Australian Astronomy

ASA Factsheet No. 4 **The Transit of Mercury, 16 Nov, 1999**

NOTE: If you wish to observe this event, it is essential to take precautions in order to view it safely. To avoid serious eye damage, do not look at the Sun, either with the unaided eye or THROUGH telescopes or binoculars.

Gereral information about the transit

On the morning of Tuesday, November 16 (at Australasian longitudes), there was a transit of the planet Mercury across the face of the Sun - an event in which Mercury is seen in silhouette against the backdrop of the Sun's disc. However, this was a transit with a difference!

During this event, Mercury was very close to the Sun's northern edge, only briefly appearing in front of the Sun before leaving again (see figure 1). In fact, from places south of a line passing through the far north of Western Australia, near Brisbane, and the southern part of the North Island of New Zealand, only part of Mercury's disc was seen, resulting in a rare partial transit from part of the Earth. The total duration of the transit from the Australia-New Zealand region was only about 40 minutes, centred on about 21h 41m Universal Time (GMT) on November 15 (7:41 am on November 16, Australian Eastern Standard Time).

The 1999 transit of Mercury was visible from a large part of the world, including Australia, New Zealand, the Pacific Ocean, Antarctica, and much of North and South America. During a transit, Mercury appeard as a tiny black dot slowly moving westwards with respect to the Sun's disc. However, from the region where this transit was only partial, Mercury's silhouette appeared only as a tiny 'notch' in the Sun, as up to about 10% of its disc was outside the Sun's edge.

The next most recent occasion on which a partial transit of Mercury occurred was on 1937 May 11. However, during that event, no part of the Earth saw the complete disc of Mercury. The November's transit - in which some observers saw the complete disc, while others saw only part of it - was the first such event since the invention of the telescope! The table gives the contact times of the event for several cities in Australia and New Zealand. First contact was when Mercury's disc first started to appear, and fourth contact occured when the last part of the planet's disc finally left the Sun. Between second and third contacts, the whole disc of Mercury lay within the Sun, but this happened only in some places.

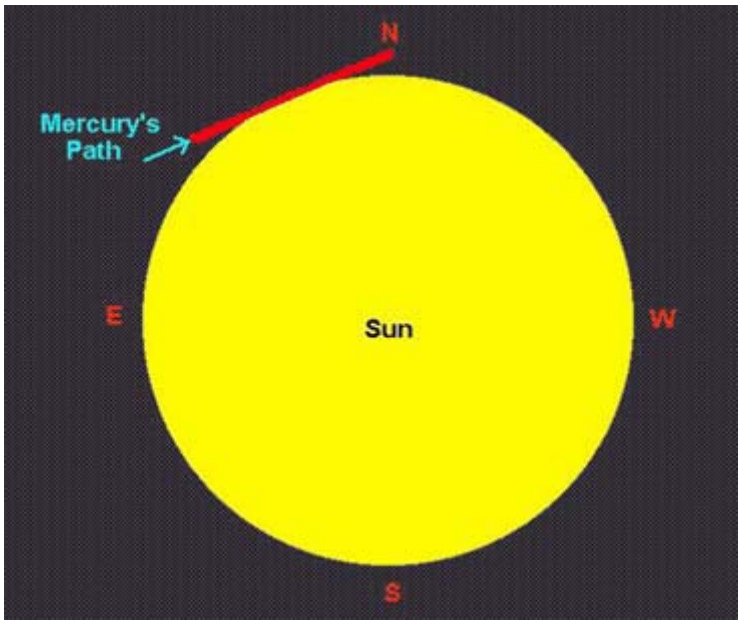
TRANSIT OF MERCURY, NOVEMBER 16

Place	First Contact	Second Contact	Mid-Transit	Third Contact	Fourth Contact
Adelaide	07:48.9		08:11.4		08:33.9
Auckland	10:17.8	10:38.4	10:41.3	10:44.1	11:04.8
Brisbane	07:18.1	-	07:41.5	-	08:04.8
Canberra	08:18.6	-	08:41.4	-	09:04.2
Darwin	06:48.1	07:08.5	07:11.6	07:14.7	07:35.2
Hobart	08:18.9	-	08:41.3	-	09:03.7
Melbourne	08:18.8	-	08:41.4	-	09:03.9
Perth	05:19.3	-	05:41.4	-	06:03.5
Sydney	08:18.5	-	08:41.4	-	09:04.3
Wellington	10:18.0	-	10:41.2	-	11:04.5

This table gives LOCAL times on the morning of November 16. One hour of summer time has been added for South Australia, Victoria, Tasmania, New South Wales and New Zealand.

