

## DREAMTIME ASTRONOMY: DEVELOPMENT OF A NEW INDIGENOUS PROGRAM AT SYDNEY OBSERVATORY

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**Abstract:** The Australian National Curriculum promotes Indigenous culture in school education programs. To foster a broader appreciation of cultural astronomy, to utilise the unique astronomical heritage of the site, and to develop an educational program within the framework of the National Curriculum, Sydney Observatory launched *Dreamtime Astronomy*—a program incorporating Australian Indigenous culture, astronomy, and Sydney’s astronomical history and heritage. This paper reviews the development and implementation of this program and discusses modifications following an evaluation that was conducted by schools.

**Keywords:** astronomy education, cultural astronomy, Aboriginal Australians, astronomical history, astronomical heritage.

### 1 INTRODUCTION AND BACKGROUND

Sydney Observatory is Australia’s oldest surviving astronomical observatory and was constructed in various stages, starting in 1858 (Orchiston, 1998; Wood, 1958; 1983). In 1982 the Observatory ceased to function as an autonomous research and educational institution and was incorporated into the Museum of Applied Arts and Sciences (Kerr, 1991; Orchiston, 1988). Whilst education has long been a role of the Observatory (Lomb, 1998; Wood, 1958), science education and the heritage of astronomy are now the primary focus. As a public observatory and museum, Sydney Observatory offers unique and site-specific educational programs in astronomy, meteorology, archaeology, and most recently on the astronomical knowledge of Aboriginal Australians, a topic dubbed ‘Aboriginal Astronomy’.

Since 1997 Aboriginal Astronomy has been part of the exhibition and all education tours have included some Aboriginal content, mainly in the planetarium component. Within the domed, darkened room, stars are digitally projected to create a virtual night sky. Aboriginal constellations, such as the Emu in the Sky, are projected on the dome and the astronomy guides recount stories from communities such as Yolngu (Northern Territory) and Murri (Queensland).

Over the past decade there has been a significant increase in research into the astronomical knowledge of the Aboriginal Australians (e.g. see Cairns and Harney, 2004; Fredrick, 2008; Hamacher, 2012; Norris and Norris, 2008). This has coincided with changes in the school cur-

riculum and a desire to increase the number of student visitors to Sydney Observatory. Day school visitation increased nearly 45% to 16,000 between 1998 and 2010, but has plateaued since 2010 (Figure 1). Student numbers for night programs have remained static at around 2,000 per annum.

A decision was made to embrace the new research in Aboriginal astronomy and develop an education program around the subject. This goal was to increase education visits and further enhance the appreciation of Indigenous Australians as arguably the world’s oldest astronomers (Norris, 2008).

### 2 PREVIOUS ABORIGINAL ASTRONOMY PROGRAMS

In 1997 a new exhibition marked the start of the Observatory’s presentation of Indigenous astronomy. The small theatre exhibit, named *Cadi Eora Biringung* (meaning “Beneath the Southern Sky” in the language of the Cadigal people of Sydney Cove), includes an immersive space where videos of astronomy-themed ‘Dreaming’ stories are projected using a ‘fishers-ghost’ technique. The animations were developed by Aboriginal artists and recorded by Aboriginal actors.<sup>1</sup> Nearby, an interactive computer display allows the user to choose between Aboriginal and Western constellations visible during different seasons of the year.<sup>2</sup>

In 2012, we developed an exhibit that featured meteorites from New South Wales, the Northern Territory (NT) and Western Australia (WA). The exhibit<sup>3</sup> includes both scientific and Aboriginal accounts of the Henbury crater field

(NT) and Wolfe Creek crater (WA). The display also features a painting of the Wolfe Creek crater (which is called *Kandimalal* in the Jaru language) by a noted Jaru artist. We have received positive feedback about the display from visitors.

