

THE *ILGARIJIRI* PROJECT: A COLLABORATION BETWEEN ABORIGINAL COMMUNITIES AND RADIO ASTRONOMERS IN THE MURCHISON REGION OF WESTERN AUSTRALIA

John Goldsmith

International Centre for Radio Astronomy Research, Curtin University,
Western Australia, GPO Box U1987, Perth, WA 6845, Australia.

Email: John.Goldsmith.MSc@gmail.com

Abstract: The international radio astronomy initiative known as the Square Kilometre Array is a cutting-edge science project, aimed at dramatically expanding our vision and understanding of the Universe. The \$2billion+ international project is being shared between Southern Africa and Australia. The Australian component, centred in the Murchison region of Western Australia, is based upon collaboration with Aboriginal communities. A collaborative project called “*Ilgarijiri - Things Belonging to the Sky*” shared scientific and Aboriginal knowledge of the night sky. Through a series of collaborative meetings and knowledge sharing, the *Ilgarijiri* project developed and showcased Aboriginal knowledge of the night sky, via an international touring Aboriginal art exhibition, in Australia, South Africa, the USA and Europe. The Aboriginal art exhibition presents Aboriginal stories relating to the night sky, which prominently feature the ‘Seven Sisters’ and the ‘Emu’, as well as the collaborative experience with radio astronomers. The success of the *Ilgarijiri* collaborative project is based upon several principles, which can help to inform and guide future cultural collaborative projects.

Note to the reader: Readers are respectfully advised that the following contains the image and name of an Aboriginal person who has passed away.

Keywords: *Ilgarijiri*, cultural astronomy, Aboriginal art, Aboriginal astronomy, radio astronomy, ASKAP, SKA, Yamatji, Murchison region, Western Australia

1 INTRODUCTION

Ilgarijiri is the Wajarri Yamatji Aboriginal word meaning “Things Belonging to the Sky”. With the development and operation of major radio astronomy facilities in the Murchison region of Western Australia (WA), an opportunity was recognised to collaborate with the local Wajarri and Yamatji people and share scientific astronomical knowledge and Aboriginal knowledge of the night sky. This proactive approach has benefitted Aboriginal communities associated with the radio astronomy facilities. This collaboration resulted in an international touring Aboriginal

art exhibition that inspired and informed the ‘Cosmos, Culture and Landscape Project’ (CCLP), which examines the sharing and communication of Aboriginal astronomical knowledge. This paper presents findings in relation to the *Ilgarijiri* collaboration.

1.1 Radio Astronomy in the Murchison Region

The major radio astronomy facilities in the Murchison region of WA are the Murchison Widefield Array (MWA) (Figure 1) and the Australian Square Kilometre Array Pathfinder (ASKAP) pro-

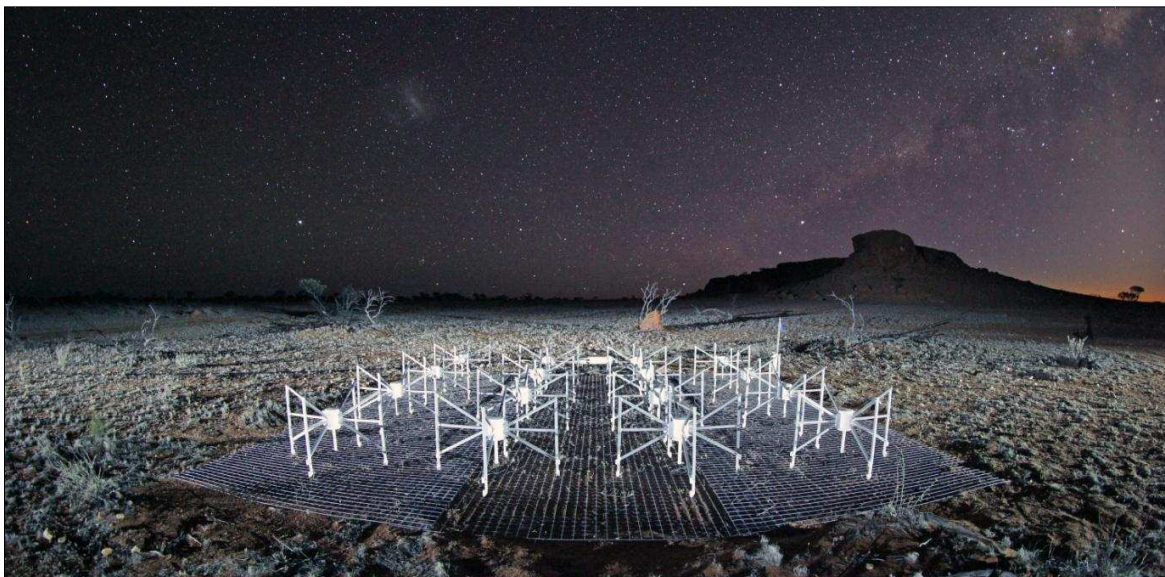


Figure 1: The Murchison Widefield Array and Southern Sky (photograph: John Goldsmith).