From Perth, the transit began only ten minutes after sunrise, which occured at 05:09. From the north and west of Western Australia, the transit began before sunrise, but the later parts of the event were visible.

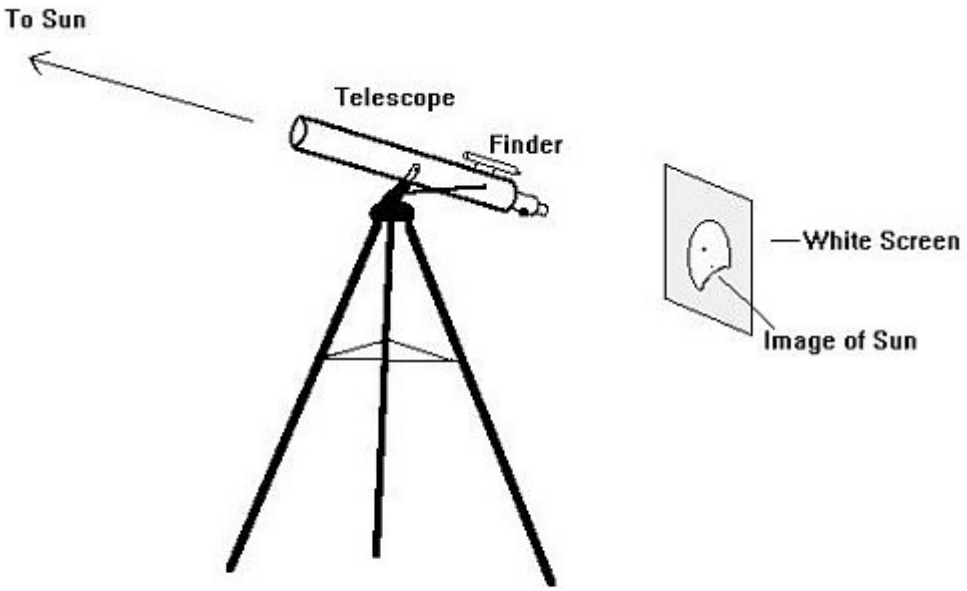
From Australia and New Zealand, first contact occured at a position angle (PA) of 31 degrees. PA is measured from the north point on the Sun's disc in an easterly direction. Mid-transit occured at a PA of 23 degrees, and last contact was at 15 degrees (see figure 1).



The path of Mercury during the transit. The tiny planet just grazes the Sun's edge. To look for Mercury near the beginning of the transit, firstly identify the north and east directions in your field of view. Then, starting from the north point on the Sun, fix your gaze at the point on its circumference about a third of the way between north and east.

Observing the transit- Safety First!

As with all solar observing, it is important NOT to attempt to see the transit with the unaided eye - in any case, Mercury is so small that its disc was not visible! You could, however, observe the event in safety by projecting the Sun's disc onto a white screen using a small telescope (see figure 2). Set up well before the event, so that you are ready to watch for the little silhouette of Mercury. DON'T LOOK THROUGH THE TELESCOPE, OR ITS FINDER! With your back to the Sun, aim the telescope at the Sun and move it until the Sun's image appears on a screen placed about 20-30 centimetres behind the eyepiece. You will need to focus the image; there will probably be some sunspots, which may help! It's important to stay with your telescope at all times when it is aimed at the Sun, and to keep children well supervised!



How to use a telescope to project an image of the Sun.
NEVER look through the telescope or its finder!

It would be then important to satisfy yourself as to the orientation of your picture. With the telescope stationary, the Sun was moving towards the west, so the last part of the Sun to disappear was its eastern side. Then, if you nudged the telescope at a right angle to the east-west line so that was directed a little to the north (on the morning, this meant aiming the telescope down and a little to the left), the last part of the Sun's disc to disappear was its northern edge. Using an astronomical refractor telescope and the projection method shown in figure 2, you should have found that the projected image is mirror-reversed and nearly upside down compared with the diagram, but different orientations are possible depending on your equipment. Once you hade identified north and east on your projected image as described above, simply remembered that Mercury was to first appear about 31 degrees around the Sun's edge, measured in an easterly direction, from the north point.

