MERCURY AND VENUS SECTION PROGRAMME
Richard McKim

Mercury and Venus are normally observed telescopically after they have become visible to the naked eye, before dawn or after sunset, though at such times they may be at quite low altitude, so the seeing conditions may not be good. Mercury can remain above the horizon for about two hours after sunset, and Venus up to about four hours. Both show phases like the Moon. It is easy to see their phases, but other details are more difficult.

Mercury

Mecury goes through a number of morning or evening 'elongations' each year, full details of which are given in the BAA *Handbook*. Best results have been obtained through daylight observation, but this will require very careful offsetting from the Sun. It is possible for a skilled observer to see the broadest surface albedo features with a 75 mm OG, and good CCD/webcam images have been secured with a 100 mm OG, but truly worthwhile results require the largest possible aperture.

Observers are invited to submit drawings to the Section that show some albedo details, but those that merely show the phase are no longer of any interest (except to the observer). The planet has an unvarying rocky surface somewhat like our Moon, and definitive maps have been in existence since the 1960s decade. The Director will be more pleased to receive really good CCD or webcam images that show distinct details, in order to improve the Section's collection of such results (see the *Journal*, **118**, 6-9 (2008)). At the time of writing, the *Messenger* spacecraft is making a series of encounters to complete the detailed mapping begun by *Mariner* in the 1970s.

Venus

Being closer to Earth, Venus shows a larger disk than Mercury. As with the case of Mercury, the less frequent elongations of Venus are listed in the *Handbook*. Successful observation of Venus requires a telescope of modest, but not large, aperture. The visible features mostly consist of large, very low-contrast bright and dark areas without definite boundaries, and an aperture as small as 100 mm may be quite satisfactory for their observation. A larger aperture will increase contrast up to a point, but as the aperture increases the more difficult features become swamped by the general brilliance of the disk. Large apertures may profit by the use of an apodising screen of fine metal mesh or suitable fabric to reduce the brilliance of the image without loss of resolution. Daylight observation is generally recommended, but the telescope must be shielded from direct sunlight to avoid tube currents. Any search for the Ashen Light or the infrared thermal emission from the dark hemisphere will require a nearly dark sky.

Let us now follow Venus through one of its evening elongations. The nearly full disk near superior conjunction is small, but is worth careful study. The planet can only be observed in broad daylight. As the phase becomes gibbous and the disk larger, it will be easier to see faint cloud shadings, and the planet stays above the horizon longer and longer in the evening sky. The latter are faintly visible in white light, are enhanced with a blue or violet filter and are best revealed by ultraviolet imaging. A number of manufacturers supply UV filters. These must always be combined with a suitable infrared blocking filter when used with a CCD or webcam. The most characteristic UV features are Y- and psi-shaped markings, their tails trailing along the equator at an altitude of some 65 km above the red hot surface of the planet, and they show a retrograde rotation period just short of four days. (Compare this with the slowly rotating surface which exhibits an almost captured rotation period.) The cloud patterns are subject to change, especially due to veiling by higher and brighter cloud, but they have persisted in the same general form for many decades. The rotation period varies slightly with latitude according to the spacecraft images, and it will be of interest to analyse the excellent amateur images now being obtained to investigate this variation further. The poles of the planet show brighter regions, the so-called cusp-caps. Their size and brightness varies in a manner that does not seem to correlate with solar activity. Ultraviolet light will also show up occasional bright clouds which share in the four-day rotation. Such features are often best seen on the limb.

As the phase decreases during an evening (eastern) elongation, the planet approaches half-phase, or dichotomy. This moment is always early at eastern elongation and late for a morning elongation, but the difference between observation and theory seems to vary, so that careful estimates of phase or unprocessed images will be of value. The difference is greater at shorter wavelengths. The planet is now setting earlier and earlier each evening.

It will be seen that the terminator of the planet, lit by oblique solar illumination, is rather dull compared to the brilliantly illuminated limb. As the disk becomes a crescent, the terminator can sometimes show small inflections or irregularities. Most are illusory, caused by the juxtaposition of dark shadings and bright areas, but any such instance should be carefully logged. As the phase falls to around 0.1 or less, the horns start to become extended beyond the semidiameter. As inferior conjunction approaches it is sometimes possible to see them extended (by diffuse scattering in the upper atmosphere of the planet) to a full circle.

Another phenomenon only recorded with phase below 0.5 is the Ashen Light. First reported in the 17th Century, this is a coppery glow, marginally brighter than the surrounding sky, that is occasionally seen on the planet's nightside. This faint glow can affect the nightside in whole or in part. Its origin may be electrical, but some authorities doubt its objective reality. Another reasonable interpretation of the Ashen Light is associated with the occasional viewing of the glowing surface of the planet. So far it has not been imaged. Its visibility should be carefully noted, and its reality should be checked by moving the planet in the field, changing the eyepiece and (if possible) by using an occulting bar. A well-known phenomenon where the nightside appears darker than the sky is a simple illusion.

At low phase with suitable equipment it is possible to image the infrared thermal emission from the nightside. This was first achieved within the amateur community in 2004. The best images even show signs of topographic detail: the higher mountains on the planet appear darker in the infrared, being slightly cooler than the ground. The elongation from the Sun must be just right for success. Too far, and irradiation from the brilliant crescent swamps the sensitive detector. Too close, and the background sky will be too bright. Infrared images of the sunlit crescent show very subtle markings, and when visible their pattern does not correspond to what is visible in the UV. The IR cloud layer is lower than the UV clouds, and so exhibits a longer (but apparently more variable) rotation period.

Transits

Both Mercury and Venus can occasionally cross the disk of the Sun at inferior conjunction, when they appear as circular black spots, darker than the umbrae of any sunspot that happens to be visible. Transits of Venus are rare, none having occurred during the entire 20th Century. Venus crossed the Sun in 2004 and will do so again in 2012, whilst transits of Mercury are more common. Special instructions about observing transits will be published at appropriate times in the *Journal*.