The installation of extensive Western heritage and Aboriginal exhibits in 1997 marked the beginning of a trend of increasing visitor attendance to Sydney Observatory (Figure 2). This increase has, for the most part, been steadily con-

tinuing ever since. There is no evidence to suggest one part of the Sydney Observatory experience is more visited than another. As it is a small building, visitors tend to see a majority of the exhibits. The *Cadi Eora Birrung* exhibit is referenced in tourism guides (Atkinson, 2012) and on the City of Sydney's self-guided walking tour and website (Aboriginal Cultural Attractions, 2014). On average, tourists account for 42% of the visitors to Sydney Observatory.

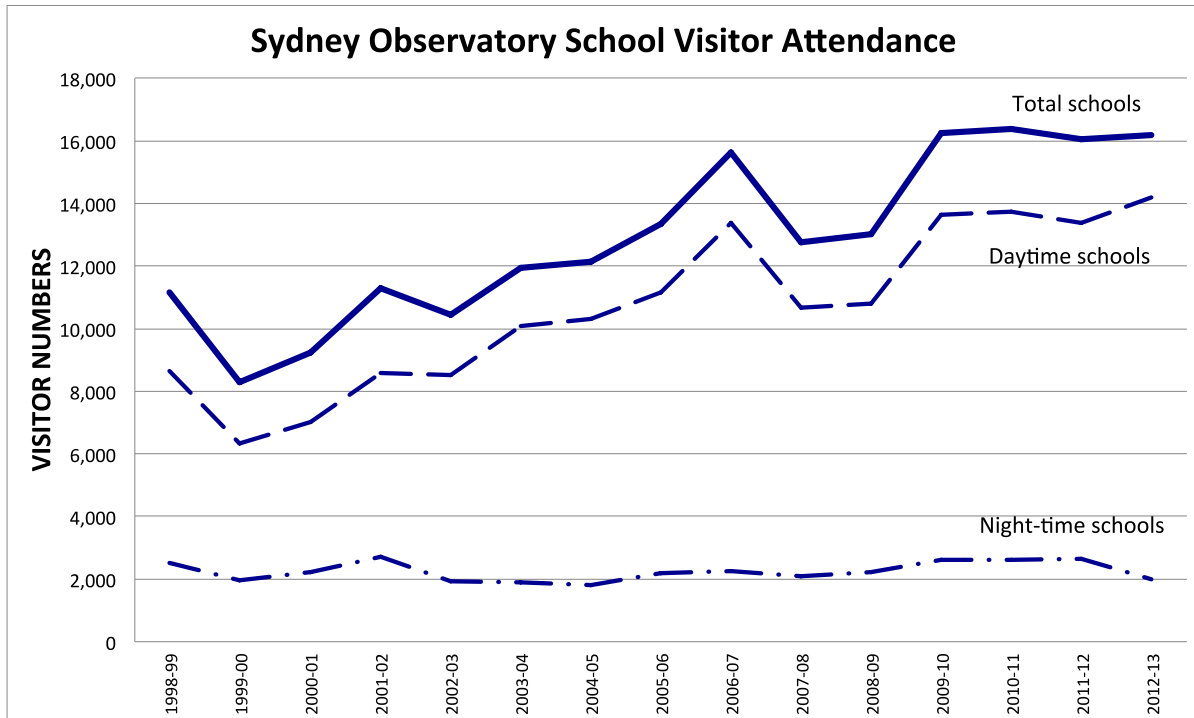


Figure 1: Education visits to Sydney Observatory between 1998 and 2013.