Mercury's disc was dark but very small! Also, the turbulent state of our atmosphere meant that Mercury was difficult to distinguish from apparent 'ripples' along the Sun's edge. Projecting into a relatively dark area (such as a car boot!) helped to increase the contrast. You could also photograph the transit - simply by photographing the projected image!

If you were lucky enough to be using a special device called a hydrogen-alpha filter, you may have seen Mercury's disc silhouetted against the Sun's chromosphere a few minutes before and after the times in the table. With such equipment, you may also have seen Mercury against the backdrop of one or more solar prominences!

More about the transits

As Mercury overtakes Earth about every 116 days in its faster orbit, it usually passes to the north or south of the Sun, because Mercury's orbit is tilted with respect to ours. Therefore, transits of the tiny planet can take place only on certain special occasions. They occur, on average, about 13 times each century. They are seen only in May or November, because these are the times when the line joining the Earth and the Sun passes near one of the nodes of Mercury's orbit - the two points where Mercury passes through the plane of the Earth's orbit (called the ecliptic). Of course, we see a transit only if Mercury happens to move through a node at the right time!

Similar considerations apply to Venus - the only other planet that can transit the Sun. These transits can take place in June or December, but they are much less common. They occur in pairs eight years apart, following which there are no more for over a century.

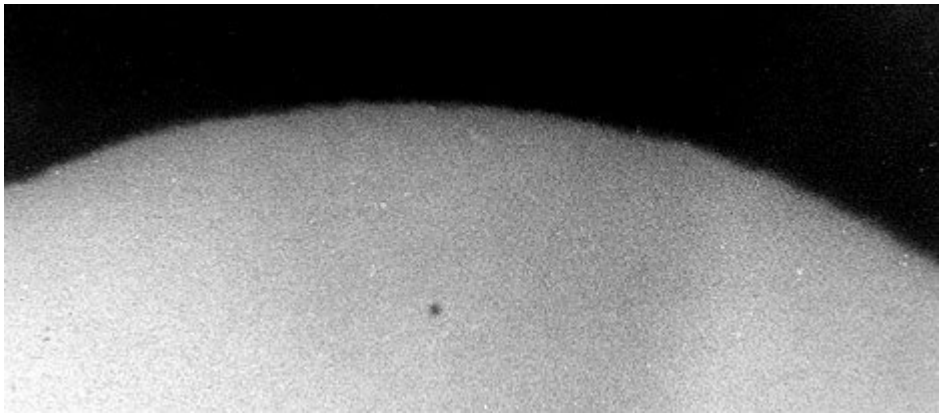
Transits hrough history

Transits of Mercury could not be observed until after the invention of the telescope in the early seventeenth century. The first person to see one was the French astronomer Pierre Gassendi in 1631 - an event that had been predicted by Johannes Kepler. A few decades later, it was pointed out that, by timing transits of Mercury and Venus from different places on Earth, it would be possible to find the distance from the Earth to the Sun. Edmund Halley tried this with Mercury in 1677, but it was soon realised that transits of Venus would be much better suited for this purpose, as Venus is closer and appears much larger. Possibly the most famous of these was the transit of Venus in 1769 which was observed by Captain James Cook and his party from Tahiti.

The most recent transit of Mercury occurred in November 1993, and the next will take place in May 2003. The most recent transit of Venus was in 1882, and the next will be in 2004 - an interval of 122 years!

Forthcoming transits, 1999-2019

Date	Time of mid-transit (UT/GMT)	Planet
1999 November 15	21:41	Mercury
2003 May 7	07:52	Mercury
2004 June 8	08:23	Venus
2006 November 8	21:41	Mercury
2012 June 6	01:35	Venus
2016 May 9	14:59	Mercury
2019 November 11	15:21	Mercury



The author captured this photograph of tiny Mercury in transit across the Sun at 08:20 UT (GMT) on 1973 November 10 from Mount Nelson, Tasmania. The seeing was very poor, as the Sun was only a few degrees above the horizon at the time!

This information sheet is adapted from an article about the transit that appears in the Oct/Nov 1999 issue of Sky and Space Magazine, available at all good newsagents and by subscription - call 02-93693344.

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