The Summer Sky

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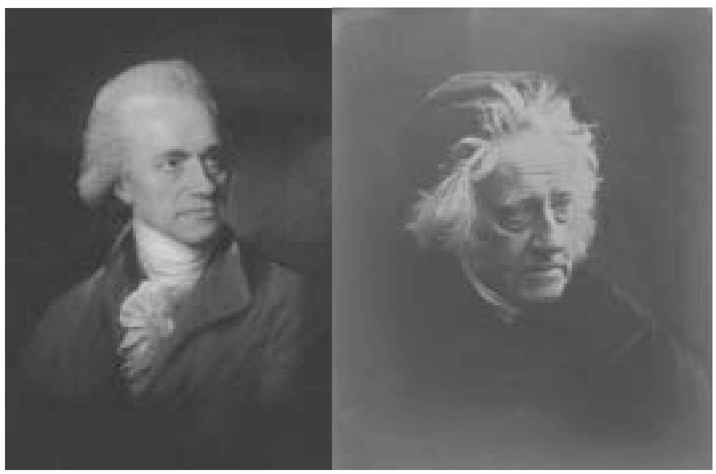
Fixed Stars

These days astronomers spend most of their time sitting at computers, even when observing, or in meetings. However, most telescopes still require that we find a clock star[1] at the beginning of each night, and for many of us, this is about the only time we really need to look at the night sky. Thus even the most constellationally challenged among us is usually able to identify a few bright stars, and Vega will be among these.

As the brightest star in the northern sky, Vega has, at least in the past, had another important function. In the second century AD Ptolemy, building on observations made four centuries earlier by Hipparchus, classified stars into six categories, or "magnitudes", according to their brightnesses. Imagine an astronomer now using 400 year old observations! He called the brightest stars first magnitude and the faintest that he could see sixth magnitude. This magnitude scale continued to be used, largely unchanged, until the nineteenth century. Early in that century John Herschel (Or was it William? Authorities disagree!) determined, rather surprisingly at the time, that a difference of one magnitude corresponded not to a fixed brightness difference but to a fixed brightness ratio, and that this ratio was about 2.5.



Sir William Herschel (1738-1822), by Lemuel Francis Abbott (l.) and his son Sir John Herschel (1792-1871), by Julia Margaret Cameron.

The method used by Herschel was quite simple. He observed stars of different magnitudes and placed diaphragms over his telescope objective so that the brightnesses appeared equal. He could then determine the brightness ratio corresponding to a magnitude difference. Using more precise measurements, Pogson, in about 1850, found that a difference of five magnitudes corresponded very closely to a brightness ratio of 100. This led him to propose the magnitude scale which we still use in which a difference of one magnitude corresponds to a brightness ratio of the fifth root of 100, or 2.512. Some astronomers, among them Walraven, who established one of the important color systems, have made the sound suggestion that we use instead the base of the system of natural logarithms, $e = 2.718$. Unfortunately this suggestion came so late that adopting it would have resulted in too much confusion.

There remained the need for a zero point for the magnitude scale, and this is where Vega enters the picture. What could have seemed more logical than to adopt the brightest star in the northern sky for this purpose and to assign it magnitude 0.0? This scale, or a closely related one, was used in the early photometric surveys, such as the Bonner Durchmusterung and the Harvard Photometry and its important revision. The disadvantages of this plan soon became apparent. All stars, including Vega and even the sun, may be slightly variable, so it is unwise to fix the magnitude system to a single star. Also, Vega is not always above the horizon and thus not available for comparison. Both problems were solved by adopting a collection of stars near the north celestial pole, the North Polar Sequence, as standards. The magnitudes of these stars were very carefully and laboriously measured by Sears at the Mount Wilson Observatory, using photographic methods, and they served as primary standards for some decades.

Photoelectric photometry and, later, CCD photometry greatly increased both the ease and the accuracy of magnitude determinations, although many puzzles remain (as we at MIRA are currently discovering to our dismay). This has encouraged the International Astronomical Union, which is responsible for such things, to adopt a set of primary standards, ten stars of different spectral type, widely spread over the sky. Vega is not one of these stars, and it is surprising to note the variety of values quoted for the magnitude of this former standard. Meanwhile extensive sets of secondary standards have been established, both in the Selected Areas [see the Winter 2005 *MIRA Newsletter*, p. 6--Ed.] and elsewhere. Most astronomers seem to agree that the most reliable

[1]A 'clock star' is a known star on which the telescope is centered at the beginning of the night to synchronize the telescope coordinates with the sky coordinates--Ed.

of such sequences is in the open cluster Messier 67. What they cannot agree upon is the correct magnitudes of these stars.

