Internet and in various books. What with new measuring techniques and observations, these lists are always being corrected and stars being added and removed. This list is as accurate as can be for summer 2010. It will change!

January

Sirius −1.46 <sup>15</sup> <sub>v</sub> m	α Canis Majoris 1.45 M	06 <sup>h</sup> 45.1 <sup>m</sup> A1 V	−16° 43′	January 1 8.58
--	---------------------------	---	----------	-------------------

Also known as the Dog Star, this is the brightest star in the night sky. It is the closest bright star visible from a latitude of 40°N, with a parallax of 0.3792". When observed from northerly latitudes, it is justly famous for the exotic range of colors it exhibits owing to the effects of the atmosphere. It also has a close companion star known as the Pup, which is a white dwarf star, the first ever to be discovered. Sirius is a dazzling sight in a telescope.

Procyon 0.34 m	α Canis Minoris 2.68 M	07 <sup>h</sup> 39.3 <sup>m</sup> F5 IV	+05° 13′	January 15 11.41
-------------------	---------------------------	--	----------	---------------------

The eighth brightest star in the sky, notable for the fact that it has, like nearby Sirius, a companion star that is a white dwarf. However, unlike Sirius, the dwarf star is not easily visible in small amateur telescopes, having a magnitude of 10.8 and a mean separation of 5 arcsec.

Pollux 1.15 m	β Geminorum 1.09 M	07 <sup>h</sup> 45.3 <sup>m</sup> K0 IIIvar	+28° 02′	January 16 33.72
------------------	-----------------------	--	----------	---------------------

The 17th brightest star is the brighter star of the two in Gemini, the other being, of course, Castor. It is also, however, the less interesting. It has a ruddier color than its brother, and thus is the bigger star.

See also:

Star	Magnitude	Month
Rigel	0.12	December
Capella	0.08	December
Betelgeuse	0.58	December
Canopus	−0.72	December

<sup>15</sup> Denotes that the star, and thus the magnitude, is variable.



## February

See:

Star	Magnitude	Month
Sirius	−1.46	January
Procyon	0.34	January
Pollux	1.15	January
Acrux	0.8	March

## March

Acrux	$\alpha$ Crucis	$12^h 26.6^m$	$-63^\circ 06'$	March 29
$0.8^{16}_m$	−4.19 M	B0.5 IV + B1 V		321

The 13th brightest star in the sky, it is a double star, components about  $4\frac{1}{2}''$  apart. Both stars are around the same magnitude, 1.4 for  $\alpha^1$  and 1.9 for  $\alpha^2$ . The colors of the stars are white and blue-white, respectively.

See also:

Star	Magnitude	Month
Mimosa	1.3	April
Spica	1.04	April
Hadar	0.64	April
Arcturus	−0.04	April

## April

Mimosa	$\beta$ Crucis	$12^h 47.7^m$	$-59^\circ 41'$	April 3
$1.30_v_m$	−3.92 M	B0.5 III		352

The 20th brightest and penultimate star in our list lies too far south for northern observers. It occurs in the same field as the Jewel Box cluster and is a pulsating variable with a very small change in brightness.

Spica	$\alpha$ Virginis	$13^h 25.2^m$	$-11^\circ 10'$	April 13
$1.04_v_m$	−3.55 M	B1 V		262

---

<sup>16</sup> This is the value for the combined magnitudes of the double-star system.

The 15th brightest star, and a fascinating one at that. It is a large spectroscopic binary with the companion star lying very close to it and thus eclipsing it slightly. Spica is also a pulsating variable star, though the variability and the pulsations are not visible with amateur equipment.

Hadar	$\beta$ Centauri	14 <sup>h</sup> 03.8 <sup>m</sup>	−60° 22′	April 22
0.60 <sub>v</sub> m	−5.45 M	B1 III		525

The 11th brightest star in the sky, and unknown to northern observers because of its low latitude, lying as it does only 4½° from  $\alpha$  Centauri. It has a luminosity that is an astonishing 10,000 times that of the Sun. A definitely white star, it has a companion of magnitude 4.1, but it is a difficult double to split as the companion is only 1.28 arcsec from the primary.

Arcturus	$\alpha$ Boötis	14 <sup>h</sup> 15.6 <sup>m</sup>	+19° 11′	April 25
−0.04 <sub>v</sub> m	−0.10 M	K2 IIIp		36.7

The fourth brightest star in the sky, and the brightest star north of the celestial equator. It has a lovely orange color. Notable for its peculiar motion through space, Arcturus, unlike most stars, is not traveling in the plane of the Milky Way, but is instead circling the galactic center in an orbit that is highly inclined. Calculations predict that it will swoop past the Solar System in several thousand years’ time, moving towards the constellation Virgo. Some astronomers believe that in as little as half a million years Arcturus will have disappeared from naked-eye visibility. At present it is about 100 times more luminous than the Sun.

See also:

Star	Magnitude	Month
Acrux	0.8	March
Rigel Kentaurus	−0.01	May
Antares	1.09	May

May

Rigel Kentaurus	$\alpha$ Centauri	14 <sup>h</sup> 39.6 <sup>m</sup>	−60° 50′	May 1
−0.01 m <sup>17</sup>	4.07 M	G2 V + K1 V		4.39

The third brightest star in the sky, this is in fact part of a triple system, with the two brightest components contributing most of the light. The system contains the closest star to the Sun, Proxima Centauri. The group also has a very large proper motion (its apparent motion in relation to the background). Unfortunately, it is too far south

<sup>17</sup> This is the value for the combined magnitudes of the double-star system.

to be seen by any northern observer. Some observers have claimed that the star is visible in the daylight with any aperture.

Antares	$\alpha$ Scorpii	16 <sup>h</sup> 29.4 <sup>m</sup>	−26° 26′	May 29
1.09 <sub>v</sub> m	−5.28 M	M1 Ib+B2.5 V		604

The 16th brightest star in the sky, this is a red giant, with a luminosity 6,000 times that of the Sun and a diameter hundreds of times bigger than the Sun’s. But what makes this star especially worthy is the vivid color contrast that is seen between it and its companion star, often described as vivid green when seen with the red of Antares. The companion has a magnitude of 5.4, with a PA of 273°, lying 2.6" away.

See also:

Star	Magnitude	Month
Mimosa	1.3	April
Spica	1.04	April
Hadar	0.64	April
Arcturus	−0.04	April

June

See also:

Star	Magnitude	Month
Rigel Kentaurus	−0.01	May
Antares	1.09	May
Vega	0.03	July
Altair	0.77	July

July

Vega	$\alpha$ Lyrae	18 <sup>h</sup> 36.9 <sup>m</sup>	+38° 47′	July 1
0.03 <sub>v</sub> m	0.58 M	A0 V		25.3

The fifth brightest star, familiar to northern observers, located high in the summer sky. Although similar to Sirius in composition and size, it is three times as distant, and thus appears fainter. Often described as having a steely blue color, it was one of the first stars observed to have a disc of dust surrounding it – a possible proto-solar system in formation. Vega was the Pole Star some 12,000 years ago and will be again in a further 12,000 years.

Altair	$\alpha$ Aquilae	19 <sup>h</sup> 50.8 <sup>m</sup>	+08° 52'	July 19
0.77 <sub>v</sub> m	2.20 M	A7 IV – V		16.77

The 12th brightest star, this has the honor of being the fastest-spinning of the bright stars, completing one revolution in approximately 6<sup>1</sup>/<sub>2</sub> h. Such a high speed deforms the star into what is called a flattened ellipsoid, and it is believed that because of this amazing property the star may have an equatorial diameter twice that of its polar diameter. The star’s color has been reported as completely white, although some observers see a hint of yellow.

See also:

Star	Magnitude	Month
Deneb	1.25	August

August

Deneb	$\alpha$ Cygni	20 <sup>h</sup> 41.4 <sup>m</sup>	+45° 17'	August 1
1.25 <sub>v</sub> m	–8.73 M	A2 Ia		3228

The 19th brightest star is very familiar to observers in the northern hemisphere. This pale-blue supergiant has recently been recognized as the prototype of a class of non-radially pulsating variable stars. Although the magnitude change is very small, the time scale is from days to weeks. It is believed that the luminosity of Deneb is some 60,000 times that of the Sun, with a diameter 60 times greater.

See also:

Star	Magnitude	Month
Vega	0.03	July
Altair	0.77	July
Formalhaut	1.16	September

September

Formalhaut	$\alpha$ Pisces Austrini	22 <sup>h</sup> 57.6 <sup>m</sup>	–29° 37'	September 5
1.16 m	1.74 M	A3 V		25.07

The 18th brightest star is a white one, which often appears reddish to northern observers owing to the effect of the atmosphere. It lies in a barren area of the sky and is remarkable only for the fact that a star close to it, which is not bound gravitationally yet lies at the same distance from Earth, is moving through space in a manner and direction similar to Formalhaut’s. It has been suggested that the two stars are

remnants of a star cluster or star association that has long since dispersed. This companion(?) star is an orange 6.5-magnitude object about 2° south of Formalhaut.

See also:

Star	Magnitude	Month
Deneb	1.25	August
Achernar	0.50	October

October

Achernar	$\alpha$ Eridani	01 <sup>h</sup> 37.7 <sup>m</sup>	−57° 14′	October 15
0.50 <sub>v</sub> m	−2.77 M	B3 Vpe		144

The ninth brightest star in the sky lies too far south for northern observers, at the southernmost end of the constellation. Among the bright stars it is one of the very few that has the designation “p” in its stellar classification, indicating that it is a “peculiar” star.

See also:

Star	Magnitude	Month
Formalhaut	1.16	September
Aldebaran	0.85	November

November

Aldebaran	$\alpha$ Tauri	04 <sup>h</sup> 35.9 <sup>m</sup>	+16° 31′	November 29
0.85 m	−0.63 M	K5 III		65.11

The 14th brightest star, apparently located in the star cluster called the Hyades. However, it is not physically in the cluster, lying as it does twice as close as the cluster members. This pale-orange star is around 120 times more luminous than the Sun. It is also a double star, but a very difficult one to separate owing to the extreme faintness of the companion. The companion star, a red dwarf star, magnitude 13.4, lies at a PA of 34° at a distance of 121.7″.

See also:

Star	Magnitude	Month
Formalhaut	1.16	September
Rigel	0.12	December
Capella	0.08	December
Betelgeuse	0.58	December
Canopus	−0.72	December

## December

Rigel	$\beta$ Orionis	05 <sup>h</sup> 14.5 <sup>m</sup>	−08° 12′	December 9
−0.12 <sub>v</sub> m	−6.69 M	B8 Iac		773

The seventh-brightest star in the sky, Rigel is in fact brighter than  $\alpha$  Orionis. This supergiant star is one of the most luminous stars in our part of the galaxy, almost 560,000 times more luminous than our Sun but at a greater distance than any other nearby bright star. Often described as bluish in color, it is a truly tremendous star, with about 50 times the mass of the Sun and around 50 times the diameter. It has a close bluish companion at a PA of 202°, apparent magnitude 6.8, at a distance of 9 arcsec, which should be visible with a 15 cm telescope, or one even smaller under excellent observing conditions.

Capella	$\alpha$ Aurigae	05 <sup>h</sup> 16.7 <sup>m</sup>	+46° 00′	December 10
0.08 <sub>v</sub> m	−0.48 M	G5 IIIe		42

The sixth brightest star in the sky. High in the sky in winter, it has a definite yellow color, reminiscent of the Sun's own hue. It is in fact a spectroscopic double and is thus not split in a telescope; however, it has a fainter tenth magnitude star about 12 arcsec to the southeast, at a PA of 137°. This is a red dwarf star, which in turn is itself a double (only visible in larger telescopes). Thus, Capella is in fact a quadruple system.

Betelgeuse	$\alpha$ Orionis	05 <sup>h</sup> 55.2 <sup>m</sup>	+07° 24′	December 20
0.58 <sub>v</sub> m	−5.14 M	M2 Iab		427

The tenth brightest star in the sky, and a favorite among observers, this orange-red star is a giant variable, with an irregular period. Recent observations by the Hubble Space Telescope have shown that it has features on its surface that are similar to sunspots, but much larger, covering perhaps a tenth of the surface. It also has a companion star, which may be responsible for the non-spherical shape it exhibits. Although a giant star, it has a very low density and a mass only 20 times greater than the Sun's, which together mean that the density is in fact about 0.000000005 that of the Sun! A lovely sight in a telescope of any aperture; subtle color changes have been reported as the star goes through its variability cycle.

Canopus	$\alpha$ Carinae	06 <sup>h</sup> 24 <sup>m</sup>	−52° 42′	December 27
−0.72 <sub>v</sub> m	−5.53 M	F0 Ib		313

The second brightest star in the sky, although its position makes it very difficult to observe for northern latitudes. An intrinsically brilliant star, it is some 30 times larger than the Sun, and over 1,000 times more luminous. Its parallax is 0.0104".

See also:

Star	Magnitude	Month
Sirius	−1.46	January
Procyon	0.34	January
Pollux	1.15	January
Aldebaran	0.85	November

### The Nearest Stars

Let’s now look at the nearest stars to us. The layout of this section is similar to that above. Also, several of the stars will be the same and in such a case, the information will not be duplicated, but a note will direct you to the relevant section. An important caveat is that the nearest stars to us will not necessarily be the brightest, and so some of the stars listed will be very faint and will need a correspondingly larger aperture telescope in order to be visible.

There is also an additional observing parameter, which gives an indication of the ease of observability – easy, moderate or difficult.<sup>18</sup>

*Easy* objects are within naked-eye limit, or just beyond it, and so will be relatively easy to locate.

*Moderate* objects include those beyond naked-eye visibility, or may be hard to detect from an urban location, thus needing a somewhat more careful approach to find and observe.

*Difficult* objects require very dark skies, or may lie in a sparse area of the sky, and will definitely need a telescope of moderate to large aperture.

With this information, you will not only be able to go out on any clear evening and find many different types of objects, but over time, you will improve your observing skills as you locate the fainter and thus more difficult objects.

An interesting point to note is that when you compare the 20 brightest stars with the 20 nearest stars, you will be surprised. Common sense would lead you to believe that there would be some sort of parity between the two lists. Far from it!

The brightest stars are mostly giants and supergiants (a topic we will cover later), and thus are bright due to the vast amount of energy they emit. However the nearest stars consist of red dwarfs, white dwarfs, K-type stars and G-type stars (the same spectral class as the Sun), and thus are low luminosity objects. The night sky would be very different if the closest stars were of the giant and supergiant variety! (Table 2.3).

<sup>18</sup>This parameter is used throughout the book but will be modified to take into account the different types of objects observed.

**Table 2.3** The 20 nearest stars in the sky

	Star	Distance (l.y.)	Constellation
1	Sun	–	–
2	Proxima Centauri <sup>a</sup>	4.24	Centaurus
3	Barnard’s Star	5.96	Ophiuchus
4	Wolf 359	7.78	Leo
5	Lalande 21185	8.29	Ursa Major
6	Sirius	8.58	Canis Major
7	UV Ceti	8.72	Cetus
8	Ross 154	9.68	Sagittarius
9	Ross 248	10.32	Andromeda
10	Epsilon Eridani	10.52	Eridanus
11	Lacaille 9352	10.74	Piscis Austrinus
12	Ross 128	10.92	Virgo
13	EZ Aquarii	11.27	Aquarius
14	Procyon	11.40	Canis Minor
15	61 Cygni	11.40	Cygnus
16	Struve 2398	11.53	Drace
17	Groombridge 34	11.62	Andromeda
18	Epsilon Indi	11.82	Indus
19	DX Cancri	11.83	Cancer
20	Tau Ceti	11.89	Cetus

<sup>a</sup>This also includes the group of stars Alpha Centauri A and B.

*January*

The Sun			January–December
–26.78 m	4.82 M	G2 V	

The closest star to Earth and the object without which no life would have evolved on Earth. It is visible every day, throughout the year, unless you happen to live in the UK or another cloudy climate.

Sirius	α Canis Majoris	06 <sup>h</sup> 45.1 <sup>m</sup>	–16° 43′	January 1
–1.46 m/+8.44 m	1.42 M/11.34 M	A1 V/DA2	8.58	Easy

The sixth closest star is also the brightest star in the night sky. It has a companion star, a white dwarf, that can be seen under excellent conditions and when its distance from the primary is at its greatest. For further details see the earlier section in this chapter on the brightest stars.



Procyon	$\alpha$ Canis Minoris	07 <sup>h</sup> 39.3 <sup>m</sup>	+05° 13'	January 15
0.38 m/10.7 m	2.66 M/12.98 M	F5 IV/DA	11.40	Easy

The 14th nearest star is a very easy object to observe as well as being the eighth brightest star in the sky. It is notable for the fact that it has, like nearby Sirius, a companion star that is a white dwarf. However, unlike Sirius, the dwarf star is not easily visible in small amateur telescopes, having a magnitude of 10.8 and a mean separation of only 5 arcsec.

See also:

Star	Distance	Month
Lalande 21185	8.29	March
Wolf 359	7.78	March
Ross 128	10.92	March
Epsilon Eridani	10.52	November

February

See:

Star	Distance	Month
Sirius	8.58	January
Procyon	11.40	January
Lalande 21185	8.29	March
Wolf 359	7.78	March
Ross 128	10.92	March

March

Lalande 21185	HD 95735	11 <sup>h</sup> 03.3 <sup>m</sup>	+35° 58'	March 8
7.47 m	10.44 M	M2 V	8.29	Moderate

The fifth closest star is a red dwarf star and has the eighth largest known proper motion<sup>19</sup> of 4.84 arcsec per year. Measurements indicate that it may have an unseen companion of very low mass.

