Evening sky in September 2016

To use the chart, hold it up to the sky. Turn the chart so the direction you are looking is at the bottom of the chart. If you are looking to the south then have 'South horizon' at the lower edge. As the earth turns the sky appears to rotate clockwise around the south celestial pole (SCP on the chart). Stars rise in the east and set in the west, just like the sun. The sky makes a small extra clockwise rotation each night as we orbit the sun.

Venus is the brilliant silver 'evening star' low in the west at dusk. Golden Jupiter and Mercury (not shown) are below it at the beginning of the month but soon slip lower and disappear in the twilight. Orange Mars and cream-colored Saturn are west of the zenith, near orange Antares the Scorpion's heart. The Scorpion's tail, a.k.a. the fish-hook of Maui, curls toward the zenith. Arcturus twinkles red and green as it sets in the northwest. Crux, the Southern Cross, and the Pointers are in the south-west. Canopus twinkles like a diamond near the southern horizon. Vega shines on the opposite horizon. The Milky Way spans the sky from north to south.
All five naked-eye planets are visible in the evening sky at the beginning of the month. Mercury, Venus and Jupiter are low in the west, setting 90 minutes after the Sun. Venus is the brightest, with golden Jupiter below it. Mercury is fainter and left of the bright pair. (Jupiter and Mercury are not shown on the chart.) Venus remains the ‘evening star’ while Jupiter and Mercury slip into the twilight over the following nights. We are leaving Jupiter behind on the far side of the Sun. Venus is catching us up. Mercury is passing between us and the Sun. The thin crescent Moon will be between Jupiter and Venus on the 3rd. At the beginning of the month Mercury is 104 million km from us, Venus 230 million km, Jupiter 960 million km.

Orange Mars and cream-coloured Saturn are northwest of the zenith at dusk. Orange Antares is on their left and fainter. Saturn stays near Antares as both drift lower through the month. Mars holds its elevation night-to-night so moves upward away from Saturn. Saturn is worth a look in any telescope. Good binoculars will show it as an oval, the planet and rings blended together. It is 1530 million km away mid-month. Mars is 146 million km away and tiny in a telescope. The first-quarter Moon will be below Saturn and Mars on the 9th.

Arcturus is on the northwest skyline. Canopus, the brightest true star in the sky, skims along the southern skyline. Both stars are shining through a lot of air which makes them twinkle colourfully. Canopus, being white, shows all colours like a diamond. Orange Arcturus twinkles red and green. Canopus is matched on the northern skyline by Vega, the second-brightest northern star after Arcturus.

Canopus is a truly bright star: 13 000 times the sun's brightness and 300 light years away. Vega is 52 times brighter than the sun and 25 light years away. From northern New Zealand the star Deneb can be seen near the north skyline in the Milky Way. It is the brightest star in Cygnus the Swan. Deneb is around 1400 light years away and 50 000 times brighter than the Sun.

Arcturus, left of Saturn, marks the body of the Scorpion. The Scorpion's tail hooks toward the zenith like a back-to-front question mark. It is the 'fish-hook of Maui' in Maori star lore. Antares is a red giant star: 600 light years away and 19 000 times brighter than the sun. It is a relatively cool 3000 C, hence its red-hot colour. Below or right of the Scorpion's tail is 'the teapot' made by the brightest stars of Sagittarius. It is upside down in our southern hemisphere view.

Midway down the southwest sky are 'The Pointers', Beta and Alpha Centauri. They point down to Crux the Southern Cross. Alpha Centauri is the third brightest star. It is also the closest of the naked eye stars, 4.3 light years away. Beta Centauri, along with most of the stars in Crux, is a blue-giant star hundreds of light years away.

The Milky Way spans the sky from north to south. It is brightest and broadest overhead in Scorpius and Sagittarius. In a dark sky it can be traced down past the Pointers and Crux into the southwest. To the northeast it passes Altair, meeting the skyline right of Vega. The Milky Way is our edgewise view of the galaxy, the pancake of billions of stars of which the sun is just one. The thick hub of the galaxy, 27 000 light years away, is in Sagittarius. The actual centre is hidden by dust clouds in space. At the very centre is a black hole four million times the sun's mass. Dust clouds near us appear as gaps and slots in the Milky Way. Binoculars show many clusters of stars and some glowing gas clouds in the Milky Way.

The Large and Small Clouds of Magellan, LMC and SMC, look like two misty patches of light in the south sky. They are easily seen by eye on a dark moonless night. They are galaxies like our Milky Way but much smaller. The LMC is about 160 000 light years away; the SMC about 200 000 light years away.

