Australian Astronomy

ASA Factsheet No.16

Total Lunar Eclipse
5 May 2004

General Information

A total lunar eclipse will be visible from all of Australia in the early morning hours of Wednesday, May 5, 2004. The event lasts from 4:48 am to 8:12 am Eastern Standard Time (AEST), with totality lasting from 5:52 am to 7:08 am.

A lunar eclipse occurs when the Moon, in its orbit around the Earth, passes into the Earth's shadow in space. This does not happen every month, because the Moon's orbit is tilted by just over 5 degrees with respect to the Earth's orbit around the Sun. Most of the time, therefore, the Moon passes 'above' or 'below' the shadow, resulting in no eclipse.

During some lunar eclipses, only part of the Moon's diameter is immersed in the shadow, resulting in at most a *partial* eclipse. In the type of eclipse we shall have on May 5, however, the entire disc of the Moon passes into the shadow, making the eclipse *total*. However, even during total eclipses, the Moon does not appear completely dark, because some of the Sun's light can still reach the Moon after passing through the Earth's atmosphere.

From a large part of eastern Australia, however, the Moon sets before the end of the eclipse (see Table 2), so from there the later stages will not be seen; from Sydney, Brisbane and Canberra, for example, the Moon sets during the total part of the eclipse.

The western part of the country is a favoured location to view the event, because from there the Moon will be higher up in a darker sky. From Perth, the eclipse is visible in its entirety.

Everyone who can see the Moon will see the eclipse simultaneously. However, because of the differences between time zones, local times of the event will be 30 minutes earlier in South Australia and The Northern Territory, and two hours earlier in Western Australia. See Table 1 below for local times of different stages of the event.

Place	**E. Australia**	**S.A./N.T.**	**W.A.**
Eclipse begins	4:48 am	4:18 am	2:48 am
Totality begins	5:52 am	5:22 am	3:52 am
Totality ends	7:08 am	6:38 am	5:08 am
Eclipse ends	8:12 am	7:42 am	6:12 am
All times in local time			

Table 1. Local Eclipse Times - May 5, 2004
(see table 2 for moonset times)

City	*Local Moonset Time*
Adelaide	7:02 am
Brisbane	6:19 am
Canberra	6:48 am
Darwin	7:00 am
Hobart	7:12 am
Melbourne	7:11 am
Perth	7:02 am
Sydney	6:37 am

Table 2. Local Moonset times - May 5, 2004
From most locations, the Moon will set before the eclipse ends.
Note that moonset occurs at about the same time as sunrise, so twilight will interfere with observations well before the Moonset times shown.

Watching the Event

Unlike a solar eclipse, a lunar eclipse is quite safe to observe with the unaided eye, binoculars or telescopes.

Times mentioned in this guide (see Table 1) refer only to passages of the Moon through the Earth's main dark, circular shadow called the *umbra*. Surrounding the umbra, there is a lighter region of shadow called the *penumbra*, through which the Moon also passes. However, except when the Moon's edge is very close to the umbra, it is very difficult to detect any penumbral effects, as this region includes some direct sunlight.

At 4:48 am AEST, the Moon, which will be visible in the western sky, begins to enter the umbra. From that time on, more and more of the Moon will be seen to be in shadow, as if a 'bite' were being taken out of it.

As the eclipse progresses toward totality, it should become obvious — especially using binoculars — that the eclipsed portion of the Moon can still faintly be seen. During totality (and for a short while before and after), the eclipsed Moon's disc will take on a coppery-red glow. This is because light has passed through the Earth's atmosphere onto the Moon; it has a red colour because the Earth's atmosphere scatters blue light more than red, and allows red light to pass through more directly.

Due to the Earth's rotation, as the eclipse progresses the Moon will gradually become lower and lower in the western sky. With twilight intervening for much of Australia, the increasing brightness of the sky is likely to make the Moon progressively harder to see during totality — especially if the Moon's brightness during totality is relatively low.

Indeed, it is difficult in advance to predict how dark the Moon will be during totality. Sometimes, it remains quite prominent (although dramatically less bright, of course, than a 'normal' full Moon). During some eclipses, however, it appears so dark that it can hardly be seen.

For people far enough west, after one hour and 16 minutes of totality the Moon will still be above the horizon as totality ends. At that stage, the upper right part of the Moon will rapidly brighten, following which the rest of the Moon will emerge from the umbral shadow over a period of just over an hour.