Wolf 359	CN Leonis	10 <sup>h</sup> 56.5 <sup>m</sup>	+07° 01'	March 6
13.44 <sub>v</sub> m	16.55 M	M6.5 Ve	7.78	Difficult

<sup>19</sup>Proper motion is the angular change in the star’s position over time, as seen from the Sun.

The fourth closest star, a red dwarf, is an extremely faint object and thus difficult to observe. It is one of the least luminous stars that can be seen. Like Barnard’s Star it, too, is a flare<sup>20</sup> star, with a proper motion of 4.7 arcsec per year.

Ross 128	FI Virginis	11 <sup>h</sup> 47.6 <sup>m</sup>	+00° 48′	March 19
11.13 <sub>v</sub> m	13.51 M	M4.5 V	10.92	Difficult

The 12th nearest star is once again a red dwarf star and correspondingly difficult to observe.

See also:

Star	Distance	Month
Sirius	8.58	January
Procyon	11.40	January
Epsilon Eridani	10.52	November
Proxima Centauri	4.14	April

April

Proxima Centauri	V645 Cen	14 <sup>h</sup> 29.7 <sup>m</sup>	−62° 41′	April 29
11.09 <sub>v</sub> m	15.53 M	M5 Ve	4.24	Difficult

The second closest star to Earth but the closest star to the Solar System. It is a very faint red dwarf star and also another flare star, with frequent bursts having a maximum amplitude difference of around one magnitude.

See also:

Star	Distance	Month
Lalande 21185	8.29	March
Wolf 359	7.78	March
Ross 128	10.92	March
Barnard’s Star	5.96	June

May

See:

Star	Distance	Month
Proxima Centauri	4.24	April
Barnard’s Star	5.96	June

<sup>20</sup> A flare star is a star that undergoes unpredictable and often spectacular increases in brightness lasting for just a few minutes.

## June

Barnard's Star	Gilese 699	17 <sup>h</sup> 57.8 <sup>m</sup>	+4° 38'	June 21
9.53 m	13.22 M	M4.0 V	5.96	Moderate

The third closest star is a red dwarf. It also has the largest proper motion of any star: 10.3 arcsec per year. Thus it would take about 150 years for the star to move the distance equivalent to the Moon's diameter across the sky. Barnard's Star is believed to be one of the oldest stars in the Milky Way, and in 1998 a stellar flare was thought to have occurred on the star. Due to the unpredictability of flares, this makes the star a perfect target for observers.

See also:

Star	Distance	Month
Proxima Centauri	4.24	April
Epsilon Indi	11.82	July
Ross 154	9.68	July
Epsilon Indi	11.82	July
Struve	11.53	July

## July

Struve 2398	HD 173740	18 <sup>h</sup> 42.7 <sup>m</sup>	+59° 37'	July 2
8.9 m	11.16 M	M3	11.53	Moderate <sup>®</sup>

The 17th closest star is one-half of one of the closest double stars to the Solar System. Both stars are red dwarfs, flare stars and a source of X-rays.

Ross 154	V1216 Sagittarii	18 <sup>h</sup> 49.8 <sup>m</sup>	−23° 50'	July 4
10.43 m	13.07 M	M3.5 Ve	9.68	Difficult

The eighth closest star is, like so many of its peers, a red dwarf star. It is a UV Ceti-type flare star, having an average time between major flares of around 2 days. Typically, the star will increase by three to four magnitudes during a flare. But note that the star is much too faint to be viewed with the unaided eye and requires at least a 65 mm telescope aperture and ideal conditions.

Epsilon Indi	HD 209100	22 <sup>h</sup> 03.3 <sup>m</sup>	−56° 47'	July 7
4.69 m	6.89 M	K5Ve	11.82	Easy

The 18th closest star is only visible to southern observers, but what makes it especially interesting is that it is believed to have two brown dwarf<sup>21</sup> companion stars. In addition, the star has the third highest proper motion of any star visible to the unaided eye (after Groombridge 1830 and 61 Cygni) and the ninth highest overall.

See also:

Star	Distance	Month
Barnard's Star	5.96	June
61 Cygni	11.40	August
EZ Aquarii	11.27	August

August

61Cygni A/B	Bessel's Star	21 <sup>h</sup> 06.9 <sup>m</sup>	+38° 45'	August 8
5.21/6.03 <sub>v</sub> m	7.49/8.31 M	K5 V/K7 V	11.40	Easy/moderate

The 14th nearest star is a famous double, the stars separated by 30.3 arcsec at a PA of 150°. Both stars are dwarfs and have a nice orange color. This was the first star to have its distance measured successfully by F. W. Bessel in 1838 using the technique of parallax.

EZ Aquarii	L789-6	22 <sup>h</sup> 38.5 <sup>m</sup>	−15° 19'	August 31
12.32 m	15.64 M	M5 Ve	11.27	Difficult

The 13th nearest star is actually part of a triple-star system, and of course, a red dwarf star, difficult to observe. The A and B components are X-ray emitters, while the C component is itself a spectroscopic binary.<sup>22</sup>

See also:

Star	Distance	Month
Struve 2398	11.53	July
Ross 154	9.68	July
Epsilon Indi	11.82	July
Lacaille 9352	10.74	September
GX Andromedae	11.62	September
Ross 248	10.32	September

<sup>21</sup> Brown dwarfs are sub-stellar objects that are too low in mass to sustain stable hydrogen fusion.  
<sup>22</sup> A binary system that can only be detected by measuring the effect of the Doppler shift on its spectral lines.

September

Lacaille 9352	HD 217987	23 <sup>h</sup> 05.5 <sup>m</sup>	−35° 52′	September 7
7.34 m	9.75 M	K2 V	10.74	Moderate

The 11th nearest star is a red dwarf, with the fourth fastest proper motion of any known star. It traverses a distance of nearly 7 arcsec a year, and thus would take about 1,000 years to cover the angular distance of the full Moon, which is half a degree. It was the first red dwarf star to have its angular diameter measured.

GX Andromedae	Groombridge 34	00 <sup>h</sup> 18.2 <sup>m</sup>	+44° 01′	September 25
8.08 <sub>v</sub> m	10.32 M	M1 V	11.62	Moderate

The 17th closest star to the Solar System and the 20th closest to Earth, this is half of a noted red dwarf binary system. The primary is in itself a spectroscopic binary.

Ross 248	HH Andromedae	23 <sup>h</sup> 41.6 <sup>m</sup>	+44° 10′	September 16
12.29 <sub>v</sub> m	14.79 M	M5 Ve	10.32	Moderate

The ninth closest star to the Solar System is a red dwarf star and a difficult object to observe. An interesting fact: the *Voyager 2* spacecraft is traveling on a path headed roughly in the direction of this star and is expected to come within 1.76 light-years (0.54 pc) of the star in 40,176 years.

See also:

Star	Distance	Month
61 Cygni	11.40	August
EZ Aquarii	11.27	August
UV Ceti	8.73	October

October

UV Ceti	L726-8	01 <sup>h</sup> 38.8 <sup>m</sup>	−17° 57′	October 16
12.54 <sub>v</sub> m/12 99 <sub>v</sub> m	15.40 M/15.85 M	M5.5Ve/M6 Ve	8.73	Difficult

The seventh closest star is a red dwarf system and is a very difficult but not impossible object to observe. The UV prefix indicates that the two components are flare stars, and the fainter is referred to in older texts as “Luyten’s Flare Star,” after its discoverer, W. J. Luyten, who first observed it in 1949.

See also:

Star	Distance	Month
Lacaille 9352	10.74	September
GX Andromedae	11.62	September
Ross 248	10.32	September
Epsilon Eridani	10.52	November

*November*

Epsilon Eridani	HD 22049	03 <sup>h</sup> 32.9 <sup>m</sup>	−.09° 27′	November 13
3.73 m	6.19 M	K2 V	10.52	Easy

The tenth closest star is a naked-eye object (it is the third closest star visible to the naked eye), which some observers describe as having a yellow color, while others say it is more orange. The star is believed to the closest system that has a planet in orbit, and maybe even two. Furthermore, there is evidence that Epilson Eridani has two asteroid belts made of rocky and metallic debris left over from the early stages of planetary formation, similar to our Solar System’s, and even and a broad outer ring of icy objects similar to our Kuiper Belt. All in all a very interesting star!

See also:

Star	Distance	Month
Lacaille 9352	10.74	September
GX Andromedae	11.62	September
Ross 248	10.32	September
UV Ceti	8.73	October

*December*

See:

Star	Distance	Month
Epsilon Eridani	10.52	November
Sirius	8.58	January
Procyon	11.40	January

## The Spectral Sequence

This section will look at examples of the spectral classification of stars as discussed earlier. Even though most amateurs observe the stars without paying too much attention to their astrophysical classification, it is always a fascinating project to be able to search out and observe examples of various classes. After all, it is a system that is used by all astronomers in the world, and to be able to understand, albeit at an introductory level, how the system is applied will give you an added level of enjoyment to your observing sessions.

Several stars and their spectral classes have already been mentioned in describing the bright stars, but to cover them again serves no positive use, therefore we have tried to include stars which may not be familiar to you (But remember that all the stars you can see, either with the naked eye or binoculars or telescopes are classified in this manner, and so there is no limit, literally, to the number of stars you could observe and classify).

A point to note: Not every class is represented, as some are not used and other representative stars may be too faint and thus beyond the scope of small telescopes.<sup>23</sup> Also, the stars have been listed as before, by date, with those transiting at midnight having a full listing, followed by those that are in the sky, but maybe at a less than favorable position. In this way, you should be able to observe several of the classes at any given time of the year. Finally, the constellation in which the star resides is also given.<sup>24</sup>

### January

Aludra	η CMa	07 <sup>h</sup> 24.1 <sup>m</sup>	−29° 18′	January 11
2.45 m	7.51 M	B5 I	Canis Major	Easy

A highly luminous supergiant, with an estimated luminosity of 50,000 times that of the Sun.<sup>25</sup>

Castor	α Geminorum	07 <sup>h</sup> 34.6 <sup>m</sup>	+31° 53′	January 14
1.43 m	0.94 M	A1 V	Gemini	Easy

<sup>23</sup>The values for the apparent and absolute magnitudes are taken from the Hipparchos catalog, and in nearly every star listed the values differ from those previously published (pre-Hipparchos). It is an interesting exercise to compare the old and new values, as sometimes there is a considerable difference.

<sup>24</sup>Note that the stars are listed in order of spectral classification.

<sup>25</sup>A wonderful month! A lot of stars are visible for this section.

This is part of the famous multiple-star system and fainter brother to Pollux. The visual magnitude stated is the result of combining the magnitudes of the two brighter components of the system, 1.9 and 2.9 (See also Sirius.).<sup>26</sup>

Velorum b	HD 74180	08 <sup>h</sup> 40.6 <sup>m</sup>	−46° 39′	January 30
3.84 m	−6.07 M	F3 Ia	Vela	Easy

This star, part of a double system, is unremarkable visually, except that its luminosity has been calculated to be that of 180,000 Suns. Due to its southerly position, it cannot be seen by northern observers, alas. Recent research suggests it may be part of the Pismis 6 star cluster and even a lower-range member of the class hypergiant,<sup>27</sup> a star of immense mass and luminosity.

γ <sup>2</sup> Vel	HD 68273	08 <sup>h</sup> 09.5 <sup>m</sup>	−47° 20′	January 23
1.99 <sub>v</sub> m	0.05 M	WC 8	Vela	Easy

The brightest and closest of all Wolf-Rayet stars, believed to be precursors to the formation of planetary nebulae. Extremely luminous, Wolf-Rayets have luminosities that may reach 100,000 times that of the Sun and temperatures in excess of 50,000 K. γ<sup>2</sup> Vel is an easy double, with colors of white and greenish-white.

See also:

Star	Class	Month
θ Orionis C	O7 V	December
15 Monocerotis	O7 Ve	December
Plaskett’s Star	O8 I	December
i Orionis	O9 III	December
Murzim	B1 II	December
λ Canis Majotris	B4 IV	December
Alhena	A0 IV	December
β Aurigae	A2 V	December
2 Monocerotis	A6	December
Canopus	F0 I	December
111 Tauri	F8 V	December
Algeiba	G7 III	February
β Leo Minoris	G8 III	February
ν <sup>2</sup> Canis Majoris	K1 III	December

February

Regulas	α Leonis	10 <sup>h</sup> 08.3 <sup>m</sup>	+11° 58′	February 19
1.36 m	−0.52 M	B7 V	Leo	Easy

<sup>26</sup>Denotes a similar class star.  
<sup>27</sup>If it were to be found a hypergiant, its classification would change to F3 0a.



Alpha Leonis is the handle of the Lion’s sickle. It’s an easy double star with an eighth-magnitude companion 3’ away, color orange-red. The companion is itself a double, but visible only in large instruments.

Algeiba	$\gamma^2$ Leo	10 <sup>h</sup> 19.9 <sup>m</sup>	+19° 50’	February 25
3.64 m	0.72 M	G7 III	Leo	Easy

A famous double; most observers report orange-yellowish colors, but some see the G7 star as greenish.

$\beta$ LMi	HD 90537	10 <sup>h</sup> 27.8 <sup>m</sup>	+36° 42’	February 27
4.20 m	0.9 M	G8 III	Leo Minor	Easy

A constellation in which there is no star given the classification  $\alpha$ ,  $\beta$  LMi has the misfortune of not even being the brightest star in the constellation; that honor goes to 46 LMi.  
See also:

Star	Class	Month
Aludra	B5 I	January
Castor	A1 V	January
Denebola	A3 V	March
Delta Leonis	A4 V	March
Velorum b	F3 I	January
$\beta$ Vir	F8 V	March
Gacrux	M4 III	March
$\gamma^2$ Vel	WC 8	January

**March**

Denebola	$\beta$ Leonis	11 <sup>h</sup> 49.1 <sup>m</sup>	+14° 34’	March 19
2.14 <sub>v</sub> m	1.92 M	A3 V	Leo	Easy

Several companion stars are visible in a variety of instruments. The star has only recently been designated a variable.

Zozma	$\delta$ Leonis	11 <sup>h</sup> 14.1 <sup>m</sup>	+20° 31’	March 10
2.56 m	1.32 M	A4 V	Leo	Easy

This star lies at a distance of 80 light-years, with a luminosity of 50 Suns.

$\beta$ Virginis	HD 102870	11 <sup>h</sup> 50.7 <sup>m</sup>	+01° 46'	March 20
3.59 m	3.40 M	F8 V	Virgo	Easy

A close star at 34 light-years, only three times as luminous as the Sun.

Gacrux	$\gamma^A$ Crucis	12 <sup>h</sup> 31.2 <sup>m</sup>	−57° 07'	March 30
1.59 m	−0.56 M	M4 III	Crux	Easy

The top star of the Southern Cross, this is a giant star.  $\gamma^A$  and  $\gamma^B$  do not form a true binary, as they are apparently moving in different directions.  
See also:

Star	Class	Month
Regulas	B7 V	February
Gamma Centauri	A1 IV	April
Algeiba	G7 III	February
$\beta$ LMi	G8 III	February
$\theta$ Apodis	M6.5 III	April

*April*

Gamma Centauri	$\gamma$ Cen	12 <sup>h</sup> 41.5 <sup>m</sup>	−48° 58'	April 2
2.17 m	−0.6 M	A1 IV	Centaurus	Easy

Binary star with both members being almost identical (see Vega).

Zeta Virginis	$\zeta$ Vir	13 <sup>h</sup> 34.7 <sup>m</sup>	−00° 36'	April 15
3.38 m	1.62 M	A3 V	Virgo	Easy

A nice white star, also called Heze, only 30 times as luminous as the Sun and lying at a distance of 92 light-years.

$\theta$ Apodis	HD 122250	14 <sup>h</sup> 05.3 <sup>m</sup>	−76° 48'	April 23
5.69 <sub>v</sub> m	−0.67 M	M6.5 III	Apus	Easy

A reddish-tinted star that stands out nicely, in contrast to its background of faint stars. This is a semi-regular variable with a period of 119 days and a range of fifth to nearly eighth magnitude. The titanium bands are now at their strongest.

See also:

Star	Class	Month
Zubeneschamali	B8 V	May
$\beta$ Leonis	A3 V	March
$\delta$ Leonis	A4 V	March
$\gamma$ Herculis	A9 III	May
Zubenelgenubi	F4 IV	May
$\beta$ Virginis	F8 V	March
Kornephorus	G8 III	May
$\nu^1$ Boö	K5 III	May
Antares	M1 I	May
Gacrux	M4 III	March

May

Zubeneschamali	$\beta$ Libris	15 <sup>h</sup> 17.0 <sup>m</sup>	−09° 23′	May 11
2.61 m	−0.84 M	B8 V	Libra	Easy

A mysterious star for two reasons. Historical records state that it was much brighter than it is seen today, while observers of the past 100 years have declared that it is greenish or pale emerald in color. Observe for yourself and decide if it is one of the rare green-colored stars!

Gamma Herculis	$\gamma$ Her	16 <sup>h</sup> 21.8 <sup>m</sup>	+19° 09′	May 27
3.74 m	−0.15 M	A9 III	Hercules	Easy

An optical double star system lying at a distance of 144 light-years and with a luminosity of 46 Suns.

Zubenelgenubi	$\alpha^1$ Lib	14 <sup>h</sup> 50.7 <sup>m</sup>	−15° 60′	May 4
5.15 m	3.28 M	F4 IV	Libra	Easy

An easily resolvable double star,  $\alpha^1$  is also a spectroscopic binary. The colors are a nice faint yellow and pale blue.