On moonless evenings in a dark sky the Zodiacal Light is visible in the west. It is a faint broad column of light surrounding Venus and extending upward toward Libra. It is sunlight reflecting off meteoric dust in the plane of the solar system. The dust may have come from a big comet, many centuries ago.

*Note: A light year (l.y.) is the distance that light travels in one year: nearly 10 million million km or 10¹³ km. Sunlight takes eight minutes to get here; moonlight about one second. Sunlight reaches Neptune, the outermost major planet, in four hours. It takes sunlight four years to reach the nearest star, Alpha Centauri.
The Sky West of Overhead at Evening in September 2016

The chart shows the sky west of the zenith at nightfall. Mars, bright and orange, is moving across the region. Cream-coloured Saturn stays near orange Antares. The Milky Way is here bright and broad as we look toward the centre of the galaxy. Many star clusters and a few nebulae are seen, some obvious to the naked eye. Those visible in binoculars or small telescopes are indicated with asterisks. They are described on the other side of this page.

Chart produced by Guide 8 software; www.projectpluto.com. Labels added by Alan Gilmore, University of Canterbury's Mt John Observatory, P.O. Box 56, Lake Tekapo 7945, New Zealand. www.canterbury.ac.nz
Interesting Objects West of Overhead in September 2016

Two bright planets highlight this region. Orange Mars crosses it through the month while Saturn, cream-coloured and slightly fainter, stays by orange Antares. Mars is near Antares and Saturn at the beginning of the month. It holds its elevation in the evening sky as the stars and Saturn slip slowly down the sky night to night due to Earth's movement around the Sun. By the month's end Mars is moving on to Sagittarius. Antares, fainter than the planets, marks the body of the Scorpion. The Scorpion is head-down, tail-up in the evening sky now. It sets in the southwest soon after midnight. Antares and the tail make a back-to-front question mark. In Maori star lore the tail is the fish-hook of Maui.

Antares is a red-giant star: 600 light years away, 19 000 times brighter than the sun, and big enough to fill Earth's orbit. Its mass or weight is about 20 times that of the sun, so the star is mostly extremely thin gas spread around a hot dense core. Red giants are stars in the last stage of life. The hot dense core of the star is wringing the last of the thermo-nuclear energy from helium to form heavier elements. For massive stars like Antares a core of iron (gas!) is finally formed. This leads to a collapse of the core into a neutron star or a black hole. In the resulting explosion -- a supernova -- chemical elements heavier than iron are made. The rich amount of heavy elements on earth shows that we are made of the matter that has been processed in two supernova explosions since the beginning of the universe.

This part of the Milky Way is broad and bright as we are looking to the centre of the galaxy. The actual centre, 27 000 light years away, is hidden from our view by intervening dust clouds. The nearer clouds make gaps and slots along the Milky Way. Some of the central bulge of the galaxy is glimpsed in gaps between the dust clouds, making brighter areas of Milky Way in this region. The dust is from old stars giving off clouds of gas rich in carbon (forming soot, roughly speaking) and silicon (making fine dust).

On the chart the direction to the centre of the galaxy is below the Teapot's spout and left of M8. Infrared telescopes, peering through the dust between us and the centre, show stars orbiting the invisible black hole at high speed. From the speed and orbits of these stars it is found that the central black hole is four million times heavier than the sun. Infra-red and x-ray 'flares' are seen from the region, as clouds of matter fall into the black hole. These confirm that the black hole is smaller than Earth's orbit, ruling out the possibility that the four million solar masses are just a dense cluster of stars.

At the right-angle bend in the Scorpion's tail is a large and bright cluster of stars (NGC 6231) looking like a small comet. It is around 6000 l.y. away. Its brightest stars are 60 000 times brighter than the sun. Right of the Scorpion's sting is M7; a cluster obvious to the eye and nicely seen in binoculars. M7 is about 800 l.y. away and around 220 million years old. Below M7 and fainter is M6, the 'butterfly cluster', around 1600 l.y. away. Other clusters worth a look in binoculars are M23, NGC 6167, and NGC 6193. The 'M' objects were listed by the 18th Century French astronomer Charles Messier (1730-1817). He hunted comets, so catalogued fuzzy objects that could be mistaken for comets. The NGC (New General Catalogue) objects were too far south to be seen from Paris.

Below Sagittarius's 'Teapot' is the glowing gas cloud M8, commonly called the Lagoon Nebula from the dark lane of dust that crosses it. The gas is glowing in ultra-violet light from very hot stars. These stars have formed within the cloud in the past two million years. M8 is about 140 light years across and 5200 light years away. Nearby is M20, called the Trifid Nebula from its three-lobed appearance. It is seen as a small glowing patch in binoculars. M16 and other nebulae are also found in this area.