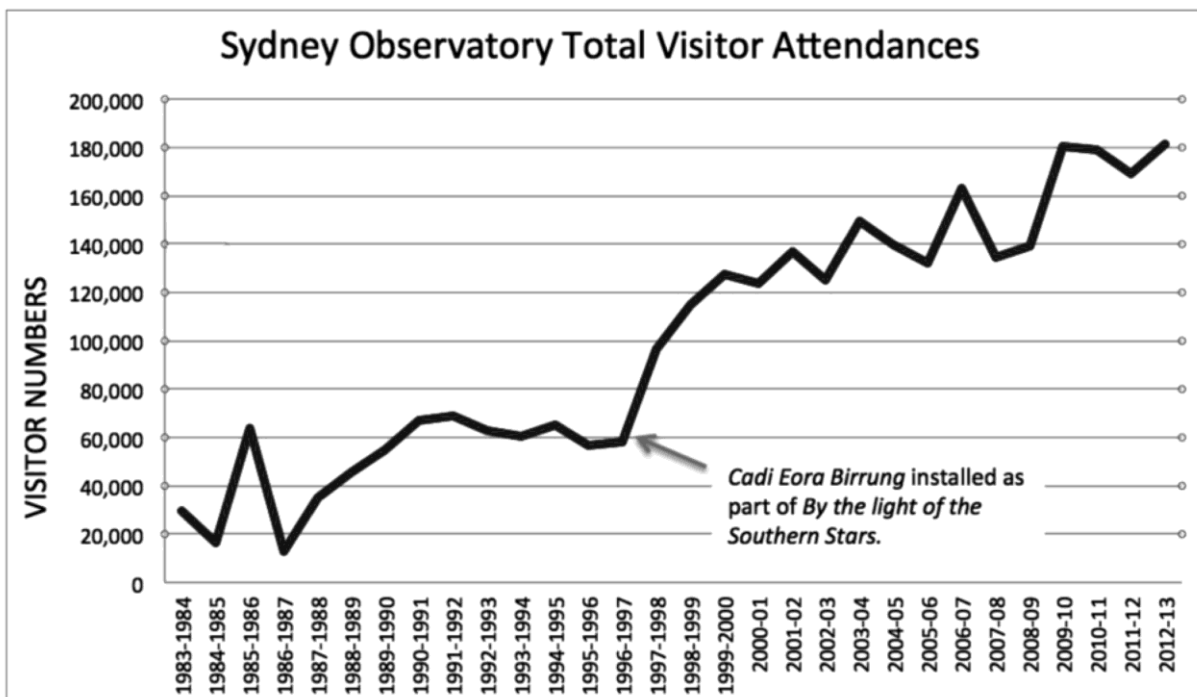


Figure 2: Thirty years of visitor attendances at Sydney Observatory showing the impact of the 'By the Light of the Southern Stars' exhibition and 'Cadi Eora Birrung'.

### 3 PROGRAM DEVELOPMENT

The development of the new Australian Curriculum (ACARA, 2013), guided by the Melbourne Declaration on Educational Goals for Young Australians in 2008,<sup>4</sup> stressed the importance of a cross-curriculum priority on Aboriginal histories and culture. This is the primary motivation for developing an Aboriginal astronomy program, along with educating the general public about the complexity of Australian Indigenous astronomical knowledge systems.

The *Interactive Experience Model* (Falk and Dierking, 1992), where the personal, social and physical intersect, is a dynamic way for museums to achieve successful learning experiences for school children using their unique attributes outside the school environment. Sydney Observatory has adopted this hands-on approach as central to all of its education programs (Lomb and Stevenson, 2008). With an Indigenous astronomy program, our aim is to achieve what Canadian astronomy educator, John Percy, calls 'minds-on' education.

Percy (2008: 20) considers methods used by ancient cultures as an ideal way of engaging students in the 'big picture' concepts of astronomy:

The first people to 'do astronomy' were the pre-technological cultures who were able to determine time, date, and direction from the sky. They made and recorded observations, archived and used them ... one could argue that these simple observations are the most relevant kinds for most students to make.

This way of thinking made it possible to tie the cultural aspects of Aboriginal astronomy and the scientific approach of astrophysics and cosmology together with a common thread of observation, recording and analysis.