Kornephorus	$\beta$ Her	16 <sup>h</sup> 30.2 <sup>m</sup>	+21° 29′	May 29
2.78 m	−0.50 M	G8 III	Hercules	Easy

A spectroscopic binary star, it lies at a distance of 100 light-years and is some 60 times as luminous as the Sun (See also Capella).

$\nu^1$ Boö	HD 138481	15 <sup>h</sup> 30.9 <sup>m</sup>	+40° 50′	May 14
5.04 m	−2.10 M	K5 III	Boötes	Easy

The star lies at a distance of 385 light-years and has a luminosity of 104 Suns (See also Aldebaran).

Antares	$\alpha$ Scopi	16 <sup>h</sup> 29.4 <sup>m</sup>	−26° 26′	May 29
1.06 <sub>v</sub> m	−5.28 M	M1 I	Scorpio	Easy

A gloriously colored star of fiery red (or, as some astronomers of the last century observed, saffron-rose), it contrasts nicely with its fainter green companion, a giant star measured to be some 600 times the diameter of our Sun (See also Betelgeuse.).

See also:

Star	Class	Month
Eta Sagitai	B9.5 III	June
Nu Draconis <sup>1</sup>	Am	June
Gamma Centauri	A1 IV	April
Zeta Virginis	A3 V	April
Ras Alhague	A5 III	June
Ras Algethi <sup>1</sup>	G5 III	June
Ras Algethi <sup>2</sup>	M5 II	June
$\theta$ Apodis	M6.5 III	April

## June

Eta Sagitai	$\epsilon$ Sgr	18 <sup>h</sup> 24.2 <sup>m</sup>	−34° 23′	June 27
1.79 m	−1.44 M	B9.5 III	Sagittarius	Easy

A brilliant orange star lying at a distance of 125 light-years with a luminosity of 250 Suns.

Nu Draconis <sup>1</sup>	$\nu^1$ Dra	17 <sup>h</sup> 32.2 <sup>m</sup>	+55° 11′	June 14
4.89 m	2.48 M	Am	Draco	Easy

A classic double star system easily visible in binoculars or small telescopes. Both stars are nearly identical in magnitude and stellar class and have a lovely white color.

Sarin	$\delta$ Her	17 <sup>h</sup> 15.0 <sup>m</sup>	+24° 50′	June 10
3.12 m	1.21 M	A3 IV	Hercules	Easy

A fine example of an optical double star. What is astonishing about these stars is the range of colors ascribed to them. They have been called greenish and pale violet, green and ashy white, pale yellow and bluish-green, white and azure, and

finally pale yellow and ruddy purple! Spectral class indicates that the stars should be yellow and orange; what colors do you see?

Ras Alhague	$\alpha$ Oph	17 <sup>h</sup> 34.9 <sup>m</sup>	+12° 34'	June 15
2.08 m	1.30 M	A5 III	Ophiuchus	Easy

This is an interesting star for several reasons. It shows the same motions through space as several other stars in the so-called Ursa Major Group (see Chap. 7). It also shows interstellar absorption lines in its spectrum. Finally, measurements show an oscillation, or wobble, in its proper motion, which would indicate an unseen companion star (See  $\beta$  Triangulum).

Ras Algethi	$\alpha^2$ Her	17 <sup>h</sup> 14.7 <sup>m</sup>	+14° 23'	June 10
5.37 m	0.03 M	G5 III	Hercules	Easy

A beautiful double star, with colors of ruddy orange and blue-green. The spectral class refers to the primary of  $\alpha^2$  Her, which is a spectroscopic double and thus visually inseparable with any telescope.

Ras Algethi	$\alpha^1$ Her	17 <sup>h</sup> 14.6 <sup>m</sup>	+14° 23'	June 10
3.03 <sub>v</sub> m	−2.32 M	M5 II	Hercules	Easy

A fine double-star system, this M5 semi-regular star is an orange supergiant, in contrast to its companion, a blue-green giant. However, it must be pointed out here that it can be resolved only with a telescope and not binoculars, as the two stars are less than 5" apart. The changes in brightness are attributed to actual physical changes to the star, as it increases and then decreases in diameter.

See also:

Star	Class	Month
Zubeneschamali	B8 V	May
$\gamma$ Herculis	A9 II	May
Albaldah	F3 III	July
Zubenelgenubi	F4 IV	May
Kornephorus	G8 III	May
$\nu^1$ Boö	K5 III	May
Antares	M1 I	May

July

Albaldah	$\pi$ Sagittarii	19 <sup>h</sup> 09.8 <sup>m</sup>	−21° 01'	July 9
2.88 m	−2.77 M	F2 III	Sagittarius	Easy

An easily visible star that is in fact a triple-star system. However, the components can only be resolved by the largest amateur telescopes (See also  $\beta^2$  Sagittarii).

See also:

Star	Class	Month
Eta Sagitai	B9.5 III	June
Nu Draconis <sup>1</sup>	Am	June
Deneb	A2 I	August
Sarin	A3 IV	June
Ras Alhague	A5 III	June
Alderamin	A7 IV	August
Sadal Suud	G0 I	August
Sadal Melik	G2 I	August
Ras Algethi	G5 III	June
Gienah	K0 III	August
Enif	K2 I	August
Ras Algethi	M5 II	June

August

Deneb	$\alpha$ Cygni	20 <sup>h</sup> 41.3 <sup>m</sup>	+45° 17'	August 1
1.25 <sub>v</sub> m	−8.73 <sup>28</sup> M	A2 I	Cygnus	Easy

The faintest star of the famous “Summer Triangle,” the others being Altair and Vega. This is a rare supergiant star with a definite pale blue color. It is also the prototype of a class of pulsating variable stars.

Alderamin	$\alpha$ Cephei	21 <sup>h</sup> 18.6 <sup>m</sup>	+62° 35'	August 11
2.45 m	1.58 M	A7 IV	Cepheus	Easy <sup>o</sup>

This is a rapidly rotating star resulting in the spectral lines becoming broad and less clear. It also has the dubious distinction of becoming the Pole Star in 7500A.D. (See also Altair).

Sadal Suud	$\beta$ Aquarii	21 <sup>h</sup> 31.6 <sup>m</sup>	−05° 34'	August 14
2.91 m	−3.46 M	G0 Ib	Aquarius	Easy

A giant star, and a close twin to  $\alpha$  Aqr. It lies at a distance of 610 light-years and is 2,200 times more luminous than the Sun. The name means “luck of lucks.”

Sadal Melik	$\alpha$ Aquarii	22 <sup>h</sup> 05.8 <sup>m</sup>	−00° 19'	August 23
2.95 m	−3.88 M	G2 Ib	Aquarius	Easy

<sup>28</sup>This value is in question. The data is awaiting reassessment.

Although it has the same spectral class and surface temperature of the Sun,  $\alpha$  Aqr is a giant star, whereas the Sun is a main sequence star (See also Sun, Alpha Centauri A).

Gienah	$\epsilon$ Cygni	20 <sup>h</sup> 46.2 <sup>m</sup>	<sup>s</sup> +33° 58'	August 2
2.48 m	0.76 M	K0 III	Cygnus	Easy

Marking the eastern arm of the Northern Cross, the star is a spectroscopic binary. In the K-class stars the metallic lines seen in the spectrum are now becoming more prominent than the hydrogen lines.

Enif	$\epsilon$ Pegasi	21 <sup>h</sup> 44.2 <sup>m</sup>	+09° 52'	August 17
2.40 <sub>v</sub> m	−4.19 M	K2 Ib	Pegasus	Easy

This star lies at a distance of 740 light-years with a luminosity 7,450 times that of the Sun. The two faint stars in the same field of view have been mistakenly classified as companions, but analysis has now shown them to be stars in the line of sight. Epsilon Pegasi is a type LC “slow irregular variable” star that varies from +0.7 to +3.5 in magnitude.

See also:

Star	Class	Month
Algenib	B2 V	September
Albaldah	F3 III	July
Scheat	M2 II	September

September

Algenib	$\gamma$ Pegasi	00 <sup>h</sup> 13.2 <sup>m</sup>	+15° 11'	September 24
2.83 <sub>v</sub> m	−2.22 M	B2 IV	Pegasus	Easy

A member of the type  $\beta$  Cephei variable star. It is the southeastern corner star of the famed square of Pegasus.

Scheat	$\beta$ Pegasi	23 <sup>h</sup> 03.8 <sup>m</sup>	+28° 045	September 6
2.44 <sub>v</sub> m	−1.49 M	M2 II	Pegasus	Easy

Marking the northwestern corner of the Square of Pegasus, this is a red, slow, irregular variable star of the type LB, its brightness varying from magnitude +2.31 to +2.74. It is noted for having been one of the first stars to have its diameter measured by the technique of interferometry, at 0.015". Being variable, its size oscillates, to a maximum diameter of about 95 Suns.

See also:

Star	Class	Month
Gamma Cas	B0 IV	October
Achernar	B3 V	October
Deneb	A2 I	August
Alderamin	A7 IV	August
Polaris	F7 I	October
Sadal Suud	G0 I	August
Sadal Melik	G2 I	August
ξ <sup>1</sup> Cet	G8 II	October
βCet	G9.5 III	October
Gienah	K0 III	August
Hamal	K2 III	October
Almach	K3 III	October
Mirach	M0 III	October
Mira	M5	October
Mira minimum	M9	October

October

Gamma Cassiopeiae	γ Cas	00 <sup>h</sup> 56.7 <sup>m</sup>	+60° 43'	October 5
2.15 <sub>v</sub> m	−4.22 M	B0 IV	Cassiopeia	Easy

A peculiar but also very interesting star. It has bright emission lines in its spectrum, indicating that it ejects material in periodic outbursts and is thus classed as an eruptive variable (it being the prototype of the class). Also, research indicates that it is a rapidly spinning star bulging outward along the equator. Thus, when combined with its high luminosity, the result is a tremendous mass loss that forms a disk around the star. The resulting emissions and observed brightness variations are apparently caused by this disk. It is a spectroscopic binary with an orbital period of about 204 days and an eccentricity alternately reported as 0.26 and “near zero.” The mass of the companion is believed to be about that of the Sun. Furthermore, it is also an optical double, with a faint 11th magnitude companion, B, about 2 arcsec distant and a further, fainter, optical companion C. Finally, it is the middle star of the familiar W-shape of Cassiopeia.

Achernar	α Eridani	01 <sup>h</sup> 37.7 <sup>m</sup>	−57° 14'	October 15
0.50 <sub>v</sub> m	−2.77 M	B3 Vpe	Eridanus	Easy

A hot and blue star. It lies so far south that it can never be seen from the UK and most of the United States but is perfectly placed for southern observers. What makes this an exceptional star is that it is one of the least spherically shaped stars in the Milky Way. Due to its extremely high rotation rate, its equatorial diameter is about 50% greater than its polar diameter!



Polaris	$\alpha$ UMi	02 <sup>h</sup> 31.8 <sup>m</sup>	+89° 16'	October 29
1.97 <sub>v</sub> m	−3.64 M	F7 Ib	Ursa Minor	Easy ☺

An interesting and famous star, even though it is only the 49th brightest star in the sky. It is a Cepheid variable type I (although it used to be classified as a type II – the W Virginis class); it will be closest to the celestial pole in 2102, and is a binary star (the companion reported as being pale bluish), being a good test for small telescopes.

$\xi^1$ Ceti	HD 15318	02 <sup>h</sup> 12.0 <sup>m</sup>	+08° 51'	October 24
4.36 m	−0.87 M	G8 II	Cetus	Easy

A star with an interesting background. Although about 550 times as luminous as the Sun, various measurements place it at 130, 175 and 640 light-years distant!

$\beta$ Ceti	Diphda	00 <sup>h</sup> 43.6 <sup>m</sup>	−17° 59'	October 2
2.04 m	−0.31 M	G9.5 III	Cetus	Easy

The star lies at a distance of 60 light-years with a luminosity of 42 Suns. Oddly, although classified as  $\beta$ , indicating it is second in brightness, it is in fact brighter than  $\alpha$  Ceti.

Hamal	$\alpha$ Ari	02 <sup>h</sup> 07.2 <sup>m</sup>	+23° 28'	October 23
2.01 m	0.48 M	K2 III	Aries	Easy

This star lies at a distance of 63 light-years with a luminosity 90 times that of the Sun (See also Arcturus.).

Almach	$\gamma^1$ Andromedae	02 <sup>h</sup> 03.9 <sup>m</sup>	+42° 20'	October 22
2.26 m	−2.86 M	K3 III	Andromeda	Easy

A famous and beautiful binary star. The colors are gold and blue, although some observers see orange and greenish-blue. Nevertheless, the fainter companion is hot enough to truly show a blue color. It is also a binary in its own right but not observable in amateur instruments.

Mirach	$\beta$ Andromedae	01 <sup>h</sup> 09.7 <sup>m</sup>	+35° 37'	October 8
2.07 <sub>v</sub> m	−1.86 M	M0 III	Andromeda	Easy

With this stellar class, the bands of titanium oxide are strengthening. This red giant star is suspected of being slightly variable, like so many other stars of the same type. In the field of view is the galaxy NGC 404 at magnitude 12, a good test for large telescopes.

Mira	o Ceti	02 <sup>h</sup> 19.3 <sup>m</sup>	−02° 59′	October 26
2.00 <sub>v</sub> m	−3.54 M	M5	Cetus	Easy

An important star, and maybe the first variable star ever observed. Written records certainly exist as far back as 1596. The prototype of a long-period pulsating variable, it ranges from third to tenth magnitude over a period of 332 days and is an ideal star for the first-time variable star observer. It has the dubious distinction of being the brightest periodic variable that is not visible to the naked eye for part of its cycle (with the exception of the even stranger Eta Carinae!).

Mira minimum	o Ceti	02 <sup>h</sup> 19.3 <sup>m</sup>	−02° 59′	October 26
10.1 <sub>v</sub> m	−0.5 M	M9	Cetus	Difficult

At minimum, the star is a deeper red color, but of course fainter. It now has a lower temperature of 1,900 K. The period, however, is subject to irregularities, as is its magnitude. At maximum it can reach first magnitude – similar to Aldebaran! See also:

Star	Class	Month
Algenib	B2 V	September
Electra	B6 III	November
Atlas	B8 III	November
Algenib	F5 I	November
Scheat	M2 II	September
Menkar	M2 III	November
Eta Persei	M3 I	November

*November*

Electra	17 Tauri	03 <sup>h</sup> 44.9 <sup>m</sup>	+24° 07′	November 16
3.71 m	−1.56 M	B6 IIIe	Taurus	Easy

Located within the Pleiades star cluster. A breathtaking and spectacular view when seen through binoculars, the cluster is a highlight of the night sky (See also Taygeta [19 Tau] and Merope [23 Tau] in the Pleiades cluster.). Electra is classified as a Be star, which is a B-type star having prominent emission lines of hydrogen in its spectrum.

Atlas	27 Tauri	03 <sup>h</sup> 49.2 <sup>m</sup>	−24° 03′	November 18
3.62 m	−2.55 M	B8 III	Taurus	Easy

A lovely blue star (See also Maia [20 Tau], Asterope [21 Tau] and Pleione [28 Tau] in the Pleiades.).

Algenib 1.79 m	$\alpha$ Per −4.5 M	03 <sup>h</sup> 24.3 <sup>m</sup> F5 Ib	+49° 52' Perseus	November 11 Easy
-------------------	------------------------	--	---------------------	---------------------

The star lies within Melotte 20, a loosely bound stellar association, also known as the Perseus OB-3, or the Alpha Persei Association. About 75 stars with magnitudes down to ten are contained within the group. All are stellar infants, only 50 million years old, lying 550 light-years away. The metallic lines now increase through the F class, especially the H and K lines of ionized calcium. Has been described as having a pale yellow hue (See also Procyon).

Menkar 2.54 <sub>v</sub> m	$\alpha$ Ceti −1.61 M	03 <sup>h</sup> 02.3 <sup>m</sup> M2 III	+0.4° 05' Cetus	November 6 Easy
-------------------------------	--------------------------	---	--------------------	--------------------

An orange-colored giant star, which contrasts nicely with a fainter blue star (93 Ceti nearly at due north) that can be seen in the same field of view with small telescopes at low power.

Eta Persei 3.77 m	$\eta$ Per −4.28 M	02 <sup>h</sup> 50.7 <sup>m</sup> M3 I	+55° 54' Perseus	November Easy
----------------------	-----------------------	---	---------------------	------------------

The yellowish star in an easily resolved double-star system. The color contrasts nicely with its blue companion.

See also:

Star	Class	Month
15 Monocerotis	O7 Ve	December
Plaskett's Star	O8 I	December
Iota Orionis	O9 III	December
Gamma Cas	B0 IV	October
$\lambda$ CMa	B4 IV	December
El Nath	B7 III	December
Alhena	A0 IV	December
Beta Aurigae	A2 V	December
2 Mon	A6	December
Polaris	F7 I	October
111 Tau	F8 V	December
$\xi^1$ Cet	G8 II	October
$\beta$ Cet	G9.5 III	October
$\nu^2$ CMa	K1 III	December
Mira	M5	October
Mira minimum	M9	October

## December

15 Monocerotis	S Mon	06 <sup>h</sup> 40.9 <sup>m</sup>	+09° 54'	December 31
4.66 <sub>v</sub> m	−2.3 M	O7 Ve	Monoceris	Easy

Both a visual binary and a variable star, it is located in the star cluster NGC 2264, which in turn is encased in a diffuse nebula. About 1° south is the famous Cone Nebula, visible only in the largest amateur telescopes under perfect conditions.