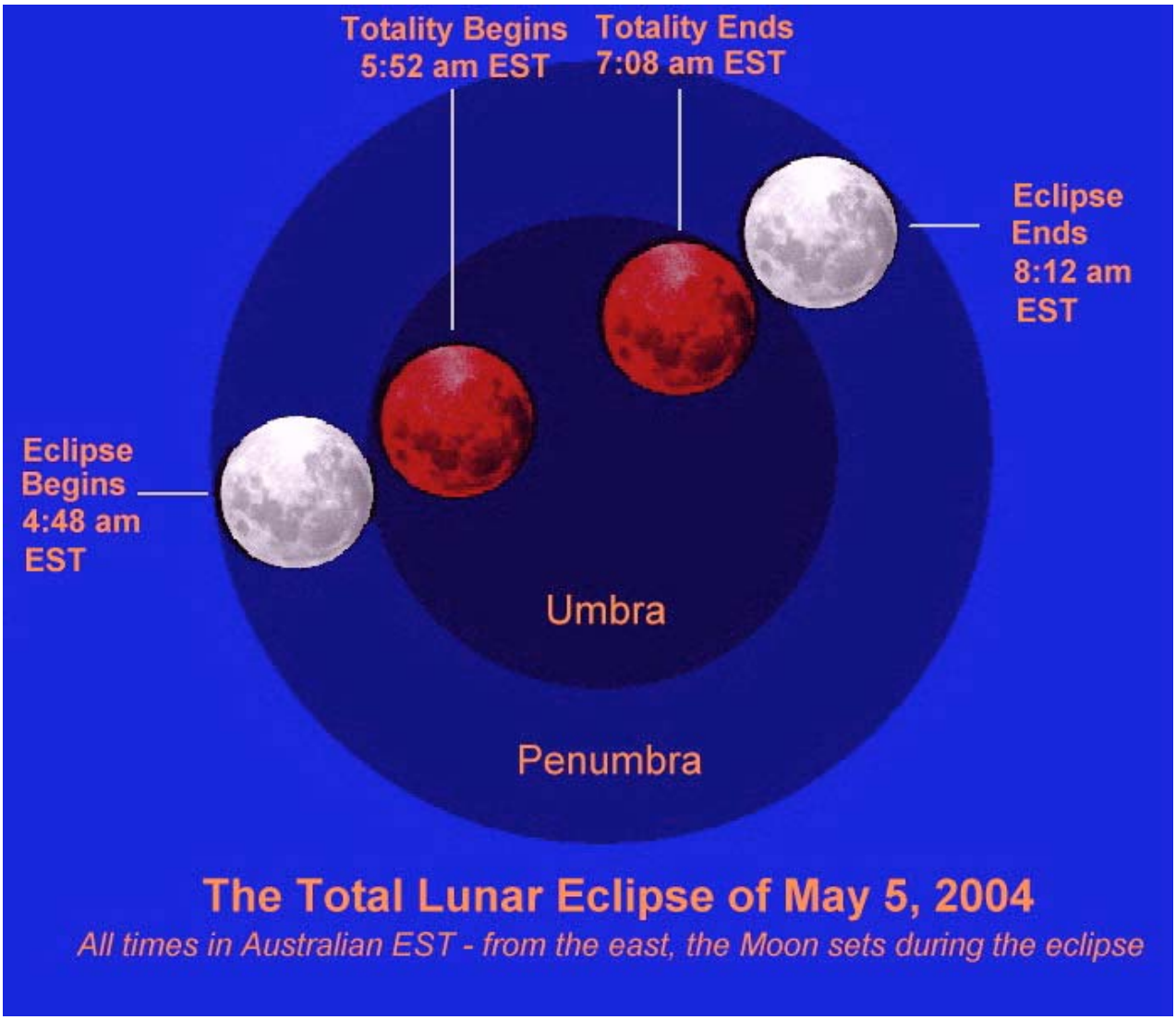

Fig. 1. The path of the Moon through the Earth's shadow on the morning of May 5.

Lunar Eclipses in History

Both solar and lunar eclipses have significant places in history. Long ago, the Greek astronomer Aristotle used lunar eclipses to support the argument that the Earth is round — as you watch the shadow of the Earth falling onto the Moon, you will clearly see that the shadow has a curved shape.

There have also been associations between lunar eclipses and significant historical events.

Information passed down to us from the writings of Flavius Josephus, in the first century AD, states that a lunar eclipse occurred shortly before King Herod's death. Many historians feel that the partial lunar eclipse of March 12-13, 4BC is the most likely, but it is

also possible that the total lunar eclipse of January 9-10, 1BC was the event to which Flavius Josephus was referring.

In August, 413 BC, the Syracusian navy destroyed an Athenian fleet after its leader delayed a retreat because of a lunar eclipse, which was seen as a bad omen. More than a thousand years later, the defenders of Constantinople in 1453 were so frightened by a partial lunar eclipse that the fall of the city was hastened.

In 1504, Christopher Columbus had been marooned in Jamaica and the natives were no longer supplying him with food. According to his son Ferdinand, Columbus told the natives that God would make his anger clear by making the Moon 'appear inflamed with wrath, denoting the evils that God would inflict upon them', on the night of February 29. Columbus, of course, knew that a total lunar eclipse would occur on that date. This solved the problem, with the natives being so frightened that they promised to satisfy Columbus' future needs.