Originally titled *Shared Sky*, and later renamed *Dreamtime Astronomy*, the program highlights the diverse astronomies of Aboriginal people and explores the ways in which they used the stars for navigation, seasonal calendars, food economics, ceremonies and social structure. The framework of Aboriginal cultures, including their beliefs, spirituality, laws and oral traditions is called the *Dreaming*, or *Dreamtime*. It can be viewed as a period in the distant past when ancestors created the land, sky, animals and plants. It can also represent a present or a future reality in which people interact with ancestor spirits (Isaacs, 1980). The *Dreamtime* contains information regarding the daily practices, social structure and knowledge of the community. The *Dreamtime* is synonymous with 'Traditional Knowledge' but is unique to Australian Aboriginal cultures. This is the reasoning behind naming the program *Dreamtime Astronomy*.

A majority of the Aboriginal content for this program was based upon the ethnographic work of William E. Stanbridge, who published a paper on the astronomical traditions he learnt from the Boorong clan of the Wergaia language group in northwestern Victoria in the mid-eighteenth century (Stanbridge, 1861). This was chosen because it represents the earliest comprehensive description of Aboriginal astronomy and is one of the most studied Aboriginal views of the night sky (Hamacher and Frew, 2010; Morison, 1996).

To implement the program, we needed to determine how to make Aboriginal content relevant and memorable to students who typically had never been exposed to Aboriginal astronomy prior to their visit to Sydney Observatory. We designed three activities to accomplish this.

### 4 PROGRAM IMPLEMENTATION

The *Dreamtime Astronomy* program, like most tours at the Observatory, lasts for 1.5 hours and involves three activities, each taking 30 minutes.

#### 4.1 Activity 1: Using *Stellarium*

In this activity, students use modern technologies familiar to them, including computers, tablets and smart phones, to use interactive astronomy apps and software packages such as *Stellarium*.<sup>5</sup> *Stellarium* allows the user to simulate the sky on their device. This is particularly important as students can set the view to the night of their visit to the Observatory.

The positions of the planets and Moon along the ecliptic are used to highlight students' existing 'latent' knowledge of constellations, which is typically limited to those of the Zodiac. The software allows students to learn to use the stars to tell time and find direction. This will provide them with a fundamental understanding of how the sky works and give them a chance to play with the software, by seeing for example what objects were in the sky the night they were born.

#### 4.2 Activity 2: Making a Planisphere

The second activity has students make a planisphere<sup>6</sup> (Figure 3) that they can take home. The planisphere includes two discs: the first shows Western names of celestial objects. It is used to help the students determine what stars are in the sky throughout the night at various times of the year; find directions; and tell time. Having explored their knowledge of constellations that relate to Greek mythology, the students replace the inner star-wheel with the second disc, which shows Boorong names of celestial objects. This is accompanied by a small pamphlet containing information about Boorong astronomy, and is red, black and yellow to reflect the colours of the Aboriginal flag.

With the aid of an Indigenous language map of Australia, students are made aware of the diverse range of Aboriginal cultures and astronomies across the continent, with emphasis on the lack of a single Aboriginal 'astronomy' or viewpoint.

Faint half-tone representations of the Southern Cross, Scorpius and Orion are included on

the Boorong star-wheel as a reference (Figure 4). These familiar constellations permit students to draw observational correlations between what they already know and what they are learning. Boorong stories that go with the stars are recited and projected on an interactive whiteboard. Problem-solving activities are presented to the students, such as identifying which Boorong stars