Plaskett's Star	V640Mon	06 <sup>h</sup> 37.4 <sup>m</sup>	+06° 08'	December 30
6.05 m	−3.54 M	O8 I	Monoceros	Easy

This is actually composed of two stars, a spectroscopic binary system, with an estimated mass of around 110 Suns, making it one of the most massive binaries known. It can be located just east of 13 Monocerotis and may be a member of NGC 2244, which in turn is part of the famous Rosette Cluster.

Iota Orionis	ι Ori	05 <sup>h</sup> 35.4 <sup>m</sup>	−05° 55'	December 15
2.75 m	−5.30 M	O9 III	Orion	Easy

The brightest star in the sword of Orion is in fact a fine triple-star system, with reported colors of white, blue and red.

Murzim	β CMa	06 <sup>h</sup> 22.7 <sup>m</sup>	−17° 57'	December 27
1.98 <sub>v</sub> m	−3.96 M	B1 II	Canis Major	Easy

This is the prototype of a class of variable star now classified as β Cepheid stars, which are pulsating variables. The magnitude variation is too small to be observed visually (See also Spica and Beta Centauri in previous sections). An interesting aside: Murzim is located near the far end of the Local Bubble – a cavity in the local interstellar medium – through which our Solar System is traveling.

λ CMa	HD 45813	06 <sup>h</sup> 28.2 <sup>m</sup>	−32° 35'	December 28
4.47 m	−1.01 M	B4 IV	Canis Major	Easy

A nice bluish-white star.

El Nath	β Tauri	05 <sup>h</sup> 26.3 <sup>m</sup>	+28° 36'	December 12
1.65 m	−1.37 M	B7 III	Taurus	Easy

Located on the border of Auriga, it is sometimes mistakenly called γ Aurigae. It lies at a distance of 160 light-years.

Alhena	$\gamma$ Gem	06 <sup>h</sup> 37.7 <sup>m</sup>	+16° 23'	December 30
1.93 m	−0.60 M	A0 IV	Gemini	Easy

This star is relatively close at about 58 light-years, with a luminosity of 160 Suns.

Beta Aurigae	$\beta$ Aur	05 <sup>h</sup> 59.5 <sup>m</sup>	+44° 57'	December 21
1.90 <sub>v</sub> m	−0.10 M	A2 V	Auriga	Easy

This is a good example of the Algol-type of variable star, which is due to stars eclipsing each other. A spectral class A2 signifies that the hydrogen lines are now at their strongest.

2 Mon	HD 40536	05 <sup>h</sup> 59.1 <sup>m</sup>	−09° 33'	December 21
5.01 m	0.02 M	A6	Monoceros	Easy

The star lies at a distance of over 1,900 light-years, with a luminosity of 5,000 Suns.

Canopus	$\alpha$ Car	06 <sup>h</sup> 23.9 <sup>m</sup>	−52° 41'	December 27
−0.72 m	−5.53 M	F0 Ia	Carina	Easy

The second brightest star in the sky. Its color is often reported as orange or yellow, as it is usually seen lying low in the sky and is thus apt to be affected by the atmosphere. Its true color is white.

111 Tau	HD 35296	05 <sup>h</sup> 24.4 <sup>m</sup>	+17° 23'	December 12
5.00 m	4.17 M	F8 V	Taurus	Easy

A close star at 52 light-years, it is only two times as luminous as the Sun.

$\nu^2$ CMa	HD 47205	06 <sup>h</sup> 36.7 <sup>m</sup>	−19° 15'	December 30
3.95 m	2.46 M	K1 III	Canis Major	Easy

This star lies at a distance of 60 light-years with a luminosity seven times that of the Sun.

See also:

Star	Class	Month
Electra	B6 III	November
Atlas	B8 III	November
Castor	A1 V	January
Algenib	F5 I	November
$\gamma^2$ Vel	WC 8	January

## Red Stars

This section will deal with the topic of colored stars. It may seem to a casual observer that stars are not strongly colored, at least to the naked eye, and only the very brightest stars show any perceptible color. Betelgeuse, for example, can be seen to be red, and Capella, yellow, while Vega is blue and Aldebaran has an orange tint. But beyond that, most stars seem to be an overall white. To the naked eye, this is certainly the case, and it is only with some kind of optical equipment that the full range of star color becomes apparent.

But what is meant by the color of a star? A scientific description of a star's color is one that is based on the stellar classification, which in turn is dependent upon the chemical composition and temperature of a star. A term commonly used by astronomers is the *color index*, determined by observing a star through two filters, the B and the V filters, corresponding to wavelengths of 440 and 550 nm, respectively, and measuring its brightness. Subtracting the two values obtained gives  $B - V$ , the color index. Usually, a blue star will have a color index that is negative, i.e.,  $-0.3$ ; orange-red stars could have a value greater than  $0.0$ , and upwards to about  $3.00$  and even greater for very red stars (M6 and greater).<sup>29</sup> But as this is an observationally based book, the scientific description will not generally apply.

From a purely observational viewpoint, the most important factor that determines what the color of a star is, is you – the observer! It is simply a matter of both physiological and psychological influences. What one observer describes as a blue star another may describe as a white star, or one may see an orange star, while another observes the same star as being yellow. It may even be that you will observe a star to have a different color when using different telescopes or magnifications, and atmospheric conditions will certainly have a role to play. The important thing to remember is that whatever color you observe a star to have, then that is the color you should record.<sup>30</sup>

As mentioned previously, red, yellow, orange and blue stars are fairly common, but are there stars that have, say, a purple tint, or blue, or violet, crimson, lemon, and the ever elusive green color? The answer is yes, but with the caveat that it depends on how you describe the color. A glance at astronomy books from the last century and beginning of the twentieth century will show you that star color was a hot topic, and descriptions such as amethyst (purple), cinerous (wood-ash tint),

---

<sup>29</sup> Note that in this section the magnitude quoted is the Hipparcos value, while the  $B-V$  value and the magnitude ranges have been taken from other sources. Also, it can be difficult to ascertain a correct value for  $B-V$  as the light can be reddened by interstellar dust.

<sup>30</sup> An interesting experiment is to observe a colored star first through one eye, then the other. You may be surprised by the result!

jacinth (pellucid orange), and smalt (deep blue), to name but a few, were used frequently. Indeed, the British Astronomical Association even had a section devoted to star colors. But today, observing and cataloging star color is just a pleasant pas-time. Nevertheless, under good seeing conditions, with a dark sky, the keen-eyed observer will be able to see gloriously tinted colors from the deepest red to steeliest blue, with a plethora of colors in between.

It is worth noting that several distinctly colored stars occur as part of a multiple star system. The reason for this may be that although the color is difficult to see in an individual star, it may appear more intense when seen together with a contrasting color. Thus, the section on double and triple stars will catalog many beautifully colored systems. For instance, the fainter of the two stars in  $\eta$  *Cassiopeiae* has a distinct purple tint, while in  $\gamma$  *Andromedae* and  $\alpha$  *Herculis*, the fainter stars are most definitely green.

Many of the strongly colored stars have already been described in the previous section, and thus will not be repeated here, and other stars will be described in the sections on double and triple stars. However, there is a star color upon which most observers agree – the red stars, and to that end, the following list will catalog the most famous and brightest of this type of star. All are classified as N- or R-type stars, as well as a few C-type stars. The N and R classification signifies that although the temperature may be of the same order as M-type stars, these stars show different chemical compositions, while the C-type stars are the carbon stars mentioned earlier. Some of these stars are intensely red and have a deeper color than even Betelgeuse and Arcturus!

The same listing system is used as before, with the addition of the color Index, B-V.

January

See:

Star	Color index	Month
Hind’s Crimson Star	3.4	December
W Orionis	3.33	December
X Cancri	2.97	February

February

X Cancri	HD 76221	08 <sup>h</sup> 55.4 <sup>m</sup>	+17° 14’	February 3
6.12 <sub>v</sub> m	B-V:2.97	C6		Moderate

An extremely orange star, this semi-regular variable star, classification SRB, has a period of 180–195 days and has been observed to range in magnitude from 5.6 to 7.5.

See also:

Star	Color index	Month
Hind’s Crimson Star	3.4	December
W Orionis	3.33	December
X Cancri	2.97	February
V Hydrae	4.5	March

March

V Hydrae	Lalande 16	10 <sup>h</sup> 51.6 <sup>m</sup>	−21° 15′	March 5
7.0 <sub>v</sub> m	B-V:4.5	C9		Easy

This star, another classic long-period variable, has a period of about 533 days and varies in brightness between 6 and 12 m. It also has a second periodicity of 18 years. One of the rare carbon stars that is visible in amateur instruments, its color has been described as a ‘magnificent copper red.’ Note however it is difficult to observe owing to its large magnitude range.

See also:

Star	Color index	Month
La Superba (Chapter 7)	2.9	April
RY Draconis	3.3	April
X Cancri	2.97	February

April

RY Draconis	HD 112559	12 <sup>h</sup> 56.3 <sup>m</sup>	+66° 00′	April 5
6.9 <sub>v</sub> m	B-V:3.3	C7		Easy <sup>®</sup>

A red giant variable star, class SRB, with a poorly understood periodicity (believed to be 200 days) and a magnitude range of 6.0–8.0 m. The star has a lovely red color, although some reports suggest it has more of an orange-red color.

See also:

Star	Color index	Month
V Hydrae	4.5	March



May

See:

Star	Color index	Month
La Superba (Chapter 7)	2.9	April
RY Dra	3.3	April
V Pavonis	2.45	June
T Lyrae	3.7?	June

June

V Pavonis	HD 160435	17 <sup>h</sup> 43.3 <sup>m</sup>	−57° 43′	June 17
6.65 <sub>v</sub> m	B-V:2.45	C5		Easy <sup>®</sup>

A red giant variable star, class SRB, varying in brightness from 6.3 to 8.2 m, over a period of 225.4 days. It also has a secondary period of about 3,735 days. It exhibits a glorious deep-red color.

T Lyrae	SAO 67087	18 <sup>h</sup> 32.3 <sup>m</sup>	+37° 00′	June 29
7.57 <sub>v</sub> m	B-V:3.7?	C8		Moderate

An extremely red-colored star, this is another with an irregular period and has a magnitude range 7.5–9.3. Its color index poses somewhat of a problem, often quoted as having a value ranging from 3.7 to 5.16, making it a *very* red star.

See also:

Star	Color index	Month
V Aquilae	5.46	July
RS Cygni	3.3	July

July

V Aquilae	HD 177336	19 <sup>h</sup> 04.4 <sup>m</sup>	−05° 41′	July 8
7.5 <sub>v</sub> m	B-V:5.46	C5		Easy

A semi-regular variable star with a period of about 350 days, varying in magnitude from 6.6 to 8.1 m. It has a very deep red color.

RS Cygni	HD 192443	20 <sup>h</sup> 13.3 <sup>m</sup>	+38° 44′	July 25
8.1 <sub>v</sub> m	B-V:3.3	C5		Easy

A red giant star with a persistent periodicity, class SRA; it has a period of 417.39 days, with a magnitude range of 6.5–9.5 m. A strange star as where the light curve can vary appreciably, the maxima sometimes doubles. Another deeply red-colored star.

See also:

Star	Colorindex	Month
V Pavonis	2.45	June
T Lyrae	3.7?	June
S Cephei	4.85	August
Garnet Star (Chapter 7)	2.26	August

August

S Cephei	HD 206362	21 <sup>h</sup> 35.2 <sup>m</sup>	+78° 37'	August 15
7.49 <sub>v</sub> m	B-V:4.85	C6		Moderate/difficult®

A moderately difficult star to observe, owing to its magnitude range of between 7 and 12 magnitudes, it nevertheless has a very high color index, making it one of the reddest stars in the sky.

See also:

Star	Color index	Month
V Aquilae	5.46	July
RS Cygni	3.3	July
19 Piscium	2.5	September

September

19 Piscium	TX Psc	23 <sup>h</sup> 46.4 <sup>m</sup>	+03° 29'	September 17
4.95 <sub>v</sub> m	B-V:2.5	C5		Easy

A slow, irregular-period variable star. Classification LB, with a magnitude range of 4.8–5.2 m. The color is an orange-red, best seen in small instruments.

See also:

Star	Color index	Month
Garnet Star (Chapter 7)	2.3	August
S Cephei	4.85	August
R Sculptoris	1.4	October

October

R Sculptoris	HD 8879	01 <sup>h</sup> 26.9 <sup>m</sup>	−32° 33′	October 13
5.79 <sub>v</sub> m	B-V:1.4	C6		Easy

A semi-regular-period variable star, with a period of between 140 and 146 days. It varies in brightness from 5.0 to 6.5.

See also:

Star	Color index	Month
19 Piscium	2.5	September
U Camelopardalis	4.1	November

November

U Camelopardalis	03 <sup>h</sup> 41.8 <sup>m</sup>	+62° 39′	November 16
8.3 <sub>v</sub> m	B-V:4.1	N5	Moderate <sup>®</sup>

A semi-regular variable star, period 412 days with a magnitude range of 7.7–9.5 m. It has a very deep-red color.

See also:

Star	Color index	Month
R Sculptoris	1.4	October
Hind’s Crimson Star	3.4	December
W Orionis	3.33	December

December

Hind’s Crimson Star	R Leporis	04 <sup>h</sup> 59.6 <sup>m</sup>	−14° 48′	December 5
7.71 <sub>v</sub> m	B-V:3.4	C7		Easy

The star, a classic long-period variable. Period about 432 days, varies in brightness between 6.0 and 9.7 m. At maximum brightness it displays the famous ruddy color that gives it its name. Discovered in 1845 by J. R. Hind with a color described as “intense smoky red,” many amateurs regard this to be the reddest star.

W Orionis	HD 32736	05 <sup>h</sup> 0.4 <sup>m</sup>	+01° 11′	December 7
6.3 <sub>v</sub> m	B-V:3.33	N5		Easy

A red giant variable star, classification SRB, with a period of 212 days although a secondary period of 2,450 days is believed to occur. Varies in magnitude from 5.5 to 7.7. A deep-red star seen in the often-regarded best season to observe – winter!

See also:

Star	Color index	Month
U Camelopardalis	4.1	November

## Double Stars

Having started our observation of the night sky by looking at single stars, we are able to use the skills developed so far to observe objects that not only display a wonderful array of colors but also allow precise measurements to be made, namely, double-star systems. The study of double stars is one that has a great pedigree. It was, and in fact still is, an area of astronomy where the observer can make useful detailed observations, and as mentioned previously many double stars present a glittering range of colors.

Double stars are stars that can appear to be just a single star to the naked eye, but on observation with either binoculars or telescopes they resolve itself into two stars. Indeed, some apparently single stars turn out to be several stars and present a marvelous challenge and observing delight to the amateur.

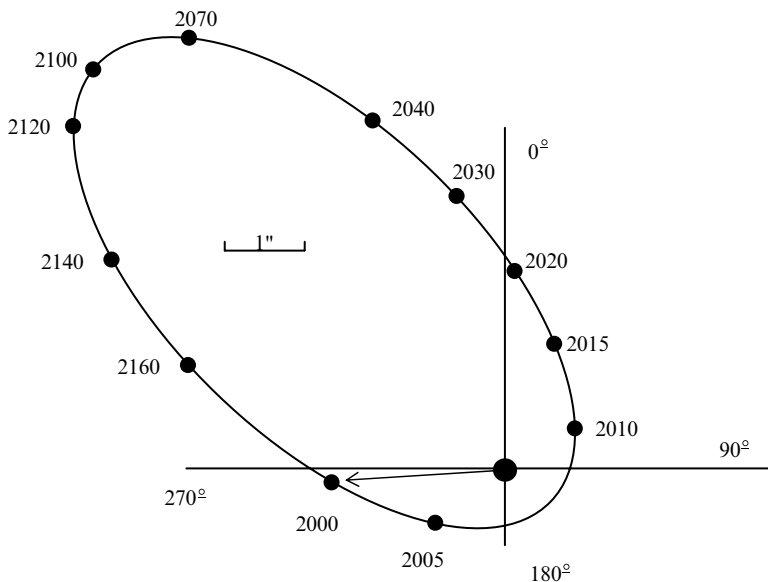
An accurate classification of double stars is quite complex, and lies really in the realm of astrophysics, but a brief description is warranted here.

There are, roughly speaking, five main types of double-star systems<sup>31</sup>:

1. *Optical Doubles*, which appear as double stars due to them lying in the same line of sight as seen from Earth, but it may well be that the two stars are separated in space by a vast distance and are not gravitationally bound.
2. *Spectroscopic Binaries*, where the components in the system cannot be resolved visually, the double component only being fully understood when the spectra is analyzed.
3. *Eclipsing Binaries*, such as Algol ( $\beta$  Persei), where one star moves during its orbit in front of its companion, thus brightening and dimming the light observed over a well-defined period of time.
4. *Astrometric Binaries*, such as Sirius ( $\alpha$  Canis Majoris), where the companion star may only be detected by its influence on the motion of the primary star.
5. *Visual Binaries*, such as Mizar ( $\zeta$  Ursae Majoris) and Alcor (80 Ursae Majoris),<sup>32</sup> where both components, gravitationally bound to each other, are resolvable in optical equipment and, using the example given here, with the naked eye.

<sup>31</sup>The last four types represent gravitationally bound systems.

<sup>32</sup>It used to be thought that the system was not a true binary; however, in 2009, research indicated that in fact Alcor is actually two stars, gravitationally bound with Mizar, and as Mizar is itself a quadruple system we now have an amazing sextuplet system of stars!



