



Australian Antarctic Division : Leading Australia's Antarctic Program

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IN THE SPIRIT OF COOPERATION



Feature

In the spirit of cooperation

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Australian Antarctic Magazine - Issue 6: Autumn 2004

Ice and fire: A total solar eclipse over Antarctica

The 23rd of November 2003 has been entered in the astronomical record books as the day when a total solar eclipse was first witnessed from Antarctica. The audience for this special event consisted of four main groups of astronomers and eclipse enthusiasts, who were lured to the ends of the Earth by the chance to see the Sun briefly swallowed by the Moon amid a frozen landscape.

The path of the total eclipse, within which the Moon fully covered the Sun, was a thin corridor, 500km in width at its narrowest point, which swept over a remote and harsh region of the Southern Ocean and East Antarctica. From a much broader area, which included Australia and most of Antarctica, the Moon was seen to partly cover the Sun.

In order to observe the eclipse at its best, two commercial aircraft were chartered to intercept the Moon's shadow over Antarctica. Approximately 200 people on these flights were able to view the total eclipse for approximately two minutes and 30 seconds while flying at an altitude of about 11km. At the surface, observers at Mirny and Maitri stations, as well as tour groups on the Russian icebreaker *Kapitan Khlebnikov* near the Shackleton Ice Shelf and Russia's Novolazarevskaya station, were within the path of totality, but were hampered by clouds.

Aside from the spectacle of seeing the ghostly glow of the Sun's outer atmosphere, or corona, revealed to the naked eye for a fleeting few tens of seconds, the eclipse presented some important scientific opportunities. On one of the eclipse-chasing aircraft, a Qantas 747B chartered by Croydon Travel, noted eclipse experts Dr. Glenn Schneider from the University of Arizona, and Professor Jay Pasachoff from Williams College, Massachusetts, took special photographs for comparison with observations by the SOHO spacecraft.

I was fortunate to be on this flight as the AAD's observer to monitor environmental aspects of the charter. I was specifically interested in looking for elusive noctilucent clouds hanging high in the atmosphere. These clouds form near 85km altitude during the summer over Antarctica, and are sensitive indicators of conditions at the top of the atmosphere. The eclipse provided a unique opportunity to locate the clouds visually, because normally the atmosphere is too bright to see them. It was hoped to compare the location and appearance of the clouds with satellite measurements. Alas, no obvious noctilucent clouds were seen, probably because the atmosphere was not cold enough above our location. Contrary to our normal experience on the ground, the high atmosphere above Antarctica cools down between winter and summer. For noctilucent clouds to form, the temperature needs to be below about -150°C, which normally occurs from late November.

My other interest was in the temperature response of the atmosphere to the advance of the Moon's shadow. At Davis, where at maximum eclipse just over 98% of the Sun's diameter was obscured, the Light Detection and Ranging (lidar) experiment obtained profiles of atmospheric temperature. The measurements showed a cooling of 5 to 15 degrees, depending on altitude, delayed slightly with respect to the time of maximum eclipse. This response is most likely due to reduced heating by ozone while the atmosphere was covered by the Moon's shadow. These measurements are the first to be obtained by lidar at high latitude during an eclipse, and will provide a new insight into atmospheric heating rates.

At Mawson, Davis and Casey, the station webcams were used to transmit live eclipse images over the internet. These images and related information created record public interest in the AAD's website.

The event has now passed, and the enthusiasts have returned home with memories and photographs of the fire-rimmed hole in the sky above Antarctica. Some are thinking of the next such opportunity in December 2021, and wondering what scientific discoveries await us then.

Andrew Klekociuk, Space and Atmospheric Sciences Program, AAD

Box:

Australia's first micro-satellite to elevate our Antarctic magnetometer science

Ice and fire: A total solar eclipse over Antarctica

Total eclipses in Antarctica - how rare are they?

EurAstro over Antarctica

Poachers pursued over 7,000 kilometers

Crackdown continues: Maya V apprehended, Lena sunk

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Through rain, hail and shine, ambitious island program completed successfully

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A remarkable contribution to world science

Australian team recovers NASA balloon

You scratch my back, and I'll scratch yours!

Mawson: Antarctica's first wind-powered station

Up, up and away: 2003-04 aircraft operations

Island exchanges enhance quarantine protection

New living quarters for Davis station

Station Leaders for 2004

Mawson station, est. 1954: a signal achievement

Australia Post celebrates 50th anniversary of Mawson station

New AAD facilities opened on Mawson station's 50 year anniversary

Australian Antarctic Arts fellowships awarded

Colours of Antarctica

Cold, dark and festive: Celebrating Midwinter in Tasmania

In the news

Total eclipses in Antarctica – how rare are they?

On average, a total solar eclipse is visible from some part of the globe every 16 months or so. Since 1900 there have been 10 total eclipses having at least some part of their path south of 60°S, and of these seven had paths which intersected the Antarctic continent. One of these eclipses was significant for Tasmanians. On 9 May 1910 a total eclipse crossed the Antarctic coast where Casey is today, and passed over southern Tasmania. It was cloudy in Hobart at the time, and coincidentally Halley's comet reached its closest point to the Earth the following day. In more recent times, total eclipses occurred over the Antarctic region in 1957, 1967 and 1985. Despite the steady increase in Antarctic scientific exploration over these years, no observations of totality were attempted for the events owing to the unfavourable location of the eclipse paths.

Box:

EurAstro over Antarctica

The EurAstro team (Dr. Matthew Poulton and I, and guests Professor Jay Pasachoff and his student Zophia Edwards) had booked seats in the first class cabin of the Croydon/Qantas dedicated flight to the total solar eclipse of 23-24 November 2003. Dr. Andrew Klekociuk advised us to look for noctilucent clouds and auroral displays. We saw none, but I nevertheless captured interesting refraction and scattering effects. After having seen a sea of clouds for hours, we were eventually treated with some clearings near the eclipse site. The view was breathtaking and everybody rushed to photograph this landscape, unusual to eclipse chasers, as the plane banked and dived while the partial phase of the eclipse was already in progress. Dr. Glenn Schneider helped bring the plane in perfect alignment with the eclipse track. He announced the onset of the Moon's shadow, the sighting of the solar corona, and the diamond ring. After totality, further sightseeing opportunities were offered to those not already celebrating.

Jean-Luc Dighaye*, Chairman, EurAstro

**Jean-Luc Dighaye has witnessed several total solar eclipses from remote corners of the globe. EurAstro is a nonprofit association for European amateur astronomers based in Munich, Germany. The association was established in 1998 and currently comprises approximately 250 members.*

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Department of the Environment
Australian Antarctic Division

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