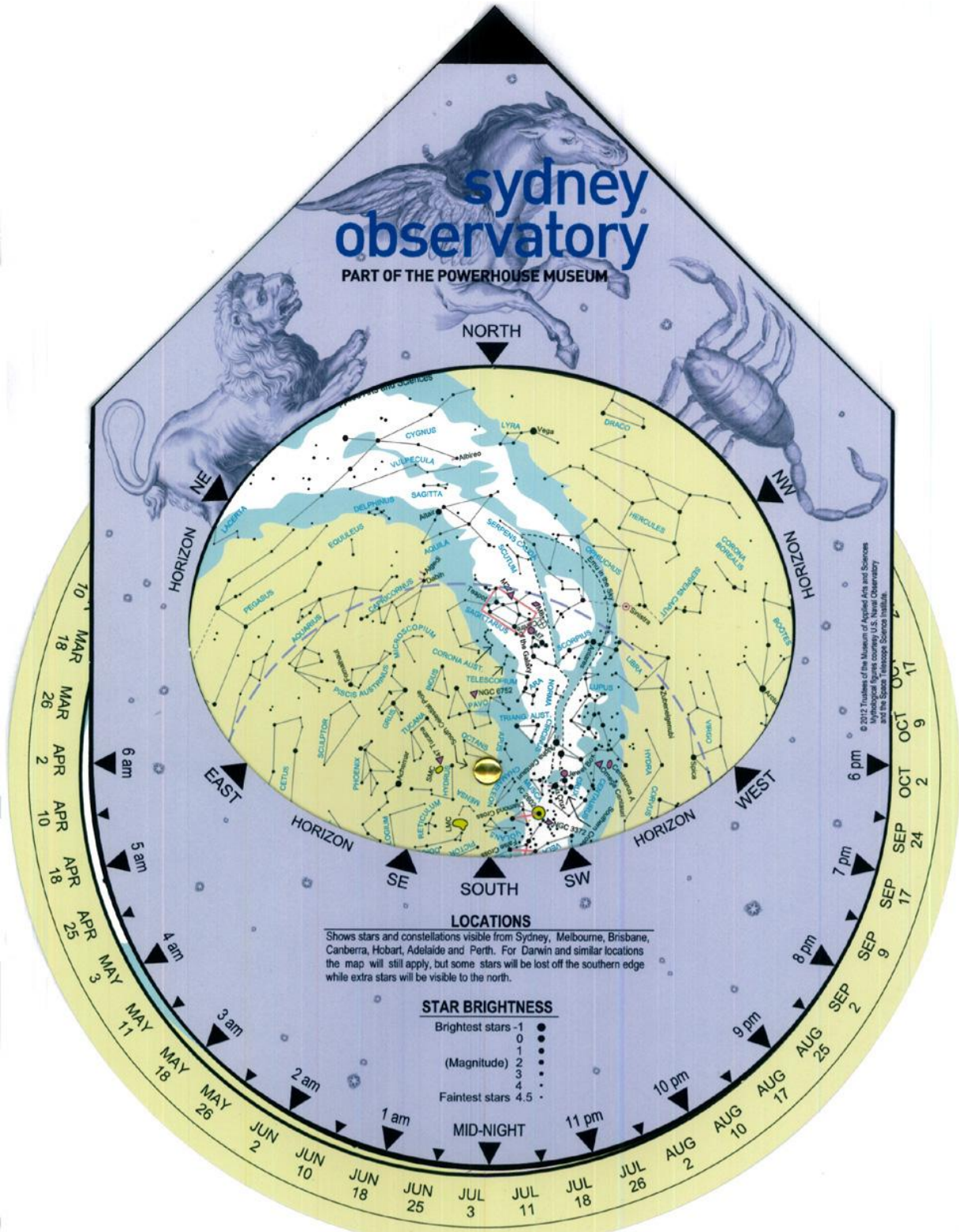


Figure 3: A 'Western' planisphere, developed by Dr Martin Anderson.





Figure 5: The 2008 flag mast recreation by the Bruce and Joy Reid Foundation (photograph: Geoffrey Wyatt).