**Fig. 2.1**  $\gamma$  Virgins

However, as this book is concerned with objects that can be observed visually, we will concentrate on double stars that can be resolved with either the naked eye or by using some sort of optical equipment such as binoculars or small telescopes.

Some terminology must now be introduced that is specific to double star observation:

- The *primary*<sup>33</sup> star is the brighter of the two stars.
- The *secondary* star is the fainter of the two stars, although in some texts it may be called the companion, and both terms will appear in this book.
- The *separation* is the angular distance between the two stars usually given in seconds of arc (") and measured from the brighter star to the fainter.
- The *position angle* (PA), a somewhat more difficult concept to understand. This is the relative position of one star, usually the secondary, with respect to the primary, and is measured in degrees, with  $0^\circ$  at due north,  $90^\circ$  at due east,  $180^\circ$  due south,  $270^\circ$  at due west, and back to  $0^\circ$ .

To illustrate the above concepts, an example would be useful here. Using Fig. 2.1, the double star  $\gamma$  Virginis, with components of magnitude 3.5 and 3.5, has a separation of  $1.8''$  (arcseconds), at a PA of  $267^\circ$  (epoch 2000.0). Note that the secondary star is the one always placed somewhere on the orbit, the primary star is at the

<sup>33</sup>This terminology is employed regardless of how massive either star is, or whether the primary is in fact the less luminous of the two in reality, but just appears brighter because it is closer.

**Table 2.4** Selected double stars

Star		RA	Dec	m1	m2	PA	Sep	Aperture
						°	"	cm
ζ CMa <sup>a</sup>	Zeta Ursa Majoris	13 <sup>h</sup> 23 <sup>m</sup> 55.5 <sup>s</sup>	+54° 55' 31"	2.5	3.9	152	709	Naked eye
ε Lyr <sup>b</sup>	Epsilon Lyrae	18 <sup>h</sup> 44 <sup>m</sup> 20.3 <sup>s</sup>	+39° 40' 12"	4.7	4.6	350	207.7	Naked eye
ο Cep	Omicron Cephei	23 <sup>h</sup> 18 <sup>m</sup> 37.4 <sup>s</sup>	+68° 06' 42"	5.0	7.3	223	2.8	5
ζ Aqr	Zeta Aquarii	22 <sup>h</sup> 28 <sup>m</sup> 49.6 <sup>s</sup>	−00° 01' 13"	4.4	4.6	192	2.1	5
ε Ari	Epsilon Arietis	02 <sup>h</sup> 59 <sup>m</sup> 12.6 <sup>s</sup>	+21° 20' 25"	5.2	5.6	203	1.4	7.5
μ Lib	Mu Librae	14 <sup>h</sup> 49 <sup>m</sup> 19.0 <sup>s</sup>	−14° 08' 56"	5.7	6.7	355	1.8	7.5
θ Aur	Theta Aurigae	05 <sup>h</sup> 59 <sup>m</sup> 43.2 <sup>s</sup>	+37° 12' 45"	2.6	7.1	313	3.6	10
η Ori	Eta Orionis	05 <sup>h</sup> 24 <sup>m</sup> 28.6 <sup>s</sup>	−02° 23' 49"	3.6	4.9	80	1.5	10
ζ Boo	Zeta Boötis	14 <sup>h</sup> 41 <sup>m</sup> 08.8 <sup>s</sup>	+13° 43' 42"	4.5	4.6	300	0.8	15
ι Leo	Iota Leonis	11 <sup>h</sup> 23 <sup>m</sup> 55.4 <sup>s</sup>	+10° 31' 45"	4.1	6.9	116	1.7	20
χ Aql	Chi Aquilae	23 <sup>h</sup> 18 <sup>m</sup> 37.4 <sup>s</sup>	+68° 06' 42"	5.8	6.9	77	0.5	25

<sup>a</sup>Mizar and Alcor, probably the most famous visual double in the northern hemisphere.

<sup>b</sup>The “double-double,” a good test for visual acuity.

center of the perpendicular lines, and that the separation and PA of any double star are constantly changing, and should be quoted for the year observed.

Some stars, where the period is very long, will have no appreciable change in PA for several years; others, however, will change from year to year. Many books that discuss double stars in detail will have similar diagrams for the stars listed; however, to present a similar facility here would entail a doubling of the book's size.<sup>34</sup>

It is worth mentioning again that although your optical equipment, including your eyes, should in theory be able to resolve many of the double listed here,<sup>35</sup> there are several factors that will constrain your observable resolution, i.e., the seeing, light pollution, dark adaption, etc., and your temperament. Thus, if you cannot initially resolve a double star, do not despair, but move onto another, and return to the one in question at another date. Also recall that the colors ascribed to the star will not necessarily be the color you see. They are just indicators of the general color, and in fact, as you will see from the text, many observers will, and can, disagree on a star's color.

Included is a brief list of several stars that can help to determine the resolution of both yourself and your binoculars/telescope.<sup>36</sup> All the positions quoted are for the primary star (Table 2.4).

<sup>34</sup>Several of the books listed in the appendices will have the double star orbits drawn, which will significantly aid you in determining which star is which.

<sup>35</sup>There are literally thousands of double-, triple- and multiple-star systems in the sky, all within reach of the amateur astronomer, and the list that follows is but a taste of what awaits the observer.

<sup>36</sup>Note that the position angle and separation are quoted for epoch 2000.0. With double stars that have small periods, these figures will change appreciably.

In the lists that follow, the same information set up is used as before, with the addition of the Position Angle (PA) and Separation (Sep).

## January

$\phi$ Aurigae	HD 48682	06 <sup>h</sup> 46.7 <sup>m</sup>	+43° 35'	January 2
5.3, 8.3 m	PA 31°  Sep. 36.2"			Easy <sup>37</sup>

A pair of yellow and blue stars set against a backdrop of faint stars.

$\pi$ Canis Majoris	HD 51199	06 <sup>h</sup> 55.6 <sup>m</sup>	−20° 08'	January 4
4.7, 9.7 m	PA 18°  Sep. 11.6"			Easy

A pale yellow primary and bluish secondary.

h 3945 <sup>38</sup>	HD 56577	07 <sup>h</sup> 16.1 <sup>m</sup>	−23° 19'	January 9
4.8, 6.1 m	PA 55°  Sep. 26.6"			Easy

A wonderful dark orange and blue double-star system. The colors have also been described as gold and blue.

Struve 1149	$\Sigma$ 1149	07 <sup>h</sup> 49.5 <sup>m</sup>	+03° 13'	January 18
7.9, 9.6 m	PA 41°  Sep. 21.7"			Easy

A lovely double-star system with a yellow primary and blue secondary.

38 Geminorum	ADS 5559 <sup>39</sup>	06 <sup>h</sup> 54.6 <sup>m</sup>	+13° 11'	January 4
4.7, 7.7 m	PA 145°  Sep. 7.1"			Moderate

Easily split using small telescopes, yellow and blue. Note that some observers see the secondary as purple.

$\mu$ Canis Majoris	ADS 5605	06 <sup>h</sup> 56.1 <sup>m</sup>	−14° 03'	January 4
5.3, 8.6 m	PA 340°  Sep. 3.0"			Moderate

<sup>37</sup>The terms “easy, moderate and difficult” have a slightly different meaning to that used previously. In the present context it refers to the ability to split the double and not just its ease of being observed, although this will also be a significant factor in the use of the definition.

<sup>38</sup>This signifies that it is the 3,945th star in the John Herschel catalog.

<sup>39</sup>The ADS number is the number given in the *New General Catalogue of Double Stars*, which covers as far south as −30°.

Two stars of differing brightness that nevertheless present a glorious double of orange and blue.

$\kappa$ Geminorum	ADS 6321	$07^h\ 44.4^m$	$+24^\circ\ 24'$	January 16
3.6, 8.1 m	PA $240^\circ$   Sep. $7.1''$			Moderate

A bright orange-yellow primary with a fainter blue secondary.

$\phi^2$ Cancri	ADS 6815	$08^h\ 26.8^m$	$+26^\circ\ 56'$	January 27
6.3, 6.3 m	PA $218^\circ$   Sep. $5.1''$			Moderate

A superb pair of white stars.  
See also:

Star	PA Sep	Month
11 & 12 Cml	$8^\circ$   $108.5''$	December
S473	$305^\circ$   $20.6''$	December
La 1	$123^\circ$   $11.0''$	December
$\gamma$ Leporis	$350^\circ$   $96.3''$	December
41 Aurigae	$356^\circ$   $7.7''$	December
15 Geminorum	$204^\circ$   $25.1''$	December
$\nu^1$ Canis Majoris	$262^\circ$   $17.5''$	December
$\omega$ Aurigae	$359^\circ$   $5.4''$	December
h3750	$282^\circ$   $4.2''$	December
$\kappa$ Leporis	$358^\circ$   $2.6''$	December
UV Aurigae	$4^\circ$   $3.4''$	December
$\theta$ Aurigae	$313^\circ$   $3.6''$	December
$\iota^1$ Cancri	$307^\circ$   $30.5''$	February
6 Leonis	$75^\circ$   $37.4''$	February
$\omicron$ Leonis	$44^\circ$   $85.4''$	February
38 Lyncis	$229^\circ$   $2.7''$	February
$\gamma$ Leonis	$125^\circ$   $4.4''$	February

*February*

$\iota^1$ Cancri	ADS 6988	$08^h\ 46.7^m$	$+28^\circ\ 46'$	February 1
4.0, 6.6 m	PA $307^\circ$   Sep. $30.5''$			Easy

Spectacular! A gold primary with a blue secondary. Can be split with as low a magnification as 12 $\times$  but is a challenge for binoculars.

6 Leonis	ADS 7416	$09^h\ 32.0^m$	$+09^\circ\ 43'$	February 12
5.2, 8.2 m	PA $75^\circ$   Sep. $37.4''$			Easy



A stunning gold and blue double-star system.

o Leonis	ADS 7480	09 <sup>h</sup> 41.2 <sup>m</sup>	+09° 54'	February 15
3.5, 9.5 m	PA 44°  Sep. 85.4"			Easy

A nice double of yellow and blue stars that are easy to resolve.

38 Lyncis	ADS 7292	09 <sup>h</sup> 18.8 <sup>m</sup>	+36° 48'	February 9
3.9, 6.3 m	PA 229°  Sep. 2.7"			Moderate

This is a nice pair of stars, where the primary is white, while some observers describe the secondary as rust-colored.

γ Leonis	ADS 7724	10 <sup>h</sup> 20.0 <sup>m</sup>	+19° 51'	February 25
2.5, 3.6 m	PA 125°  Sep. 4.4"			Easy/Moderate

A fine pairing of yellow stars, one deep and the other paler. Easy to find as it is the brightest star in the curve of the sickle of Leo (See also Regulus).

See also:

Star	PA/Sep	Month
φ <sup>5</sup> Aurigae	31°  36.2"	January
π Canis Majoris	18°  11.6"	January
h 3945	55°  26.6"	January
Struve 1149	41°  21.7"	January
38 Geminorum	145°  7.1"	January
μ Canis Majoris	340°  3.0"	January
κ Geminorum	240°  7.1"	January
φ <sup>2</sup> Cancrī	218°  5.1"	January
N Hydrae	210°  9.2"	March
δ Corvi	214°  24.2"	March
35 Sextantis	240°  6.8"	March
2 CVn	260°  11.4"	March
γ Crt	96°  5.2"	March
ξ Ursae Majoris	273°  1.8"	March
ι Leonis	116°  1.7"	March

*March*

N Hydrae	17 Crt	11 <sup>h</sup> 32.3 <sup>m</sup>	−29° 16'	March 15
5.8, 5.9 m	PA 210°  Sep. 9.2"			Easy

This is an easy double to resolve with a small telescope, consisting of unequally bright yellow stars.

δ Corvi	ADS 8572	12 <sup>h</sup> 29.9 <sup>m</sup>	−16° 31′	March 30
3.0, 9.2 m	PA 214°  Sep. 24.2″			Easy

A superb double-star system consisting of a bright white primary and fainter pale blue secondary. First observed in 1823.

35 Sextantis	ADS 7902	10 <sup>h</sup> 43.3 <sup>m</sup>	+04° 45′	March 3
6.3, 7.4 m	PA 240°  Sep. 6.8″			Easy/moderate

Easily resolved by small telescope, a fine system of orange and yellowish stars.

2 CVn	ADS 8489	12 <sup>h</sup> 16.1 <sup>m</sup>	+40° 40′	March 26
5.8, 8.1 m	PA 260°  Sep. 11.4″			Easy/moderate

An easy double for small telescopes, with a yellow primary and pale blue secondary.

γ Crt	ADS 8153	11 <sup>h</sup> 24.9 <sup>m</sup>	−17° 41′	March 13
4.1, 9.6 m	PA 96°  Sep. 5.2″			Moderate

An unequally bright double consisting of a white primary and blue secondary.

ξ Ursae Majoris	ADS 8119	11 <sup>h</sup> 18.2 <sup>m</sup>	+31° 32′	March 12
4.3, 4.8 m	PA 273°  Sep. 1.8″			v. difficult

Discovered by William Herschel in 1780, this is a close pair of pale yellow stars. It also has the distinction of being the first binary system to have its orbit calculated by Savary in 1828. Both components are also spectroscopic binaries.

ι Leonis	ADS 8148	11 <sup>h</sup> 23.9 <sup>m</sup>	+10° 32′	March 13
4.0, 6.7 m	PA 116°  Sep. 1.7″			v. difficult

A difficult double star to resolve owing to its small angular separation. However, it is widening now (E 2000.0), and so will get easier to split. The components are yellow and white.

See also:

Star	PA/Sep	Month
ι <sup>1</sup> Cancri	307°  30.5"	February
6 Leonis	75°  37.4"	February
ο Leonis	44°  85.4"	February
38 Lyncis	229°  2.7"	February
γ Leonis	125°  4.4"	February
α CVn	229°  19.4"	April
κ Boötis	236°  13.4"	April
ε Boötis	339°  2.8""	April
84 Virginis	229°  2.9"	April
γ Virginis	259°  1.5"	April

April

α CVn	ADS 8706	12 <sup>h</sup> 56.0 <sup>m</sup>	+38° 19'	April 5
2.9, 5.5 m	PA 229°  Sep. 19.4"			Easy

Also known as Cor Caroli, the stars of this system are separated by a distance equivalent to five Solar System widths – 770 astronomical units! The two stars are yellowish in small instruments; however, with large aperture, subtle tints become apparent and have been called flushed white and pale lilac or pale yellow and fawn!

κ Boötis	ADS 9173	14 <sup>h</sup> 13.5 <sup>m</sup>	+51° 47'	April 25
4.6, 6.6 m	PA 236°  Sep. 13.4"			Easy <sup>o</sup>

A nice double for small telescopes, where the primary is white, although some observers see yellow, and the secondary is blue. The primary is also a variable.

ε Boötis	ADS 9372	13 <sup>h</sup> 45.0 <sup>m</sup>	+27° 04'	April 18
2.5, 4.9 m	PA 339°  Sep. 2.8"			Moderate

A wonderful contrast of gold and green stars that has also been reported to be yellow and blue. However, it is difficult with apertures of around 7.5 cm, and even a challenge for beginners with apertures of 15.0 cm. With small telescopes a high power is needed to resolve them. Also known as Mirak.

84 Virginis	ADS 9000	13 <sup>h</sup> 43.1 <sup>m</sup>	+03° 32'	April 17
5.5, 7.9 m	PA 229°  Sep. 2.9"			Difficult

A high magnification will split this system into vivid orange and pale yellow stars.

$\gamma$ Virginis	ADS 8630	$12^h\ 41.7^m$	$-01^\circ\ 27'$	April 2
3.5, 3.5 m	PA $259^\circ$   Sep. $1.5''$			v. difficult

A very difficult double to resolve owing to the small separation, which will decrease even further until soon they will be  $0.9''$  apart, and so to all intents and purposes appear single. It is, however, a nice pair of pale yellow stars.

See also:

Star	PA/Sep	Month
N Hydrae	$210^\circ$   $9.2''$	March
$\delta$ Corvi	$214^\circ$   $24.2''$	March
35 Sextantis	$240^\circ$   $6.8''$	March
2 CVn	$260^\circ$   $11.4''$	March
$\gamma$ Crt	$96^\circ$   $5.2''$	March
$\xi$ Ursae Majoris	$273^\circ$   $1.8''$	March
$\iota$ Leonis	$116^\circ$   $1.7''$	March
$\iota^1$ Librae	$314^\circ$   $231.0''$	May
54 Hydrae	$126^\circ$   $8.6''$	May
$\iota^1$ Librae	$111^\circ$   $57.8''$	May
$\nu^1$ Corona Borealis	$165^\circ$   $364.4''$	May
$\beta$ Scorpii	$21^\circ$   $13.6''$	May
$\text{O}\Sigma\ 300$	$261^\circ$   $15.3''$	May
$\xi$ Corona Borealis	$305^\circ$   $6.3''$	May
$\rho$ Ophiuchi	$344^\circ$   $3.1''$	May
$\lambda$ Ophiuchi	$29^\circ$   $1.4''$	May
$\nu$ Scorpii	$03^\circ$   $0.9''$	May
$\nu$ Scorpii	$51^\circ$   $2.3''$	May

May

$\alpha$ Librae	h186	$14^h\ 50.9^m$	$-16^\circ\ 02'$	May 4
2.8, 5.2 m	PA $314^\circ$   Sep. $231.0''$			v. easy

This can be seen with binoculars as a widely separated pair of white and yellow stars. The primary is itself a spectroscopic binary.

