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## SUMMER TRIANGLE, PLUS ONE

Ken Tapping, 18<sup>th</sup> July, 2017

On clear evenings at this time of year, the bright, blue-white star Vega lies almost overhead. If you scan down the sky in a southeasterly direction you'll find another bright star – Altair. Now scan northward to a third star, Deneb. These stars make the familiar grouping known as the Summer Triangle. The three stars are in different constellations; Vega is in Lyra, "The Lyre", Altair is in Aquila, "The Eagle", and Deneb in Cygnus, "The Swan". There is a Winter Triangle too, comprising the stars Sirius, Betelgeux and Procyon.

All of the Summer Triangle stars have been featured in movies or TV series: Altair in "Forbidden Planet" (1956), and Vega in "Contact" (1997). In Star Trek, Captain Kirk and his crew went to Deneb IV, the fourth planet out from Deneb, for a vacation (1966).

The stars are similar in appearance, basically white, although Vega is a little bluer. Vega looks the brightest, Altair second brightest and Deneb a close third. However, when we look at how far away these stars are, we get a more intriguing picture. Vega is on our doorstep in cosmic terms, lying only 25 light years away (a light year is just under 10,000,000,000,000 kilometres). Altair is even closer, a mere 17 light years away. Then comes Deneb, at about 1400 light years.

Altair produces energy at about 11 times the rate the Sun does. It has a luminosity of 11. Vega is more high-powered, with a luminosity of 40. To be at a distance of 1400 light years while appearing as bright in our sky as it does, Deneb has to be in a completely different league, with a luminosity of about 200,000! Vega and Altair, like the Sun, are "Main Sequence Stars", part of the cosmic "working class of stars". Deneb is something else altogether, a white supergiant.

To produce its energy output, the Sun is converting its mass into energy at a rate of 4 million tonnes a second. For comparison a billion-watt power station is converting about a hundred of a millionth of a kilogramme per second. The Sun

should be able to keep this up for about 8 billion years. Altair is converting 44 million tonnes a second, and Vega 160 million tonnes a second. Both these stars have about twice the Sun's amount of fuel but are using it much faster. So Altair will have a lifetime about 1.3 billion years. Vega will run out of fuel in 400 million years.

Deneb is another issue entirely. It has a mass of about 20 times the Sun, but is using up its fuel 200,000 times faster: 800,000 million tonnes a second is converted into energy. That star cannot last more than a million years or so. It will then collapse and explode. Supergiant stars are often variable and produce hurricane versions of the solar wind. Deneb IV, if it exists, will have had its atmosphere blown away long ago, and would be a place for high-risk adventure vacations only.

At the moment, the planet Saturn is the most obvious thing in the southern sky. However, scan lower and you will find the star Antares, the brightest star in the constellation of Scorpius, "The Scorpion". This is definitely a summer evening star. Unlike the stars of the Summer Triangle, this star is red. It looks great through binoculars.

Antares lies about 550 light years away, is almost 60,000 times more luminous than the Sun, and has about 12 times the Sun's mass. It should have a lifetime of about 1.5 million years and that time is almost up. Swelling into a red giant is the final phase in a star's life. The Sun will do this, and then cool off. Massive stars like Antares will blow themselves up. This can happen any time now (in the next few thousand years or so), and we will have a grandstand seat.

Jupiter is low in the southwest after sunset, and Saturn low in the south. Venus rises before dawn, shining brilliantly, like an escaped aircraft landing light. The Moon will be New on the 23<sup>rd</sup>.

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