ject, both of which are technology demonstrators for the Square Kilometre Array (SKA) radio telescope. The entire project is shared between Southern Africa and Australia/New Zealand. The MWA, ASKAP and SKA are described by Lonsdale et al. (2009), Johnston et al. (2007) and Dewdney et al. (2009), respectively. In WA, the Murchison region was selected after an extensive international search for a location where artificial radio noise interference was minimal. In addition, the region exhibits dark skies.

2 HYPOTHESIS AND OBJECTIVE

This paper examines the hypothesis that collaborative, cross-cultural projects can act as an important catalyst in encouraging the appreciation and respect of Aboriginal and scientific astronomical knowledge. This hypothesis is supported by a research objective, which is to collaborate with Aboriginal people to document and communicate, in a culturally-appropriate manner, contemporary Indigenous astronomical knowledge.



Figure 2: Professor Steven Tingay and Wajarri Elder Teddo Ryan (photograph: Dr Megan Argo, ICRAR).

3 METHODOLOGIES

Research methodologies for the CCLP used a variety of data-collection methods, including site visits, video-based interviews and 360° digital site photography. The selection of interviewees and general coordination was facilitated by Yamaji Art in Geraldton, WA, and members from Marra Arts in Mullewa, WA. The face-to-face interviews were video recorded, with the permission of the interviewees. Interviewees include Yamaji artists Barbara Merritt, Margaret Whitehurst, Olive Boddington (deceased), Kevin Merritt and the then Yamaji Art Coordinator Charmaine Green. Mullewa artists included Wendy Jackamarra, Christine Collard, Debra Maher, Susan Merry and Barbara Comeagain. Radio astronomer Dr Megan Argo (then based at the International Centre for Radio Astronomy Research—ICRAR—in Perth) was also interviewed. Interviews were transcribed, and selected quotes are presented in Section 6.1 below. In

addition to the video interviews, site photography was conducted at the Murchison Wide-field Array radio telescope, based on 360° imaging techniques, as described in Goldsmith (2011). These images were then processed using Autopano Giga software to create 360° images of the radio telescope site.

4 THE *ILGARIJIRI* COLLABORATION AND KNOWLEDGE SHARING

Ilgarijiri is a collaborative project between radio astronomers and Aboriginal communities, aimed at sharing scientific and Aboriginal knowledge of the night sky. The project was facilitated by interactions between radio astronomers and Aboriginal communities in the Murchison, and developed concurrently with Australia's bid for the Square Kilometre Array (SKA). In this bid, the SKA was envisaged as a radio telescope consisting of thousands of small antennas spread across Australia and New Zealand with a combined collecting area of one square kilometre. This innovative array would be used by astrophysicists to try to better understand the fundamental structure and evolution of the Universe (Tingay et al., 2013).

The Commonwealth Scientific and Industrial Research organisation (CSIRO) developed a public outreach project called "Wildflowers in the Sky" (Drok, 2009/2010), which helped to place optical telescopes in various schools in the Murchison Region, including some remote schools. This public outreach work was complemented by the work of CSIRO Liaison Officer Robin Boddington, who facilitated discussions between Aboriginal communities and radio astronomers.

Recognising opportunities for collaboration, Professor Steven Tingay (ICRAR) began discussions with Yamaji Art to share scientific and Aboriginal perspectives of the night sky (Tingay, 2011). Aboriginal Elder Teddo Ryan and Professor Tingay visited sites in the Murchison Region, including Boolardy Station (Figure 2). As the concept of the *Ilgarijiri* project developed, Yamaji Art took a leading role in working with Aboriginal artists, in collaboration with Marra Arts, Mullewa. The project was conducted under Aboriginal leadership and direction, by Yamaji Art, which facilitated the day-to-day management of artists involved in the collaboration, provided logistical support for site visits, supported artists during the development of artwork, and managed aspects of the exhibition, including the sale of artworks. Artwork sales directly benefitted the artists financially. Thirty Aboriginal Elders and artists were involved in the collaboration, with members from both Yamaji Art and Marra Arts.