54 Hydrae	ADS 9375	$14^h\ 46.0^m$	$-25^\circ\ 27'$	May 3
5.1, 7.1 m	PA $126^\circ$   Sep. $8.6''$			Easy

An easy double of yellowish stars with the primary a pale yellow, while the secondary is a stronger yellow.

$\iota^1$ Librae	ADS 9532	$15^h\ 12.2^m$	$-19^\circ\ 47'$	May 10
4.5, 9.4 m	PA $111^\circ$   Sep. $57.8''$			easy

A rather nice system of white and red stars. There is a much fainter third star, magnitude 11.1, that is sometimes described as having a purplish color. However, this is only 1.9" away from the primary and exceedingly difficult to detect.

$\nu^1$ Corona Borealis	ADS 9913	$15^h 22.4^m$	$+33^\circ 48'$	May 12
5.4, 5.3 m	PA $165^\circ$   Sep. $364.4''$			Easy

A nice binocular pair of orange stars.

$\beta$ Scorpii	ADS 9913	$16^h 05.4^m$	$-19^\circ 48'$	May 23
2.6, 4.9 m	PA $21^\circ$   Sep. $13.6''$			Easy

A good double for small apertures of around 5.0 cm, this has a brilliant blue-white primary with a paler blue secondary. The primary is itself a binary.

$\text{O}\Sigma$ 300	ADS 9740	$15^h 40.2^m$	$+12^\circ 03'$	May 17
6.4, 9.5 m	PA $261^\circ$   Sep. $15.3''$			Easy/moderate

Located within the faint and often overlooked constellation Serpens Caput. This is a nice system consisting of yellow and blue stars.

$\xi$ Corona Borealis	ADS 9737	$15^h 39.4^m$	$+36^\circ 38'$	May 17
5.1, 6.0 m	PA $305^\circ$   Sep. $6.3''$			Moderate

These two stars contrast each other nicely with definite blue and green colors.

$\rho$ Ophiuchi	ADS 10049	$16^h 25.6^m$	$-23^\circ 27'$	May 28
5.3, 6.0 m	PA $344^\circ$   Sep. $3.1''$			Moderate

A medium-sized telescope of at least 10.0 cm aperture along with a high magnification is needed to resolve this pair of blue stars.

$\lambda$ Ophiuchi	ADS 10087	$16^h 30.9^m$	$+01^\circ 59'$	May 30
4.1, 5.2 m	PA $29^\circ$   Sep. $1.4''$			Difficult

A nice pairing of white and pale lemon stars. Can be used as a test for small telescopes.

$\nu$ Scorpii	ADS 9951	$16^h 12.0^m$	$-19^\circ 28'$	May 25
4.3, 6.8 m	PA $03^\circ$   Sep. $0.9''$			v. difficult
6.4, 7.8 m	PA $51^\circ$   Sep. $2.3''$			Easy

Another system of double-double stars. The main white pair will appear as two discs in contact, but only under near-perfect conditions; the easier pair are nice

yellowish stars. The two components appear as magnitude 4.2 and 6.1, separation 41.1", and with a PA of 337° (See Antares.).

See also:

Star	PA/Sep	Month
α CVn	229°  19.4"	April
κ Boötis	236°  13.4"	April
ε Boötis	339°  2.8"	April
84 Virginis	229°  2.9"	April
γ Virginis	259°  1.5"	April
ο Ophiuchi	355°  10.3"	June
56 Herculis	93°  18.1"	June
21 Sagittarii	289°  1.8"	June
α Herculis	104°  4.6"	June

June

ο Ophiuchi	ADS 10442	17 <sup>h</sup> 18.0 <sup>m</sup>	−24° 17′	June 11
5.4, 6.9 m	PA 355°  Sep. 10.3"			Easy

Located in a field of bright stars, this double makes a nice contrast of orange and yellow.

56 Herculis	ADS 10259	16 <sup>h</sup> 55.0 <sup>m</sup>	+25° 44′	June 5
6.1, 10.6 m	PA 93°  Sep. 18.1"			Easy/moderate

The primary is a semi-regular variable star, type M, with a magnitude change of 3.1–3.9 and a period of 90 days. It is a wonderful double, with an orange primary and a greenish secondary.

21 Sagittarii	ADS 1325	18 <sup>h</sup> 25.3 <sup>m</sup>	−20° 32′	June 28
4.9, 7.4 m	PA 289°  Sep. 1.8"			Moderate

A rigorous test for small telescopes, and even a challenge for medium apertures, this is a nice contrast of orange and blue stars. Some observers report the secondary as greenish.

α Herculis	ADS 10418	17 <sup>h</sup> 14.6 <sup>m</sup>	+14° 23′	June 10
3.5 <sub>v</sub> , 5.4 <sub>v</sub> m	PA 104°  Sep. 4.6"			Difficult

A lovely color contrast double: orange and bluish green. The primary star is itself variable, while the secondary is an unresolvable double.

See also:

Star	PA/Sep	Month
$\alpha$ Librae	314°  231.0"	May
54 Hydrae	126°  8.6"	May
$\iota^1$ Librae	111°  57.8"	May
$\nu^1$ Corona Borealis	165°  364.4"	May
$\beta$ Scorpil	21°  13.6"	May
OΣ 300	261°  15.3"	May
$\zeta$ Corona Borealis	305°  6.3"	May
$\rho$ Ophiuchi	344°  3.1"	May
$\lambda$ Ophiuchi	29°  1.4"	May
$\nu$ Scorpil	03°  0.9"	May
$\nu$ Scorpil	51°  2.3"	May
$\rho$ Capricornin	150°  247.6"	July
$\zeta$ Lyrae	150°  43.7"	July
$\beta$ Lyrae	149°  45.7"	July
11 Aquilae	286°  17.5"	July
$\beta$ Cygni	54°  34.4"	July
H N 84	302°  28.2"	July
$\sigma$ Capricornin	179°  55.9"	July
$\epsilon$ Lyrae <sup>1</sup> (Chapter 7)	357°  2.6"	July
$\epsilon$ Lyrae <sup>2</sup> (Chapter 7)	94°  2.3"	July
HN 119	142°  7.8"	July
OΣ 394	294°  11.0"	July
23 Aquilae	05°  3.1"	July
$\delta$ Cygni	221°  2.5"	July
$\beta$ 441 (Vulpecula)	66°  5.9"	July

July

$\rho$ Capricornin	ADS 13887	20 <sup>h</sup> 28.9 <sup>m</sup>	−17° 49′	July 29
5.0, 6.7 m	PA 150°  Sep. 247.6"			v. easy

Easily seen in binoculars. This attractive pair of stars are colored yellow and purplish.

$\zeta$ Lyrae	ADS 11639	18 <sup>h</sup> 44.8 <sup>m</sup>	+37° 36′	July 3
4.3, 5.9 m	PA 150°  Sep. 43.7"			Easy

An easy pair of yellowish stars.

$\beta$ Lyrae	ADS 11745	18 <sup>h</sup> 50.1 <sup>m</sup>	+33° 22′	July 4
3.4 <sub>v</sub> , 8.6 m	PA 149°  Sep. 45.7"			Easy

This pair of white stars is a challenging double for binoculars.  $\beta^1$  is also an eclipsing binary. A fascinating situation occurs owing to the gravitational effects of the components of  $\beta^1$ . The stars are distorted from their spherical shapes into ellipsoids.

11 Aquilae	$\Sigma 2424$	$18^h 59.1^m$	$+13^\circ 37'$	July 6
5.2, 8.7 m	PA $286^\circ$   Sep. $17.5''$			Easy

An optical double with a nice color contrast – yellow and blue.

$\beta$ Cygni	ADS 12540	$19^h 30.7^m$	$+27^\circ 58'$	July 14
3.1, 5.1 m	PA $54^\circ$   Sep. $34.4''$			Easy

Thought by many to be the finest double in the skies, Albireo is a golden-yellow primary and lovely blue secondary against the backdrop of the myriad fainter stars of the Milky Way. Easy to locate at the foot of the Northern Cross, the colors can be made to appear even more spectacular if you slightly defocus the images. Wonderful!

H N 84	ADS 12750	$19^h 39.4^m$	$+16^\circ 34'$	July 16
6.5, 8.9 m	PA $302^\circ$   Sep. $28.2''$			Easy

Located in the constellation of Sagitta, this is a fine double of orange and blue.

$\sigma$ Capricornin	ADS 13675	$20^h 19.4^m$	$-19^\circ 07'$	July 27
5.5, 9.0 m	PA $179^\circ$   Sep. $55.9''$			Easy

An easy system to resolve although the primary is considerably brighter than the secondary. The stars are a yellow and a pale blue in color.

HN 119	ADS 12506	$19^h 29.9^m$	$-26^\circ 59'$	July 14
5.6, 8.6 m	PA $142^\circ$   Sep. $7.8''$			Easy/moderate

Known as far back as 1821, this is a nice double of orange and blue stars.

O $\Sigma$ 394	ADS 13240	$20^h 00.2^m$	$+36^\circ 25'$	July 22
7.1, 9.9 m	PA $294^\circ$   Sep. $11.0''$			Easy/moderate

A delightful system consisting of an orange primary and a blue secondary.

23 Aquilae	$\Sigma 2492$	$19^h 18.5^m$	$+1^\circ 05'$	July 11
5.3, 9.3 m	PA $5^\circ$   Sep. $3.1''$			Moderate

A very close pair, but a lovely deep yellow and greenish-blue double system.



δ Cygni	ADS 12880	19 <sup>h</sup> 45.0 <sup>m</sup>	+45° 08′	July 18
2.9, 6.3 m	PA 221°  Sep. 2.5″			Difficult

Contrasting reports of this system’s colors abound: a blue-white or greenish-white primary, and a blue-white or bluish secondary. A test for telescopes of 10.0–15.0 cm, and exceptional seeing is needed.

β441 (Vulpecula)	ADS 13648	20 <sup>h</sup> 17.5 <sup>m</sup>	+29° 09′	July 26
6.2, 10.7 m	PA 66°  Sep. 5.9″			Difficult

Also known as Burnham 441, this is a nice contrasting pair of yellow and blue stars.

See also:

Star	PA/Sep	Month
ο Ophiuchi	355°  10.3″	June
56 Herculis	93°  18.1″	June
21 Sagittarii	289°  1.8″	June
α Herculis	104°  4.6″	June
61 Cygni	150°  30.3″	August
β Cephei	249°  13.3″	August
Σ2894Lac	194°  15.6″	August
94 Aquarii	350°  12.7″	August
Aquarius	184°  17.6″	August
γ Delphini	268°  9.6″	August
12 Aquarii	192°  2.8″	August
29 Aquarii	244°  3.7″	August
41 Aquarii	114°  5.0″	August
ξ Aquarii	192°  2.1″	August

August

61 Cygni	ADS 14636	21 <sup>h</sup> 06.9 <sup>m</sup>	+38° 45′	August 8
5.2, 6.0 m	PA 150°  Sep. 30.3″			Easy

Best seen with binoculars (but sometimes a challenge if conditions are poor) that seem to emphasize the vibrant colors of these stars, both orange-red. This system is famous for being the first to have its distance measured by the technique of parallax. The German astronomer Friedrich Bessel determined its distance to be 10.3 light-years; modern measurements give a figure of 11.36. Also has an unseen third component, which has the mass of eight Jupiters. Has a very large proper motion.<sup>40</sup>

<sup>40</sup>Motion across the sky.

$\beta$ Cephei	ADS 15032	$21^h 28.7^m$	$+70^\circ 34'$	August 13
3.2, 7.9 m	PA 249°  Sep. 13.3"			Easy <sup>o</sup>

Also known as Alfirk, it is a cepheid variable. The system is a nice white and blue double. Using a large-aperture telescope, the secondary takes on a definite green tint.

$\Sigma$ 2894Lac	ADS 15828	$22^h 18.9^m$	$+37^\circ 46'$	August 26
6.1, 8.3 m	PA 194°  Sep. 15.6"			Easy

A nice system of yellow and blue stars in the constellation Lacerta.

94 Aquarii	HD 219834	$22^h 19.1^m$	$-13^\circ 28'$	August 26
5.3, 7.3 m	PA 350°  Sep. 12.7"			Easy

A lovely double, yellowish red and pale green.

Aquarius	$\Sigma$ 2838	$21^h 54.7^m$	$-03^\circ 18'$	August 20
6.3, 9.1 m	PA 184°  Sep. 17.6"			Easy/Moderate

A yellow and bluish pair of stars with a background of many faint stars.

$\gamma$ Delphini	ADS 14279	$20^h 46.7^m$	$+16^\circ 07'$	August 3
4.3, 5.5 m	PA 268°  Sep. 9.6"			Easy/Moderate

Easily resolved with a small telescope, this is a beautiful double with a yellow primary and a rare green secondary.

12 Aquarii	$\Sigma$ 2745	$21^h 04.1^m$	$-05^\circ 49'$	August 7
5.9, 7.3 m	PA 192°  Sep. 2.8"			Moderate

A close pair of pale blue and yellow stars.

29 Aquarii	S 802 <sup>41</sup>	$22^h 02.4^m$	$-16^\circ 58'$	August 22
7.2, 7.4 m	PA 244°  Sep. 3.7"			Moderate

A high power is needed to split this pair of white stars.

41 Aquarii	ADS 15753	$22^h 14.3^m$	$-21^\circ 04'$	August 25
7.1, 7.1 m	PA 114°  Sep. 5.0"			Moderate

<sup>41</sup>This signifies that it is the 802nd star in the John South catalog.

A lovely double system consisting of contrasting gold and blue stars.

ξ Aquarii	ADS 15971	22 <sup>h</sup> 28.8 <sup>m</sup>	−00° 01′	August 28
4.3, 4.5 m	PA 192°  Sep. 2.1″			Moderate

Good conditions and optics are needed to be able to split this double star, which is white and white. This is the central star of the Water Jar asterism in Aquarius.

See also:

Star	PA/Sep	Month
ρ Capricorni	150°  247.6″	July
ζ Lyrae	150°  43.7″	July
β Lyrae	149°  45.7″	July
11 Aquilae	286°  17.5″	July
β Cygni	54°  34.4″	July
H N 84	302°  28.2″	July
σ Capricorni	179°  55.9″	July
HN 119	142°  7.8″	July
OΣ394	294°  11.0″	July
23 Aquilae	05°  3.1″	July
δ Cygni	221°  2.5″	July
β441 (Vulpecula)	66°  5.9″	July
τ <sup>1</sup> Aquarii	121°  23.7″	September
Herschel 975	243°  51.0″	September
42 Piscium	324°  28.5″	September
51 Piscium	83°  27.5″	September
57 Pegasi	198°  32.6″	September
107 Aquarii	136°  6.6″	September
σ Cassiopeiae	326°  3.0″	September
Struve 3050	335°  1.7″	September
Groombridge 34	62°  40.0″	September

September

τ <sup>1</sup> Aquarii	ADS 16268	22 <sup>h</sup> 47.7 <sup>m</sup>	−14° 03′	September 2
5.8, 9.0 m	PA 121°  Sep. 23.7″			Easy

A double that exhibits many colors to different observers; yellowish and orange, blue-white and greenish, white and yellow, white and pale red. What do you see?

Herschel 975	h975	22 <sup>h</sup> 55.7 <sup>m</sup>	+36° 21′	September 4
5.6, 9.5 m	PA 243°  Sep. 51.0″			Easy

A system with a large magnitude difference. A white primary and pale blue secondary. Located in the constellation Lacerta.

42 Piscium	00 <sup>h</sup> 22.4 <sup>m</sup>	+13° 29'	September 26
6.2, 10.1 m	PA 324°  Sep. 28.5"		Easy

An easy double-star system to split comprised of an orange primary and blue secondary.

51 Piscium	00 <sup>h</sup> 32.4 <sup>m</sup>	+06° 57'	September 29
5.7, 9.5 m	PA 83°  Sep. 27.5"		Easy

A wonderful double-star system with a bluish-white primary and greenish secondary.

57 Pegasi	HD 218634	23 <sup>h</sup> 09.5 <sup>m</sup>	+08° 41'	September 8
5.1, 9.7 m	PA 198°  Sep. 32.6"			Easy/moderate

A lovely system that is easily resolved in small telescopes. It consists of an orange primary and bluish secondary.

107 Aquarii	H II 24	23 <sup>h</sup> 46.0 <sup>m</sup>	-18° 41'	September 17
5.7, 6.7 m	PA 136°  Sep. 6.6"			Easy/moderate

A close double with colors of pale yellow and a definite bluish white.

σ Cassiopeiae	ADS 17140	23 <sup>h</sup> 59.0 <sup>m</sup>	+55° 45'	September 20
5.0, 7.1 m	PA 326°  Sep. 3.0"			Moderate <sup>©</sup>

Located within a nice star field, a bluish and yellow system. Has also been described as green and blue.

Struve 3050	Σ3050	23 <sup>h</sup> 59.5 <sup>m</sup>	+33° 43'	September 20
6.6, 6.6 m	PA 335°  Sep. 1.7"			Moderate

A very close double that shows the two yellow stars almost touching.

Groombridge 34	ADS 246	00 <sup>h</sup> 17.9 <sup>m</sup>	+44° 00'	September 25
8.2, 10.6 m	PA 62°  Sep. 40.0"			Moderate/difficult

A red dwarf binary system, with a large proper motion that could easily be plotted over several years. Discovered in 1860.