Lunar Eclipse Photography

It is possible to photograph this eclipse, but it is important to have a camera whose exposures can be set manually. Unfortunately, a camera giving automatic exposures will usually produce a very overexposed image of the Moon! It is advisable to use a tripod (you will certainly need one for totality), and you may need a cable release during totality to hold your shutter open. It is also important to realise that the disc of the Moon appears very small as seen from the Earth. If you use a 'normal' lens — which, on modern 35mm cameras, has a focal length of typically 35 to 50 millimetres — a disappointingly small image will appear on your film. You should, therefore, use a lens of much longer focal length than this; 200 mm or longer is recommended. The lens must be focused on infinity.

Fig. 2. The total lunar eclipse of July 16-17, 2000, photographed by Karenne Barnes of the Astronomical Society of Tasmania Inc.

If you are using 100 ISO (ASA) film, the typical correct exposure of the partially eclipsed Moon is 1/125 second at f/8, increasing to 1/60 when the Moon is more than half eclipsed and 1/30 second when the eclipse is nearly total. Different f/numbers, of course, will mean using different exposures. For example, using f/5.6 you can halve the above exposure times, but using f/11 the exposures must be doubled. It is a good idea to bracket your exposures — that is, to try additional exposures of both one stop less and one stop more (i.e. halving or doubling the exposure).

For the totally eclipsed Moon, it is necessary to make much longer exposures. Because the Moon's brightness during totality is difficult to predict, exposure times vary from eclipse to eclipse. If the moon is relatively bright, exhibiting a quite conspicuous orange-red disc, a suitable exposure with 100 ISO film is about 2 seconds at f/4 (or equivalent). Darker eclipses, however, can require several stops more, so you should try quite a range of exposures during totality. Unless the exposure you are giving is relatively short, you will need to attach your camera to a device called an *equatorial mount* (with a motor drive) if you wish to avoid having the Earth's rotation 'blur' the Moon's image. If using a fixed camera, you can determine how much the image will be 'blurred' by remembering that the Earth's rotation causes the Moon to appear to move its own diameter in about two minutes.

If you are using a different speed film, you can adjust your exposures accordingly. If the Moon is seen through misty cloud, make sure that your exposure range (when bracketing) extends to several stops more than the above figures. It is interesting to take a sequence of photographs of the eclipse — you will have a fine record of the Moon passing through the Earth's shadow!

It is also possible to use a digital camera to photograph the eclipse. The same comments apply, however, to the focal lengths of lenses used for the purpose; short focal length lenses, or lenses with a very limited zoom capability, may still produce disappointingly small images. Also, in general, digital cameras capable only of automatic exposure are likely to overexpose the Moon, because the Moon will cover only a small section of the field. It would, therefore, be a good idea take some digital photographs of the Moon before the event to learn the scale of the image that is produced, and to see if you can get the camera to correctly expose the Moon.

SLR-type digital cameras are ideal, as they have interchangeable lenses and can even be set to simulate having a film of a certain speed in the camera. In that case, the exposure times mentioned above can still be used as a good guide, as such cameras also normally offer manual control of the exposure time.

The advantage of digital cameras, of course, is that you can see the finished product almost immediately!

Recent and Forthcoming Eclipses

The most recent lunar eclipse visible from Australia was a partial one, occurring on the night of July 5-6, 2001. The most recent *total* lunar eclipse seen from this country was on January 10, 2001, but totality was seen only from the western parts of the country.

The next lunar eclipse (after that of May 5, 2004) to be visible from Australia will occur on October 17, 2005; it will be a very minor partial eclipse with only 6% of the Moon's diameter obscured. Following this, there will be an 18% partial eclipse on September 8, 2006; the partial stages only of a total eclipse on March 4, 2007 (visible from the far west of the country); and a total eclipse, with totality being seen from all of the country, on August 28, 2007.

The next *solar* eclipse visible from Australia will take place on February 7, 2008, and will be a partial one visible from the south east of the country. Following this, a partial solar eclipse will be seen from all of Australia except Tasmania on January 26, 2009; a very minor partial solar eclipse seen from the Cape York area on July 22, 2009; another minor partial solar eclipse seen from Tasmania November 25, 2011; and a total solar eclipse, seen from a narrow path across northern Queensland, on November 14, 2012 (the rest of the country will witness a partial eclipse).

This information was prepared for the ASA by Martin George of Launceston Planetarium (http://www.qvmag.tased.edu.au/planetarium.html). This sheet may be freely copied for wide distribution provided the Australian Astronomy and ASA logos are retained.

ASA Factsheets are an initiative of the Astronomical Society of Australia's Education and Public Outreach Committee. Other sheets are available from the ASA's Australian Astronomy web site (http://www.astronomy.org.au/).

ASTRONOMICAL SOCIETY OF AUSTRALIA