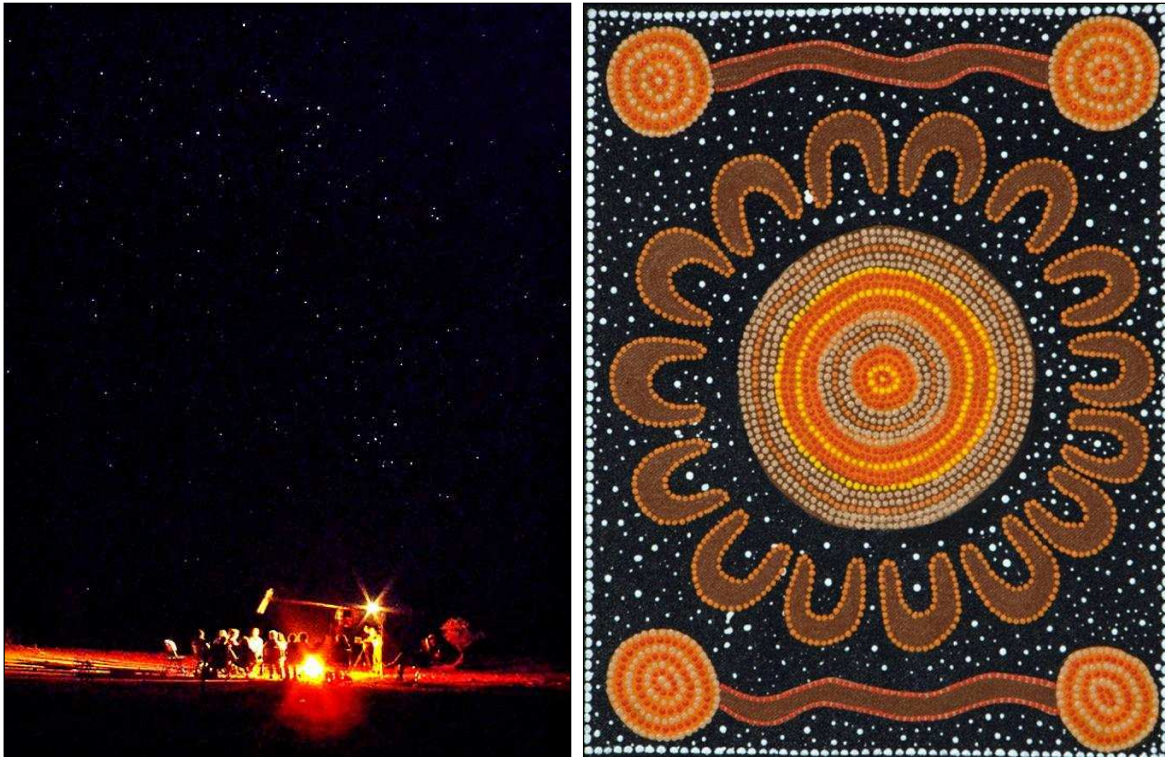


Figure 3: Two views of *Ilgarijiri* campfire discussions in the Murchison (photograph: Dr Megan Argo (ICRAR); painting: Wendy Jackamarra (Yamaji Art)).

ICRAR radio astronomers involved in the Murchison Widefield Array were brought in as part of the collaboration (Brophy, 2009; Drok, 2009/2010).

Elders, artists and radio astronomers met at Boolardy Station to share their knowledge. After talking around a campfire at night, the group then used telescopes to view a variety of celestial objects, including Saturn and the Jewel Box star cluster, both of which made a considerable impression on the artists. This 'on Country' meeting proved to be a very successful way of opening and developing discussions about the night sky between people who had very different astronomical backgrounds and experiences. The campfire encounter and discussion was filmed as part of the ABC TV's 'Message Stick' series in an episode called "Before Galileo" (ABC, 2009). Two different representations of this meeting are shown in Figure 3.

Inspired by the 'on Country' meeting, *Ilgarijiri* artists then proceeded to create artworks, based on their experiences with the radio astronomers, their impressions of the 'deep space' objects seen through the telescopes, and the shared stories about the night sky. Approximately 30 artists created more than 80 works, and the exhibition has developed over time, with new works created to replace artworks sold during exhibitions. The catalogue of the *Ilgarijiri* exhibition is available online.¹

5 *ILGARIJIRI* EXHIBITIONS

Coinciding with the International Year of Astronomy in 2009 (Russo and Lindberg, 2010), the first *Ilgarijiri* exhibition was at Geraldton, followed by Curtin University in Perth (Figure 4). *Ilgarijiri* featured prominently at the first national symposium on Aboriginal astronomy, which was held at the Australian Institute of Aboriginal and Torres Strait Islander Studies in Canberra in November 2009 (AIATSIS, 2011; Norris, 2010; Tingay, 2011). The exhibition had its first international showing in Cape Town, South Africa, where it featured at the Communicating Astronomy with the Public conference in 2010 (Figure 5). The next tour was to the USA, to Washington, D.C., in 2011, followed by a tour through the Netherlands, Belgium and Germany in early 2012.