See also:

Star	PA/Sep	Month
61 Cygni	150°  30.3"	August
β Cephei	249°  13.3"	August
Σ2894Lac	194°  15.6"	August
94 Aquarii	350°  12.7"	August
Aquarius	184°  17.6"	August
γDelphini	268°  9.6"	August
12 Aquarii	192°  2.8"	August
29 Aquarii	244°  3.7"	August
41 Aquarii	114°  5.0"	August
ξ Aquarii	192°  2.1"	August
η Cassiopeiae	317°  12.9"	October
26 Ceti	253°  16.0"	October
γ Arietis	0°  7.8"	October
λ Arietis	46°  37.4"	October
66 Ceti	234°  16.5"	October
α Ursae Minoris	218°  18.4"	October
33 Arietis	0°  28.6"	October
ι Trianguli	71°  3.9"	October
84 Ceti	310°  4.0"	October
36 Andromedae	313°  0.9"	October
ε Trianguli	118°  3.9"	October

October

η Cassiopeiae	ADS 671	00 <sup>h</sup> 49.1 <sup>m</sup>	+57° 49'	October 3
3.4, 7.5 m	PA 317°  Sep. 12.9"			Easy <sup>®</sup>

Discovered by William Herschel in 1779. Another system that has different colors being reported. The primary has been described as gold, yellow and topaz, while the secondary has been called orange, red and purple. Has an apparently near-circular orbit.

26 Ceti	Σ84	01 <sup>h</sup> 03.8 <sup>m</sup>	+01° 22'	October 7
6.2, 8.6 m	PA 253°  Sep. 16.0"			Easy

A nice system, reported as yellow and lilac.

γ Arietis	ADS 1507	01 <sup>h</sup> 53.5 <sup>m</sup>	+19° 18'	October 19
4.8, 4.8 m	PA 0°  Sep. 7.8"			Easy

Discovered by Robert Hooke in 1664 this is a lovely pair of equally bright bluish white stars.

$\lambda$ Arietis	ADS 1563	01 <sup>h</sup> 57.9 <sup>m</sup>	+23° 35'	October 20
4.9, 7.7 m	PA 46°  Sep. 37.4"			Easy

An easy pair to split in binoculars with colors of pale yellow and pale blue.

66 Ceti	ADS 1703	02 <sup>h</sup> 12.8 <sup>m</sup>	−02° 24'	October 24
5.7, 7.5 m	PA 234°  Sep. 16.5"			Easy

With small aperture, the colors are yellow and blue, but with large aperture, they are reported to be topaz and violet!

$\alpha$ Ursae Minoris	ADS 1477	02 <sup>h</sup> 31.8 <sup>m</sup>	+89° 16'	October 29
2.0, 8.2 m	PA 218°  Sep. 18.4"			Easy <sup>®</sup>

Possibly the most famous star in the entire sky, Polaris, or the Pole Star, is located less than a degree from the celestial pole, and is a nice double consisting of a yellowish primary and a faint whitish-blue secondary. The primary is also a Population II<sup>42</sup> Cepheid variable, and a spectroscopic binary. Although claims have been made to the effect that the system can be resolved in an aperture as small as 4.0 cm, at least 6.0 cm will be required to split it clearly.

33 Arietis	HD 16628	02 <sup>h</sup> 40.7 <sup>m</sup>	+27° 04'	October 31
5.5, 8.4 m	PA 0°  Sep. 28.6"			Easy

An easy pair to split consisting of pale yellow and pale blue stars.

55 Piscium	ADS 558	00 <sup>h</sup> 39.9 <sup>m</sup>	+21° 26'	October 1
5.4, 8.7 m	PA 194°  Sep. 6.5"			Moderate

A lovely system with a vivid yellow primary and blue secondary.

1 Arietis	ADS 1457	01 <sup>h</sup> 50.1 <sup>m</sup>	+22° 17'	October 18
6.2, 7.2 m	PA 166°  Sep. 2.8"			Moderate

A nice system consisting of yellow and faint blue stars. Could be used as a test for a 5.0 cm telescope.

$\iota$ Trianguli	ADS 1697	02 <sup>h</sup> 12.4 <sup>m</sup>	+30° 18'	October 24
5.3, 6.9 m	PA 71°  Sep. 3.9"			Moderate

<sup>42</sup>See Chap. 3 for a discussion of Population I and II stars.

A nice yellow and blue system. First observed by Herschel in 1781, both stars are themselves spectroscopic binaries.

84 Ceti	Σ295	02 <sup>h</sup> 41.2 <sup>m</sup>	−00° 42′	October 31
5.8, 9.0 m	PA 310°  Sep. 4.0″			Moderate

A lovely double-star system, consisting of a yellow primary and reddish secondary.

36 Andromedae	ADS 755	00 <sup>h</sup> 55.0 <sup>m</sup>	+23° 38′	October 4
6.0, 6.4 m	PA 313°  Sep. 0.9″			Difficult

This pair of brilliant yellow stars is a test for large amateur telescopes. Discovered by F. Struve in 1836.

ε Trianguli	HD 12471	02 <sup>h</sup> 03.0 <sup>m</sup>	+33° 17′	October 22
5.4, 11.4 m	PA 118°  Sep. 3.9″			Difficult

This is a difficult double because of the large magnitude difference. It consists of a blue white primary and white secondary.

See also:

Star	PA/Sep	Month
τ <sup>1</sup> Aquarii	121°  23.7″	September
Herschel 975	243°  51.0″	September
42 Piscium	324°  28.5″	September
51 Piscium	83°  27.5″	September
57 Pegasi	198°  32.6″	September
107 Aquarii	136°  6.6″	September
σ Cassiopeiae	326°  3.0″	September
Struve 3050	335°  1.7″	September
Groombridge 34	62°  40.0″	September
η Persei	300°  28.3″	November
Struve 390	159°  14.8″	November
φ Tauri	250°  52.1″	November
θ Persei	305°  20.0″	November
ο <sup>2</sup> Eridani	104°  83″	November
30 Tauri	59°  9.0″	November
32 Eridani	347°  6.8″	November
39 Eridani	146°  6.4″	November
ε Arietis	208°  1.5″	November
47 Tauri	351°  1.1″	November

## November

$\eta$ Persei 3.8, 8.5 m	ADS 2157 PA 300°  Sep. 28.3"	02 <sup>h</sup> 50.7 <sup>m</sup>	+55° 54'	November 3 Easy <sup>®</sup>
-----------------------------	---------------------------------	-----------------------------------	----------	---------------------------------

Seek this one out as it has a gold primary and blue secondary. Magnificent!

Struve 390 5.1, 9.5 m	$\Sigma$ 390 PA 159°  Sep. 14.8"	03 <sup>h</sup> 30.0 <sup>m</sup>	+55° 27'	November 13 Easy <sup>®</sup>
--------------------------	-------------------------------------	-----------------------------------	----------	----------------------------------

Two stars of very different brightness; the primary is white, but the secondary is a lovely purple color.

$\phi$ Tauri 5.0, 8.4 m	ADS 3137 PA 250°  Sep. 52.1"	04 <sup>h</sup> 20.4 <sup>m</sup>	+27° 21'	November 26 Easy
----------------------------	---------------------------------	-----------------------------------	----------	---------------------

Easily seen in binoculars. Bright yellow primary and blue secondary.

$\theta$ Persei 4.1, 9.9 m	HD 16895 PA 305°  Sep. 20.0"	02 <sup>h</sup> 44.2 <sup>m</sup>	+49° 14'	November 1 Easy/moderate
-------------------------------	---------------------------------	-----------------------------------	----------	-----------------------------

A nice system with a bright yellow primary and blue secondary.

$\omicron^2$ Eridani 4.4, 9.5 m	ADS 3093 PA 104°  Sep. 83"	04 <sup>h</sup> 15.2 <sup>m</sup>	−07° 39'	November 24 Easy/moderate
------------------------------------	-------------------------------	-----------------------------------	----------	------------------------------

Now for a challenge to split with binoculars. What makes this system so interesting is that the secondary is the brightest white dwarf star visible from Earth.

30 Tauri 5.1, 10.2 m	HD 23793 PA 59°  Sep. 9.0"	03 <sup>h</sup> 48.3 <sup>m</sup>	+11° 09'	November 17 Moderate
-------------------------	-------------------------------	-----------------------------------	----------	-------------------------

An interesting system lying in a star field, comprising a bluish-white and reddish double. Observers have reported the primary as green and pale yellow, and the secondary as purple.

32 Eridani 4.8, 6.1 m	HD24555 PA 347°  Sep. 6.8"	03 <sup>h</sup> 54.3 <sup>m</sup>	−02° 57'	November 19 Moderate
--------------------------	-------------------------------	-----------------------------------	----------	-------------------------

A yellow and white double-star system, with colors that have also been described as yellow and blue, and topaz and bright green.

39 Eridani 5.0, 8.0 m	HD 26846 PA 146°  Sep. 6.4"	04 <sup>h</sup> 14.4 <sup>m</sup>	−10° 15'	November 24 Moderate
--------------------------	--------------------------------	-----------------------------------	----------	-------------------------



Situated in a star field, consisting of a nice orange and white double-star system.

$\epsilon$ Arietis	ADS 2257	$02^h\ 59.2^m + 21^\circ\ 20'$	November 5
5.2, 5.5 m	PA $208^\circ$   Sep. 1.5"		Difficult

A test of the optics of your telescope. Both white stars are nearly equally bright. Test for 7.5 cm.

47 Tauri	HD 26722	$04^h\ 13.9^m$	$+09^\circ\ 16'$	November 24
4.9, 7.4 m	PA $351^\circ$   Sep. 1.1"			v. difficult

A high magnification is needed to split this system, where both stars appear yellow.

See also:

Star	PA/Sep	Month
$\eta$ Cassiopeiae	$317^\circ$   12.9"	October
26 Ceti	$253^\circ$   16.0"	October
$\gamma$ Arietis	$0^\circ$   7.8"	October
$\lambda$ Arietis	$46^\circ$   37.4"	October
66 Ceti	$234^\circ$   16.5"	October
$\alpha$ Ursae Minoris	$218^\circ$   18.4"	October
33 Arietis	$0^\circ$   28.6"	October
$\iota$ Trianguli	$71^\circ$   3.9"	October
84 Ceti	$310^\circ$   4.0"	October
36 Andromedae	$313^\circ$   0.9"	October
$\epsilon$ Trianguli	$118^\circ$   3.9"	October
11 & 12 Cml	$8^\circ$   108.5"	December
S473	$305^\circ$   20.6"	December
La 1	$123^\circ$   11.0"	December
$\gamma$ Leporis	$350^\circ$   96.3"	December
41 Aurigae	$356^\circ$   7.7"	December
15 Geminorum	$204^\circ$   25.1"	December
$\nu^1$ Canis Majoris	$262^\circ$   17.5"	December
$\omega$ Aurigae	$359^\circ$   5.4"	December
h3750	$282^\circ$   4.2"	December
$\gamma$ Leporis	$358^\circ$   2.6"	December
UV Aurigae	$4^\circ$   3.4"	December
$\theta$ Aurigae	$313^\circ$   3.6"	December

December

11 & 12 Camelopardalis		$05^h\ 06.1^m$	$+58^\circ\ 58'$	December 7
5.4, 6.5 m	PA $8^\circ$   Sep. 108.5"			Easy <sup>o</sup>

Easily spotted in binoculars, this is a pair of white and deep yellow stars.

S473 6.7, 8.7 m	ADS 3883 PA 305°  Sep. 20.6"	05 <sup>h</sup> 17.1 <sup>m</sup>	−15° 13'	December 10 Easy
--------------------	---------------------------------	-----------------------------------	----------	---------------------

A system that is suitable for small telescopes with a white primary and blue secondary.

La 1 6.9, 7.9 m	ADS 4260 PA 123°  Sep. 11.0"	05 <sup>h</sup> 39.7 <sup>m</sup>	−20° 26'	December 16 Easy
--------------------	---------------------------------	-----------------------------------	----------	---------------------

Now for a rare treat, a system consisting of white and purple stars!

γ Leporis 3.7, 6.3 m	ADS 4334 PA 350°  Sep. 96.3"	05 <sup>h</sup> 44.5 <sup>m</sup>	−22° 27'	December 17 Easy
-------------------------	---------------------------------	-----------------------------------	----------	---------------------

A glorious system that is easy to resolve for even the smallest telescope. Bright yellow and pale tinted orange. Test for 7.5 cm.

41 Aurigae 6.3, 7.0 m	ADS 4773 PA 356°  Sep. 7.7"	06 <sup>h</sup> 11.6 <sup>m</sup>	+48° 43'	December 24 Easy
--------------------------	--------------------------------	-----------------------------------	----------	---------------------

A nice white and bluish-white double-star system.

15 Geminorum 6.6, 8.0 m	h 70 PA 204°  Sep. 25.1"	06 <sup>h</sup> 27.8 <sup>m</sup>	+20° 47'	December 28 Easy
----------------------------	-----------------------------	-----------------------------------	----------	---------------------

A double-star system of yellow and blue stars.

ν <sup>1</sup> Canis Majoris 5.8, 8.5 m	ADS 5253 PA 262°  Sep. 17.5"	06 <sup>h</sup> 36.7 <sup>m</sup>	−18° 40'	December 30 Easy
--	---------------------------------	-----------------------------------	----------	---------------------

An easily resolved pair of yellow stars.

ω Aurigae 5.0, 8.0 m	ADS 3572 PA 359°  Sep. 5.4"	04 <sup>h</sup> 59.3 <sup>m</sup>	+37° 53'	December 5 Moderate
-------------------------	--------------------------------	-----------------------------------	----------	------------------------

Stars appear white and blue in small telescopes but have shown subtle tints in larger instruments.

h3750 4.7, 8.4 m	ADS 3930 PA 282°  Sep. 4.2"	05 <sup>h</sup> 20.4 <sup>m</sup>	−21° 14'	December 11 Moderate
---------------------	--------------------------------	-----------------------------------	----------	-------------------------

A lovely yellow and blue star system that has been described as “most beautiful.”

$\kappa$ Leporis	ADS 3800	05 <sup>h</sup> 13.2 <sup>m</sup>	−12° 56′	December 9
4.5, 7.4 m	PA 358°  Sep. 2.6″			v. difficult

A pair of white stars that will require the best conditions and optics in order to be resolved.

UV Aurigae	05 <sup>h</sup> 21.8 <sup>m</sup>	+32° 31′	December 11
7–10.6, 11.5 m	PA 4°  Sep. 3.4″		v. difficult

This is a difficult object to locate owing to its variable nature. It is a carbon star, coupled with a B-type giant star. But persevere and you will be rewarded by a lovely combination of orange and blue stars.

$\theta$ Aurigae	ADS 4566	05 <sup>h</sup> 59.7 <sup>m</sup>	+37° 13′	December 21
2.6, 7.1 m	PA 313°  Sep. 3.6″			v. difficult

With small telescopes, excellent seeing conditions and superb optics are required to see these two bluish-white stars. The spectrum shows strong lines of silicon. Would be a good test for a 10 cm telescope.

See also:

Star	PA/Sep	Month
$\eta$ Persei	300°  28.3″	November
Struve 390	159°  14.8″	November
$\varphi$ Tauri	250°  52.1″	November
$\theta$ Persei	305°  20.0″	November
$\sigma^2$ Eridani	104°  83″	November
30 Tauri	59°  9.0″	November
32 Eridani	347°  6.8″	November
39 Eridani	146°  6.4″	November
$\varepsilon$ Arietis	208°  1.5″	November
47 Tauri	351°  1.1″	November
$\varphi^5$ Aurigae	31°  36.2″	January
$\mu$ Canis Majoris	18°  11.6″	January
h 3945	55°  26.6″	January
Struve 1149	41°  21.7″	January
38 Geminorum	145°  7.1″	January
$\mu$ Canis Majoris	340°  3.0″	January
$\kappa$ Geminorum	240°  7.1″	January
$\phi^2$ Cancrī	218°  5.1″	January

Other Multiple Star Systems

Double stars are not the only type of multiple-star system. There exist many beautiful triple and even quadruple stars within reach of modest telescopes. A few of these are presented in the following lists. The same nomenclature applies as in the double-star section.

January

17 Canis Majoris	ADS 5585	06 <sup>h</sup> 55.0 <sup>m</sup>	−20° 24′	January 4
5.8, 9.3, 9.0 m	PA 147°  Sep. 44.4″			Easy

A nice triple system. Wonderful color contrasts of white and orange-red stars.

Burnham 324	ADS 5498	06 <sup>h</sup> 49.7 <sup>m</sup>	−24° 05′	January 2
6.3, 7.6, 8.6 m	PA 206°  Sep. 1.8″			Easy/moderate

A nice multiple-star system in the constellation of Canis Major, consisting of many white and blue stars.

Struve 1245	ADS 6886	08 <sup>h</sup> 35.8 <sup>m</sup>	+06° 37′	January 29
6.0, 7.2, 10.7, 12.2, 8.8 m	PA 25°  Sep. 10.3″			Easy/moderate/difficult

A lovely multiple-star system in the constellation Cancer. The triple aspect is seen in small telescopes. Yellow, pale yellow and white stars. Depending on the telescope used, you will see a double-, triple- or multiple-star system!

τ Canis Majoris	ADS 5977	07 <sup>h</sup> 18.7 <sup>m</sup>	−24° 57′	January 10
4.4, 10.5, 11.2 m	PA 90°  Sep. 80.2″			Difficult

Wonderful! This triple is within the open cluster NGC 2362, and so its yellow and blue components are set against a glorious backdrop of faint stars.