Before the twentieth century essentially all photometric measurements were made visually, and not much was done to compensate for the differences in color sensitivity of different instruments and observers. Photographic plates, with or without color filters, and later photoelectric and CCD detectors made it possible to define color systems almost at will, and the result has been a multiplicity of color systems, each with its own advantages and disadvantages. All of these systems follow the Pogson rule. For the zero point we return to Vega, now adding five more stars, all with the same spectral type, A0 dwarf. It has been agreed that in all color systems, except sometimes where only a single spectral line is measured, the mean of these stars shall always have the same value. Thus once the color sensitivity of an instrument (detector, filter and telescope) has been established, the magnitude scale can be accurately defined. Since no two instruments are the same, we have to determine the corrections needed to convert the magnitudes measured with each instrument to whatever color system we have decided to adopt. Determining these corrections with sufficient accuracy is only one of the many complications of modern astronomical photometry.

Planets

Mercury will be easily visible from the northern hemisphere for only a brief period in early August, when it can be seen in the east-northeastern morning sky.

Venus will be very low in the east-northeastern morning sky during most of the quarter, and toward the end of September it will be lost in the morning twilight. On August 26 it will be in very close conjunction (4 arc minutes) with Saturn.

Mars can still be observed low in the west in the evening in early July, but it will soon be lost in the evening twilight and will not reappear until December. Mars will be occulted by the moon on July 27 and August 25, but it is too close to the sun for observation and the occultations could not be seen from our part of the world in any case.

Jupiter is stationary on July 6 when it can be seen in the southwest during the evening hours. By the end of September it will be very low in the southwest and almost lost in the evening twilight.

Saturn is visible briefly in the evening twilight in the west-northwest at the beginning of July. It is in conjunction on August 7 but reappears in the east-northeast in the morning sky later in the month. By the end of September it will be fairly high in the morning sky.

Uranus, which is in Aquarius, will be in opposition on September 5. The series of lunar occultations continues, occurring on July 14, August 11 and September 7, but these are still visible only from the far southern hemisphere.

Neptune will be in opposition on August 11, but it will be rather far south and the moon will be nearly full on that night.

Meteor Showers

The Perseids, everyone's favorite meteor shower and by far the best of the summer quarter, will be with us for a couple of days around August 12, but this year it will be spoiled by the nearly full moon.

The only other summer meteor shower of note is the southern delta-Aquarids which peaks about the beginning of August and lasts for one or two weeks (depending on whom you like to believe). This is the most active of a complex of five, presumably related, showers which are observable throughout July and August. The early part is observable without much interference by the moon.

A few other weak showers later in the summer will be of interest only to specialists.

Comets

The much fragmented 73P/Schwassmann-Wachmann 3 still dominates the comet pages. I counted 65 fragments, each with a nicely determined orbit. The brightest components, B and C, will fade from ninth magnitude in July to eleventh or fainter in September. The fragments will spend the summer wandering around in Cetus, where they will become increasingly accessible for observation in the morning sky as the summer progresses.

Comet 4P/Faye will be in Piscus and thus well placed for observation. It is still brightening and is predicted to reach ninth magnitude by September.

Another ninth magnitude comet, which is now just passing maximum brightness, is 41P/Tuttle-Giacobini-Kresak. This comet will be passing through Virgo in July and thus observable, rather low down in the west during the evening hours.

Comet 71P/Clark will reach its maximum brightness of twelfth magnitude in July when it will be in Sagittarius, rather far south but well enough observable.

Two recently discovered thirteenth magnitude comets can also be observed, C/2004 B1 (LINEAR) in the early summer and C/2005 E2 (McNaught) later on.

Eclipses

There will be a partial lunar eclipse on 7 September , visible from the Indian Ocean and surrounding land masses, extending north into Siberia. On 22 September there will be an annular solar eclipse, commencing on the northern coast of South America and moving across the South Atlantic to a point well south of South Africa. Neither eclipse will be visible from North America.