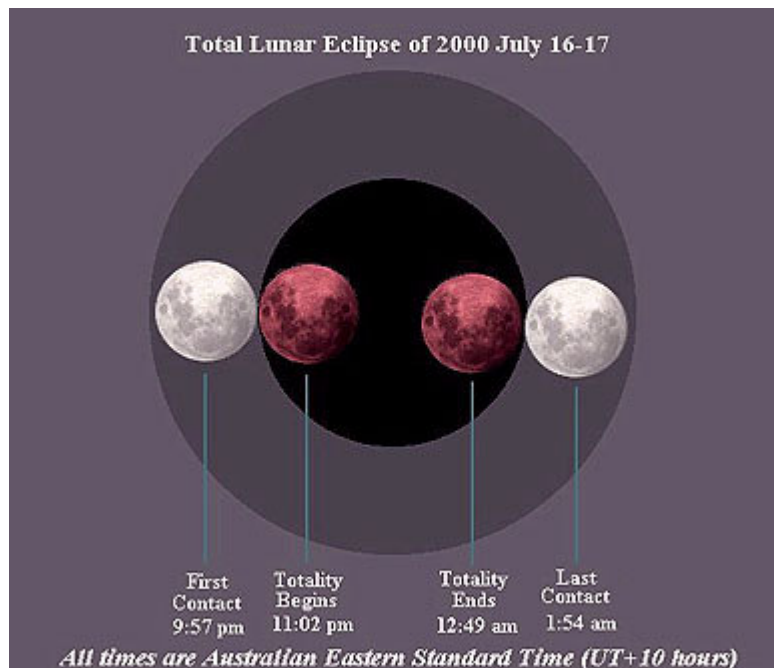


A total eclipse of the Moon was visible from all of Australia on the night of Sunday, 2000 July 16. The eclipse began at 9:57 pm Eastern Australian Standard time, and was total between 11:02 pm and 12:49 am (July 17). The eclipse ended at 1:54 am. Everyone who can see the Moon saw the eclipse simultaneously. However, because of the differences between time zones, local times of the event were 30 minutes earlier in South Australia and The Northern Territory, and two hours earlier in Western Australia.



This diagram shows the passage of the Moon from west to east through the Earth's shadow on July 16. However, the Moon will appear to move from east to west across the sky because of the Earth's rotation.

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, such as the one that occurred last July 28, only part of the Moon's diameter is immersed in the shadow, resulting in at most a partial eclipse. During others, like the 2000 event, the entire disc of the Moon passes into the shadow, making the eclipse total. However, even then, 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.

Times and dates mentioned in this guide refer only to passages through the Earth's 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 (sometimes, the Moon passes through only this region, missing the umbra altogether). 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.



This photograph of a lunar eclipse was taken on the morning of 1986 October 18, just before the start of totality. Even before the Moon is completely within the Earth's shadow, it becomes possible to see the orange-red colouring in the eclipsed portion. The uneclipsed portion (at lower left) is overexposed, but the circular shape of the edge of the Earth's shadow is easy to see. Photo: M. George

Watching the Eclipse

Eclipses of the Moon, which are seen at night, are quite safe to watch. Indeed, binoculars can be used to give a better view than is seen with the unaided eye. Some confusion arises here because it is dangerous to look directly at the disc of the Sun at any time, including those times when part of the Sun's disc is hidden by the Moon during solar eclipses, which are seen during the day.

As the eclipse commenced, shortly before 10 pm (EAST), it was obvious that the right hand - or eastern - side of the Moon was entering the shadow. Gradually, more and more of the Moon passed into the shadow until just a slender piece of the Moon was still illuminated. During the subsequent period of total eclipse, the entire disc of the Moon was within the Earth's shadow. However, some light still fell onto the Moon: sunlight bent by our atmosphere is usually enough to illuminate the Moon so that it remains easily visible to us. The light has a reddish colour because red light tends to pass through our atmosphere, whereas blue light is scattered (this is why clouds can appear red at sunset, and is why the sky is blue!). The brightness of the totally eclipsed Moon varies from one eclipse to the next, because it depends on the state of the Earth's atmosphere at the time. For example, volcanic material in our atmosphere tends to make the Moon look much darker. On some occasions, the eclipsed Moon has been so dark that people reported it to be quite difficult to see.