It was this idea about signals and message sticks that was used to develop the third (although not entirely astronomical) component of the program. After consultation with staff at the Australian Museum in 2011, the more neutral term 'signal stick' was used, as message sticks sometimes contained information that was gender sensitive (e.g. 'Men's business' or 'Women's business', such as initiation ceremonies). A brief history of signal sticks is presented to the students, with a two-fold intention:

- (1) To show their analogous connection to modern passports; and
- (2) To show that they represent a complex form

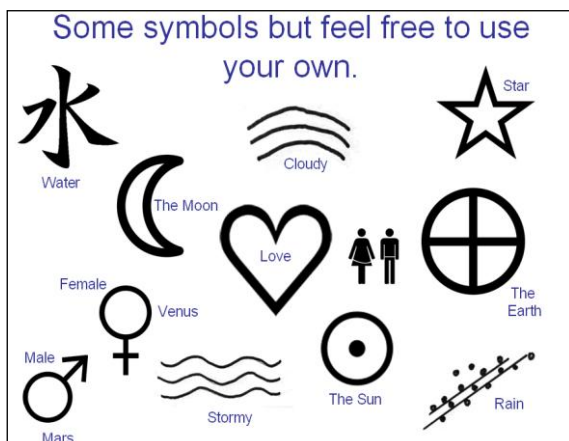


Figure 6: Sample of multi-cultural symbols (image: Geoffrey Wyatt).

of non-verbal communication, comparable to Fort Phillip's flag mast.

To inspire the students and serve as a visual prompt, a sample of symbols from various cultures is projected during this section of the tour. The symbols used were taken from Aboriginal, Asian and Middle Eastern cultures, but also included commonly-used symbols such as those for stars, the heart, males and females, and the astronomical symbols for Mars and Venus (see Figure 6).

Students were then given the opportunity to create a signal stick to take home (Figure 7). Each student could decorate their signal stick with symbols that would mean something to them or their immediate circle of friends and family. It could be of any design, and it would not need to be intelligible to anyone other than the intended recipient(s).

## 5 PROGRAM EVALUATION

In 2013 the program was tested with a sample of four schools with students ranging from Year 2 to Year 4 (aged 7 to 10). Teachers were asked to provide feedback, and it was predominantly positive. The use of modern technologies, such as computers, tablets and smart phones, was well received and the students enjoyed learning with *Stellarium*.

There were, however, a few major points of criticism from the teachers, the students and the guides:

- (1) The planisphere could be improved by using local Aboriginal astronomical content (for the Sydney region) rather than content from western Victoria or other parts of Australia.
- (2) Students were disappointed that they did not get to use the planetarium.
- (3) The signal sticks were an enjoyable activity, but were the least relevant to an experience at Sydney Observatory.
- (4) The students were extremely disappointed that they did not get to look through a telescope.
- (5) Indigenous guides delivering the content would improve the program.

This feedback enabled us to modify and improve *Dreamtime Astronomy*.

## 6 PROGRAM MODIFICATIONS

### 6.1 Modified Activity 1

Students and teachers found Activity 1 (using *Stellarium*) to be educational, enjoyable and engaging. But we decided to combine it with Activity 2 (making a planisphere), as they complemented each other. We also decided to replace the Boorong astronomy content in the

planispheres with Sydney Aboriginal astronomy content. Unfortunately, little has been published on Aboriginal astronomy in the Sydney region, so we developed a partnership between the Observatory and the Nura Gili Indigenous Programs Unit at the University of New South Wales (UNSW) to address this issue.

The UNSW partnership involves a co-author of this paper (Hamacher), who is an academic at Nura Gili and works casually at the Observatory as an astronomy educator. Hamacher teaches an undergraduate unit called *ATSI 3006: Astronomy of Indigenous Australians*. A major assessment for students enrolled in the course is to research an area of Australian Indigenous astronomical knowledge and develop educational materials utilising that research. Students in *ATSI 3006* will research Aboriginal astronomical traditions in the Sydney region and develop a planisphere based on these findings. Preliminary findings have already revealed a number of Aboriginal stories of the sky from the Sydney region, including those of the Dharug, Dharawal, Gundungurra, and Kuringai peoples. This content will be incorporated into the *Dreamtime Astronomy* program in mid-2014.