Globular clusters, spherical clouds of ancient stars, are found throughout the region. The brightest is M4 by Antares. It is also one of the closest at 7000 l.y. away but is dimmed by a dust cloud between us and it. In binoculars and small telescopes globular clusters appear as round fuzzy spots. Others marked on the chart, with their distances in light years, are M10 (14 000 l.y.), M12 (19 000), M19 (27 000), M22 (10 000), M55 (20 000), M62 (22 000), M80 (30 000) and NGC 6541. The concentration of globular clusters in this part of the sky was an early clue that the centre of the galaxy lay in this direction.

*One light year (l.y.) is about 10 000 billion km, 10^{13} km, or 6 000 billion miles. Sunlight takes 8 minutes to reach us and 4 hours to get to Neptune the most distant big planet. Light takes 4 years to get to the nearest star.

Notes by Alan Gilmore, University of Canterbury's Mt John Observatory, P.O. Box 56, Lake Tekapo 7945, New Zealand.
Southern Evening Sky in September

The chart shows the southern and southwest sky. Interesting star clusters and nebulae are indicated with asterisks. They are described on the other side of this page.

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Interesting Objects in the Southern Sky

Large & Small Clouds of Magellan (LMC & SMC) appear as two luminous patches, easily seen by eye in a dark sky. They are two galaxies like the Milky Way but much smaller. Each is made of billions of stars. The Large Cloud contains many clusters of young luminous stars seen as patches of light in binoculars and telescopes. The LMC is about 160 000 light years away and the SMC 200 000 l.y away, both very close by for galaxies. (1 light year is about 10 000 billion km, 10^13 km.)

47 Tucanae, looks like a faint fuzzy star on the edge of the SMC. It is a globular cluster, a ball of millions of stars. A telescope is needed to see a peppering of stars around the edge of the cluster. Though it appears on the edge of the SMC it is one-tenth the distance, 15 000 light years away, and is has no connection to the Small Cloud. Globular clusters are mostly very old, 10 billion years or more; at least twice the age of the sun. Omega Centauri, right of the Pointers, is a similar cluster around 17 000 light years away.

Tarantula nebula is a glowing gas cloud in the LMC. The gas glows in the ultra-violet light from a cluster of very hot stars at centre of the nebula. The cloud is about 800 light years across. It is easily seen in binoculars and can be seen by eye on moonless nights. This nebula is one of the brightest known. If it was as close as the Orion nebula (in The Pot's handle in the summer sky) then it would be as bright as the full moon.

Canopus is the second brightest star. It is 14 000 times brighter than the sun and 300 light years away. Sirius, in the eastern dawn sky, is the brightest star in the sky. The planets Venus and Jupiter are brighter.

Alpha Centauri, the brighter Pointer, is the closest naked-eye star, 4.3 light-years away. Alpha Centauri is a binary star: two stars about the same size as the sun orbiting around each other in 80 years. The pair appear close together now so are not easily split in a telescope. (A very faint and slightly closer star, Proxima Centauri, orbits a quarter of a light-year, or 15 000 Sun-Earth distances, from the Alpha pair.)

Coalsack nebula is a cloud of dust and gas about 600 light years away, dimming the more distant stars in the Milky Way. Many similar 'dark nebulae' can be seen, appearing as slots and holes in the Milky Way. These clouds of dust and gas eventually coalesce into clusters of stars.

The Jewel Box is a compact cluster of young luminous stars about 6400 light years away. The cluster formed about 14 million years ago. It is best seen in a telescope. To the eye it looks like a faint star.

Eta Carinae nebula is a glowing gas cloud about 8000 light years away. The golden star in the cloud, visible in binoculars, is Eta Carinae. (Eta is the Greek 'e'.) It is estimated to be to be 80 times heavier than the sun and four million times brighter but is dimmed by dust clouds around it. It is expected to explode as a supernova any time in the next few thousand years. Many star clusters are found in this part of the sky.

The Southern Pleiades is a newish name for a cluster of stars at one point of the 'Diamond Cross'. It is formally the Theta Carinae cluster, after its brightest star but is also known as the 'Five of Diamonds' cluster, the reason obvious when it is seen in a telescope. It is much fainter and smaller than the real Pleiades in Taurus but a nice sight in binoculars. The cluster is about 500 light years away and is around 30 million years old.

NGC 2516, right of the False Cross, looks to the eye like a tailless comet. It is a nice sight in binoculars. The cluster is about 1200 light years away and 110 million years old.

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