See also:

Star	PA/Sep	Month
Struve 1369	148°  24.7″	February
β Camelopardalis	208°  80.8″	December
Trapezium	241°  13.4″	December
σ Orionis	238°  11.4″	December
ε Monocerotis	27°  13.4″	December
β Monocerotis	132°  7.3″	December

(continued)

Star	PA/Sep	Month
14 Aurigae	352°  14.6"	December
ΟΣ 147	73°  43.2"	December
Struve 939	106°  30.2"	December
ξ Orionis	165°  2.3"	December
ι Orionis	141°  11.3"	December
η Orionis	80°  1.5"	December
λ Orionis	43°  4.4"	December

February

Struve 1369	ADS 7438	09 <sup>h</sup> 35.4 <sup>m</sup>	- + 39° 57'	February 13
7.9, 8.0, 8.7 m	PA 148°  Sep. 24.7"			Easy

Located in the constellation Lynx, this is an easily resolved system of yellow stars, along with faint white stars.

See also:

Star	PA/Sep	Month
17 Canis Majoris	147°  44.4"	January
Burnham 324	206°  1.8"	January
Struve 1245	25°  10.3"	January
τ Canis Majoris	90°  80.2"	January
Struve 1604	89°  9.9"	March

March

Struve 1604	ADS 8440	12 <sup>h</sup> 09.5 <sup>m</sup>	-11° 51'	March 24
6.8, 8.5, 9.1 m	PA 89°  Sep. 9.9"			Moderate

Another rare but lovely triple-star system that forms an equilateral triangle. Lies in the constellation Corvus.

See also:

Star	PA/Sep	Month
Struve 1369	148°  24.7"	February
Burnham 800	106°  6.8"	April
35 Comae Berenices	182°  1.2"	April
ι Boötis	33°  38.5"	April

April

Burnham 800 6.6, 9.7, 10.4 m	β800 <sup>43</sup> PA 106°  Sep. 6.8"	13 <sup>h</sup> 16.9 <sup>m</sup>	+17° 01'	April 10 Moderate
---------------------------------	--	-----------------------------------	----------	----------------------

In the constellation of Coma Berenices lies this lovely triple-star system of orange, pale red and white stars.

35 Comae Berenices 5.1, 7.2, 9.1 m	ADS 8695 PA 182°  Sep. 1.2"	12 <sup>h</sup> 53.3 <sup>m</sup>	+21° 14'	April 5 Difficult
---------------------------------------	--------------------------------	-----------------------------------	----------	----------------------

A fine triple-star system, consisting of one yellow and two of the very rare purple-colored stars.

ι Boötis 4.9, 7.5, 12.6 m	ADS 9198 PA 33°  Sep. 38.5"	14 <sup>h</sup> 16.2 <sup>m</sup>	+51° 22'	April 26 Difficult <sup>©</sup>
------------------------------	--------------------------------	-----------------------------------	----------	------------------------------------

A nice triple-star system, although difficult to see in small instruments. The brighter members are yellow- and blue-colored stars.  
See also:

Star	PA/Sep	Month
Struve 1604	89°  9.9"	March
16 & 17 Draconis	194°  90.3"	May
5 Serpentis	36°  11.2"	May
β Serpentis	265°  30.6"	May
μ Boötis	8°  2.3"	May
ξ Scorpii	61°  0.5"	May
σ Coronae Borealis	236°  7.1"	May
λ Ophiuchi	30°  1.5"	May

May

16 & 17 Draconis 5.4, 5.5, 6.4 m	ADS 10129 PA 194°  Sep. 90.3"	16 <sup>h</sup> 36.2 <sup>m</sup>	+52° 55'	May 31 Easy <sup>©</sup>
-------------------------------------	----------------------------------	-----------------------------------	----------	-----------------------------

An easily split triple-star system. The two main stars can be seen in binoculars. However, the third star will require a small telescope in order to be seen. Consists of three white stars.

<sup>43</sup>This signifies that it is the 800th object in the S. W. Burnham catalog.

5 Serpentis 5.1, 10.1, 9.1 m	ADS 9584 PA 36°  Sep. 11.2"	15 <sup>h</sup> 19.3 <sup>m</sup>	+01° 46'	May 12 Moderate
---------------------------------	--------------------------------	-----------------------------------	----------	--------------------

A triple system of unequally bright stars, which always seems to enhance color contrast. It consists of a pair of yellow and red stars with a faint white companion.

β Serpentis 3.7, 9.9, 10.7 m	Σ1970 PA 265°  Sep. 30.6"	15 <sup>h</sup> 46.2 <sup>m</sup>	+15° 25'	May 18 Moderate
---------------------------------	------------------------------	-----------------------------------	----------	--------------------

A nice system for small telescopes. The stars are colored lemon, blue and white.

μ Boötis 4.3, 7.0, 7.6 m	ADS 9626 PA 8°  Sep. 2.3"	15 <sup>h</sup> 24.5 <sup>m</sup>	+37° 23'	May 13 Difficult
-----------------------------	------------------------------	-----------------------------------	----------	---------------------

A nice triple-star system of close stars consisting of a pale yellow primary and pale yellow and orange companions. Discovered by G. Struve in 1835.

ξ Scorpii 4.8, 5.1, 7.3 m	Σ 1998 PA 61°  Sep. 0.5"	16 <sup>h</sup> 04.4 <sup>m</sup>	−11° 22'	May 23 Difficult
------------------------------	-----------------------------	-----------------------------------	----------	---------------------

A triple-star system that is a test for medium aperture telescopes. Consists of two yellow stars and a fainter blue companion, although reports describe the primary as golden in color.

σ Coronae Borealis 5.6, 6.6, 13.1, 10.6 m	ADS 9979 PA 236°  Sep. 7.1"	16 <sup>h</sup> 14.7 <sup>m</sup>	+33° 52'	May 26 Difficult
--	--------------------------------	-----------------------------------	----------	---------------------

A quadruple-star system. The two main stars are easily seen, colored pale and deep yellow, although some observers report that the color contrast is slight. The remaining two companion stars, however, are very faint.

λ Ophiuchi 4.2, 5.2, 11.1, 9.5 m	ADS 10087 PA 30°  Sep. 1.5"	16 <sup>h</sup> 30.9 <sup>m</sup>	+01° 59'	May 30 Difficult
-------------------------------------	--------------------------------	-----------------------------------	----------	---------------------

A nice though difficult quadruple-star system. The white and yellow primaries are a good test for small telescopes.

See also:

Star	PA/Sep	Month
Burnham 800	106°  6.8"	April
35 Comae Berenices	182°  1.2"	April
ι Boötis	33°  38.5"	April
μ Herculis	247°  33.8"	June
Struve 2306	221°  10.2"	June

June

$\mu$ Herculis	ADS 10786	17 <sup>h</sup> 46.5 <sup>m</sup>	+27° 43'	June 18
3.4, 10.1 m	PA 247°  Sep. 33.8"			Moderate

A triple-star system consisting of a yellow primary star and two faint red dwarf stars. Discovered by William Herschel in 1781.

Struve 2306	$\Sigma$ 2306	18 <sup>h</sup> 22.2 <sup>m</sup>	−15° 05'	June 27
7.9, 8.6, 9.0 m	PA 221°  Sep. 10.2"			Moderate

Located in the constellation Scutum, this is a wonderful triple-star system of delicately colored stars. Observers have reported the primary as gold or copper-colored and the secondary as cobalt blue or blue. The blue secondary will need a high magnification in order to split it.

See also:

Star	PA/Sep	Month
16 & 17 Draconis	194°  90.3"	May
5 Serpentis	36°  11.2"	May
$\beta$ Serpentis	265°  30.6"	May
$\mu$ Boötis	8°  2.3"	May
$\xi$ Scorpii	61°  0.5"	May
$\sigma$ Coronae Borealis	236°  7.1"	May
$\lambda$ Ophiuchi	30°  1.5"	May
Struve 2445	263°  12.6"	July
$\beta$ Capricorni	267°  205.3"	July
$\alpha$ Lyrae	173°  62.8"	July
54 Sagittarii	38°  274"	July

July

Struve 2445	$\Sigma$ 2445	19 <sup>h</sup> 04.6 <sup>m</sup>	+23° 20'	July 8
7.2, 8.9, 8.9 m	PA 263°  Sep. 12.6"			Easy

Located in the constellation Vulpecula, this is a nice triple for small telescopes or binoculars. Blue stars and white ones.

$\beta$ Capricorni	$\Sigma$ 152	20 <sup>h</sup> 21.0 <sup>m</sup>	−14° 47'	July 27
3.4, 6.2, 9.0 m	PA 267°  Sep. 205.3"			Easy



A fine triple-star system that can be easily resolved by binoculars. It has a nice color contrast of a yellow primary with blue and pale yellow secondaries.

$\alpha$ Lyrae	ADS 11510	18 <sup>h</sup> 36.9 <sup>m</sup>	+38° 47'	July 1
0.0, 9.5, 11.0, 9.5 m	PA 173°  Sep. 62.8"			Moderate

A very famous star, Vega is the brightest in the summer sky, and has a wonderful steely blue-white color. The star has many faint companions that are not physically associated. It was the first star to be photographed (1850), and recent measurements of infrared radiation from it indicate proto-planetary material surrounding the star that imply a solar system in formation.

54 Sagittarii	ADS 12767	19 <sup>h</sup> 40.7 <sup>m</sup>	−16° 18'	July 17
5.4, 11.9, 8.9 m	PA 38°  Sep. 274"			Moderate

A wonderfully colored triple-star system, with a yellow-orangish primary, a pale blue secondary and pale yellow companion.

See also:

Star	PA/Sep	Month
$\mu$ Herculis	247°  33.8"	June
Struve 2306	221°  10.2"	June
$\epsilon$ Equulei	70°  10.7"	August

August

$\epsilon$ Equulei	ADS 14499	20 <sup>h</sup> 59.1 <sup>m</sup>	+04° 18'	August 6
6.0, 6.3, 7.1 m	PA 70°  Sep. 10.7"			Difficult

This is a very difficult triple-star system to resolve. The two brightest members are very close at the moment, and will remain so for quite some time, and so it will appear as an elongated blob, even under high magnification. The third member of the system is blue, in contrast to the yellow of the main stars.

See also:

Star	PA/Sep	Month
Struve 2445	263°  12.6"	July
$\beta$ Capricornin	267°  205.3"	July
$\alpha$ Lyrae	173°  62.8"	July
54 Sagittarii	38°  274"	July

September

See:

Star	PA/Sep	Month
ε Equulei	70°  10.7"	August
ι Cassiopeiae	230°  2.5"	October

October

ι Cassiopeiae	ADS 1860	02 <sup>h</sup> 29.1 <sup>m</sup>	+67° 24'	October 28
4.6, 6.9, 8.4 m	PA 230°  Sep. 2.5"			Difficult <sup>®</sup>

Thought by many to be one of the loveliest triple-star systems in the entire sky. A brilliant yellowish-white primary with bluish companions. The primary is also a variable of the Alpha Canum Venaticorum type, with a magnitude range of only 0.03.

See also:	PA/Sep	Month
γ Ceti	294°  2.8"	November
ο <sup>2</sup> Eridani	347°  7.6"	November

November

γ Ceti	ADS 2080	02 <sup>h</sup> 43.3 <sup>m</sup>	+03° 14'	November 1
3.5, 7.3, 10.1 m	PA 294°  Sep. 2.8"			Moderate

In medium-aperture telescopes (between 20.0 and about 25 cm) this triple appears as a lovely white, yellow and faint red system, although the latter has been called tawny or dusky!

ο <sup>2</sup> Eridani	ADS 3093	04 <sup>h</sup> 15.2 <sup>m</sup>	−07° 39'	November 24
4.4, 9.4, 11.2 m	PA 347°  Sep. 7.6"			Moderate/difficult

A triple-star system consisting of a creamy yellowish star along with pale blue companions. What is exceptional about the two fainter companions is that they are a white dwarf and a red dwarf. The white dwarf is the brightest visible from Earth, with a mass equal to that of the Sun, although only 17,000 miles across. The red dwarf has a mass only one-fifth that of Earth.

See also:

Star	PA/Sep	Month
ι Cassiopeiae	230°  2.5"	October
Trapezium	241°  13.4"	December
σ Orionis	238°  11.4"	December
ε Monocerotis	27°  13.4"	December
β Monocerotis	132°  7.3"	December
14 Aurigae	352°  14.6"	December
ΟΣ 147	73°  43.2"	December
Struve 939	106°  30.2"	December
ζ Orionis	165°  2.3"	December
ι Orionis	141°  11.3"	December
η Orionis	80°  1.5"	December
λ Orionis	43°  4.4"	December

December

β Camelopardalis	HD 31910	05 <sup>h</sup> 03.4 <sup>m</sup>	+60° 27'	December 6
4.0, 8.6, 11.2 m	PA 208°  Sep. 80.8"			Easy <sup>⊙</sup>

This is a nice triple system of yellow and blue stars. What makes this system so memorable is that it is seen against the dark nebula of the Milky Way.

Trapezium	θ Orionis	05 <sup>h</sup> 35.3 <sup>m</sup>	−05° 23'	December 14
5.1, 6.7 m	PA 241°  Sep. 13.4"			Easy
6.7, 7.9 m				

Probably the most famous multiple-star system in the sky and always a test for small telescopes. The four stars that make up the famous quadrilateral are set among the wispy embrace of the Orion Nebula, M42, one of the most magnificent sites in any telescope. Very young stars recently formed from the material in the nebula, and so should all appear bright white, but the nebula itself probably affects the light that is observed, so the stars appear as off-white, delicately tinted yellowish and bluish. Other observers have reported the colors as pale white, faint lilac, garnet and red-dish! It is believed that these four stars contribute nearly all the radiation that makes the Orion Nebula glow. Well worth spending an entire evening just observing this region. A glorious sight! (See the relevant entry in Chapter 7).

σ Orionis	ADS 4241	05 <sup>h</sup> 38.7 <sup>m</sup>	−02° 36'	December 15
4.0, 10.3, 7.5, 6.5 m	PA 238°  Sep. 11.4"			Easy

A multiple-star system of white and bluish stars.

$\epsilon$ Monocerotis	ADS 5012	$06^h 23.8^m$	$+04^\circ 36'$	December 27
4.5, 6.5, 5.6 m	PA $27^\circ$   Sep. $13.4''$			Easy

A lovely triple system of pale yellow stars, along with a very faintly tinted blue companion. Set against the star fields of the Milky Way.

$\beta$ Monocerotis	ADS 5107	$06^h 28.8^m$	$-07^\circ 02'$	December 28
4.7, 5.2, 6.1 m	PA $132^\circ$   Sep. $7.3''$			Easy

A magnificent triple star first discovered in 1781 by Herschel. All the stars are a lovely steely blue-white in color. What makes this system so unique is that all the stars are very nearly equal in brightness.

14 Aurigae	ADS 3824	$05^h 15.4^m$	$+32^\circ 31'$	December 9
5.1, 11.1, 7.4 m	PA $352^\circ$   Sep. $14.6''$			Easy/moderate

A nice system visible in all sizes of telescopes consisting of yellow, blue and white stars.

$\text{O}\Sigma 147$	ADS 5188	$06^h 34.3^m$	$+38^\circ 05'$	December 29
6.6, 10, 10.6 m	PA $73^\circ$   Sep. $43.2''$			Moderate

Located in the constellation Auriga, this is a wonderful triple star system forming a triangle of yellow and blue stars.

Struve 939	$\Sigma 939$	$06^h 35.9^m$	$+05^\circ 19'$	December 30
8.3, 9.2, 9.4 m	PA $106^\circ$   Sep. $30.2''$			Moderate

A fascinating but rare triple system with all its members forming a nearly perfect equilateral triangle.

$\xi$ Orionis	ADS 4263	$05^h 40.8^m$	$-01^\circ 57'$	December 16
1.9, 4.0, 9.9 m	PA $165^\circ$   Sep. $2.3''$			Moderate

A nice triple system of blue, white and very pale red stars. Located among and near several bright and dark nebulae.

$\iota$ Orionis	ADS 4193	$05^h 35.4^m$	$-05^\circ 55'$	December 15
2.8, 7.3, 11.1 m	PA $141^\circ$   Sep. $11.3''$			Moderate/difficult

A nice color-contrasted triple system that is also a test for small telescopes. The stars are colored white with delicately tinted blue and red companions.

η Orionis	ADS 4002	05 <sup>h</sup> 24.5 <sup>m</sup>	−02° 24′	December 12
3.6, 5.0, 10.1 m	PA 80°  Sep. 1.5"			Difficult

Also known as Dawes 5, this is a wonderful system. Even under high magnification, the two brighter members will appear as two white discs in contact. η Orionis is also a spectroscopic binary.

λ Orionis	ADS 4179	05 <sup>h</sup> 31.1 <sup>m</sup>	+09° 56′	December 13
3.5, 5.6, 11.1, 11.1 m	PA 43°  Sep. 4.4"			Difficult

A nice quadruple-star system consisting of white and blue stars. Various observers have reported them as yellowish and purple and pale white and violet.

See also:

Star	PA/Sep	Month
17 Canis Majoris	147°  44.4"	January
Burnham 324	206°  1.8"	January
Struve 1245	25°  10.3"	January
τ Canis Majoris	90°  80.2"	January
γ Ceti	294°  2.8"	November
ο²Eridani	347°  7.6"	November

<http://www.springer.com/978-1-4614-1265-6>

A Field Guide to Deep-Sky Objects

Inglis, M.

2012, XVII, 261 p. 61 illus., 2 illus. in color., Softcover

ISBN: 978-1-4614-1265-6