It is interesting to compare the view of the starry night sky before the eclipse commences and again during the total part of the eclipse. When the Moon is full, the Milky Way is difficult or impossible to see, but a total lunar eclipse dims the Moon so much that the Milky Way is easily visible, provided that you are away from bright city lights!



Away from city lights, the Milky Way is easy to see during a total lunar eclipse. This picture of the totally eclipsed Moon (the disc at lower left) and the Milky Way was taken during the eclipse of 1993 June 4. The 400 ASA film was exposed for 10 minutes at f/3.5, the camera being driven to cancel out the effects of the Earth's rotation.

Lunar Eclipses in History

While watching lunar eclipses, it is interesting to reflect on the fact that the Greek astronomer Aristotle (384-322 BC) used them to support the argument that the Earth is round: as we can see in the first photograph, the circular nature of the shadow of the Earth on the Moon is quite obvious!

Lunar eclipses, like solar eclipses, have been associated with many historical events. In August 413 BC, the Syracusan navy destroyed an Athenian fleet after its leader delayed a retreat on account of the 'bad omen' of a total lunar eclipse, and in 1453 the defenders of Constantinople were so frightened by a partial lunar eclipse that the fall of the city was hastened.

One of the most famous such stories dates from 1504. In February of that year, Christopher Columbus was experiencing problems in Jamaica. He had been marooned there for over six months with unseaworthy ships and - because of the actions of some of his crew, who had mutinied - the natives were no longer supplying him with food. As written by 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 God would inflict upon them', on the night of February 29. Of course, Columbus knew that a total eclipse of the Moon would occur on that date. The Moon rose at 6:12 pm*, just after the eclipse began, and totality commenced at 7:15 pm* during the last stages of twilight. This solved the problem - the natives were so frightened that they promised to satisfy Columbus' future needs.

*Times here refer to the modern time zone of Jamaica: UT (GMT) minus 5 hours.

Photographing the Eclipse

It is possible to photograph the 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's 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 Earth. If you use a 'normal' lens - which, on a modern camera, 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 millimetres or longer is recommended. The lens must be focused on infinity.

If you are using 100 ISO (100 ASA) film, the typical exposure for 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 when the eclipse is nearly total. Different f/numbers, of course, will mean using different exposures. For example, if you are using f/5.6 you can halve the above exposure times, but using f/11 the exposures must be doubled. Also, to ensure that you get the best possible results, it's a good idea to 'bracket' your exposures - that is, try additional exposures of both one stop less and one stop more (one 'stop' extra is equivalent to doubling the exposure). For example, in the early partial stages try 1/250, 1/125 and 1/60 at f/8.

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). However, darker eclipses can require several stops more, so you should try quite a range of exposures during totality. Unless the exposure you are using 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. For example, if you have 200 ISO film, you can halve the above exposures. If the Moon is seen through misty cloud, make sure that your exposure range extends up to several stops more than the above figures. It is interesting to take a sequence of pictures of the eclipse - you will have a fine record of the Moon passing through the Earth's shadow!



The colouring of the totally eclipsed Moon stands out well in this photograph taken early in the morning of 1974 November 30. Photo: M. George

Recent and Forthcoming Eclipses

A recent lunar eclipse visible from Australia occurred on 1999 July 28, but it was only partial. The next most recent total lunar eclipse visible from here was on 1997 September 17. Another lunar eclipse of either kind (after this year's) visible from Australia was a total one early on the morning of 2001 Jan 10, but no part of Australia saw all of the eclipse, and totality was visible only from the western parts of the country. Following this, there was a 50% partial lunar eclipse visible from all of Australia on the night of 2001 July 5-6.

Recent solar eclipses seen from Australia: a minor partial eclipse on the morning of 2002 June 11, seen from the more northerly parts of the country; then, on December 4 in that year, a total solar eclipse, with totality being seen just before sunset from Ceduna in South Australia and along a narrow path to its north east.



Framed by trees, the totally eclipsed Moon glows eerily in the morning twilight on 1986 October 18. Photo: M. George

This information was prepared by
[Martin George](#)
[Launceston Planetarium](#)
Queen Victoria Museum and Art Gallery
Wellington Street, Launceston
Tasmania, 7250
Phone: (03) 63316777
Fax: (03) 63345230