We also realised the pamphlet containing Aboriginal astronomical information was not ideal for the students, as most were left behind. But the students valued the planispheres and kept these. When each student completes the planisphere, the guides show them how to use it. The guides then demonstrate the connection between the rising or setting times of stars and their connection to seasonal cycles using *Stellarium*. The students are given a short demonstration and shown how to download the program to their devices. The pamphlet was discontinued and instead the information will be presented on a webpage from mid-2014.

## 6.2 Modified Activity 2

We determined that the low astronomical significance of the signal stick activity did not reflect an ideal approach to teaching the students about Aboriginal astronomy. Additionally, the sticks did not serve a useful purpose once the students left the Observatory. In fact, many were left behind. The students' biggest expectation was to look through the telescopes at the Observatory, and they were extremely disappointed that the program did not include this. This came as no surprise as Observatory staff are anecdotally aware that all visitors, regardless of the program, have a strong desire to look through the telescopes in the domes.

We therefore replaced the signal stick activity with telescope viewing in one of the domes. Day-time programs involve students viewing the

Sun through a solar telescope. This enables staff to draw attention to the astronomical significance of the solar symbol in the Aboriginal flag while the students observe sunspots and prominences and learn about the physical structure of the Sun.

For night-time programs, students view astronomical objects of significance to Aboriginal people. These may include the Moon, planets, stars and star clusters. This gives the guides a chance to discuss the Aboriginal and scientific significance of these objects. One aspect relates to the colour of stars. The colour of a star can tell astronomers about its surface temperature and age, but in many Aboriginal cultures colours of stars might signify an association with a particular animal or plant. For example, in the Western Desert the red star Antares in Scorpius was associated with the red-tailed black cockatoo. When Antares rises at dusk in May it



Figure 7: Making signal sticks (photograph: Geoffrey Wyatt).

reminds Aboriginal people that the first clutches of eggs will begin hatching (Hamacher and Leaman, 2014). On cloudy nights (and days), when telescope-viewing is not possible, the planetarium session is extended and students are guided through the Aboriginal astronomy exhibits in the Observatory.

## 6.3 Modified Activity 3

In response to the student's disappointment that they did not get to use the planetarium, we developed a new activity that incorporates use of the planetarium and emphasizes some of the relevant local history.

The earliest information we have about Aboriginal astronomy was recorded by Lieutenant William Dawes, the astronomer on the First Fleet that arrived in Sydney in 1788. He founded the first observatory in Australia on the shores of the harbour at the place now called Dawes Point, which lies at the southern base of the Sydney Harbour Bridge (see Laurie, 1988; Orchiston, 1989). During the short time he lived

in the colony, he befriended a young Aboriginal woman named Patyegarang who taught him the local language and customs. He kept detailed journals, which contain local Dharug names for the Sun, Moon, Milky Way and Magellanic Clouds (Dawes, 1788-1791).

The new activity involves giving each student a worksheet that incorporates Sydney Aboriginal astronomy and the interactions between Dawes and Patyegarang. Aboriginal names of astronomical objects are written on the worksheet for the students to learn and use. They are then taken into the planetarium, where they experience Sydney's twenty-first century light-polluted sky. As the guides share Aboriginal stories of the sky, the planetarium is set to 1788 conditions, enabling the Milky Way to be seen clearly as Dawes and Patyegarang would have seen it. This gives the students an opportunity to learn by experience, just as Dawes did. Additionally, the simulated night sky on the planetarium dome displays other visual cues, including images of animals, plants and Aboriginal ancestors important to the story.

#### 6.4 Other Implementations and Feedback

It was deemed important for the Observatory to have the program delivered by Aboriginal guides so that the students get a more appropriate experience. This also promotes Indigenous involvement in the program. Consequently, in January 2014 the Observatory hired Aboriginal guides to present the *Dreamtime Astronomy* program.<sup>8</sup>

Australia contains two different Indigenous peoples: the Aborigines and the (Melanesian) Torres Strait Islanders. Our current programs only focus on Aboriginal astronomy. There has been little research on the astronomy of the Torres Strait Islanders, but related research does show that Islander culture contains a significant degree of astronomical knowledge (e.g. see Sharp, 2003). A major grant to study Torres Strait Islander astronomy was recently awarded by the Australian Research Council (Hamacher, 2014), and in the future information about Islander astronomy will be incorporated into the *Dreamtime Astronomy* program at Sydney Observatory in order to present a more comprehensive account of Indigenous Australian astronomy.

The modified program, which will not include Sydney Aboriginal content until mid-2014, has recently been trialled during evening public tours, and feedback in the form of ratings on a social media website (Trip Advisor, 01 April 2014)<sup>9</sup> indicate its success. The following is typical of the comments recorded:

Got there early and toured museum. Very well done. Willy gave us stories from his people

about the stars. Interesting, educational and fun. Recommend it.

Ever since it developed an Aboriginal astronomy program, Sydney Observatory has been listed on the 'Portal to the Heritage of Astronomy' website developed by UNESCO and the International Astronomical Union as part of the Astronomy and World Heritage Initiative (Ruggles and Cotte, 2010). This listing provides staff at the Observatory with further incentive to project astronomy as a science with cultural and heritage dimensions.

#### 7 CONCLUDING REMARKS

Astronomy education at Sydney Observatory has enjoyed growth and strong visitation over many years whilst operating as an astronomical museum and adopting an Interactive Experience Model for its learning programs. New cross-curriculum opportunities have inspired activity-rich experiences in Aboriginal astronomy. The *Dreamtime Astronomy* program will provide students and their teachers with an opportunity to visit and engage in the history and heritage of Sydney Observatory and Sydney Aboriginal astronomy. The ambition is to achieve a 'minds-on' experience for students, which engages them in astronomy through a cultural experience. Further evaluation will continue to guide the development and modification of the program and its delivery.

For more than 150 years Sydney Observatory acted as a portal for European-based science, but it now also provides visitors, and especially school students, with an opportunity learn about and experience the astronomical knowledge and traditions of Australia's Indigenous peoples.

#### 8 NOTES

1. Aboriginal Nations created the Dreamtime cartoons, and the Powerhouse Museum especially filmed Aboriginal actors to introduce these in a 'fireside' setting. <http://www.thedreamingstories.com.au/>. The display was curated by Nick Lomb and James Wilson-Miller.
2. The display was developed by Kathy La Fontaine.
3. The exhibit was curated by Duane Hamacher and Katrina Sealy.
4. Ministerial Council on Education Employment Training and Youth Affairs: [http://www.curriculum.edu.au/verve/\\_resources/National\\_Declaration\\_on\\_the\\_Educational\\_Goals\\_for\\_Young\\_Australians.pdf](http://www.curriculum.edu.au/verve/_resources/National_Declaration_on_the_Educational_Goals_for_Young_Australians.pdf)
5. <http://stellarium.org/>
6. The planisphere was designed by Martin Anderson.
7. A re-creation of the flag masts was devel-



- oped in 2008 through the generosity of the Bruce and Joy Reid Foundation.
8. William 'Willy' Stevens is the first Aboriginal guide to present *Dreamtime Astronomy*.
  9. Pdm267, posted 1 April 2014, 'Dream makers tour', Trip Adviser, [http://www.tripadvisor.com.au/ShowUserReviews-g255060-d256722-r199493592-Sydney\\_Observatory-Sydney\\_New\\_South\\_Wales.html#UR199493592](http://www.tripadvisor.com.au/ShowUserReviews-g255060-d256722-r199493592-Sydney_Observatory-Sydney_New_South_Wales.html#UR199493592)

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