Figure 4: Teddo Ryan (left) and Kevin Merritt (right) at the 2009 Curtin University *Ilgarijiri* exhibition (photograph: John Goldsmith).



Figure 5: *Ilgarijiri* at Cape Town, with Communicating Astronomy with the Public 2010 (photograph: John Goldsmith).

6 RESULTS AND OUTCOMES

The results of the research are presented here, including the interviews with *Ilgarijiri* participants, astronomical themes expressed in the *Ilgarijiri* project, and the creation of new resources, including an exhibition video and virtual tour.

6.1 Interviews With *Ilgarijiri* Artists and Elders

The video-based interviews with the *Ilgarijiri* artists (Figure 6) provided considerable insight into the experience of the various participants in the *Ilgarijiri* collaboration.

The process of developing the *Ilgarijiri* project occurred over an extended period of time so that a number of issues could be carefully considered by Yamaji Art and the participants. Charmaine Green comments:

Well, anything with the sky is sort of culturally problematic and it took the committee at least eight months to even say yeh, we will go there. It took them a long time sitting in with the board, throwing it back and forth. Shall we do this? Are we doing the right thing? Are we going to get in trouble? What sort of stories? But then the positive side of it out-weighed that because there is not enough a lot of opportunities to tell stories to the wider public, and not enough opportunities to tell stories to our kids or our community ... People knew their boundaries. They knew that there is stories connected to the sky that they can't tell, and they won't tell.

CSIRO Aboriginal Liaison Officer Robin Boddington noted gender restrictions in relation to some Aboriginal sky knowledge:

... from a woman's point of view, we can't talk

about the stars and all that. I could give you the Aboriginal names, but I can't, because it's all related to men's law. Seven Sisters dreaming story and the Milky Way and the Emu, we could tell you that one, but I don't know how much the men could tell you. I can't speak for that ...

The initial responses by Aboriginal artists to the *Ilgarijiri* project were in general enthusiastic and very positive, as Kevin Merritt recounts:

... when I first heard about it, I thought it was a really great thing for the artists in this region to be able to put on canvas stories that they've learnt and heard from the old people ... while we are growing. To be able to display to the world as it is, you know, the stories of the stars, I thought that was really great.

However, one artist, Margaret Whitehurst, initially expressed scepticism and doubt, which subsequently developed into a very positive and affirming attitude:

... well, when I first started I thought, oh, well nah ... it was going to be boring. Nah ... I haven't got much stories of the sky. When they first approached us and said that we are going to do these stories about the sky, look I don't know much about stories in the sky. All I knew was about this Emu in the sky and (the Yamaji Art Centre staff) said: "You go out and you look at the sky and will see." So we did, and we went out and I just couldn't believe all the things that we saw in the sky, you know. I didn't even know even half of the things that was in the sky, because we didn't look for them things. All we did was look for the Seven Sisters, and the pot in the sky, what they used to tell us. The Seven Sisters, the Emu in sky, that was it. I didn't know any more, till I saw the ones in the sky.



Figure 6: *Ilgarijiri* interviewees (montage image: John Goldsmith).

During the development of the *Ilgarijiri* project, radio astronomer Dr Megan Argo (then based at ICRAR in Perth), participated in site visits to the Murchison region and Boolardy Station. Her astronomy outreach activities provided information about the SKA project to communities in the Murchison region, including remote Aboriginal communities. As she explained:

... it's important to go out there and talk to the communities that are there, so that they have an understanding what is happening (in relation to the Square Kilometre Array).

So the first trip I took up there was with Steven Tingay and Rob Hollow and Mary Mul-

cave from CSIRO, and it was part of the 'Wild-flowers in the Sky' project which was a CSIRO initiative, that provided a whole bunch of ... schools in the region with their own telescopes. They had 8-inch Dobsonian telescopes that they could use to look at the sky.

... and we've visited quite a lot of schools in the region, including the remote schools such as ... Pia Wajarri which is the closest one to Boolardy Station, where ASKAP is ... So we've done quite a few visits to Pia Wajarri. Actually, we've done viewing nights; we've done class room activities; we've done model Solar Systems; we've had kids running around the school yard pretending to be planets and

comets, crashing in to each other; we've done water rockets, and things like that as well. There's quite a variety of things that we've done in the region with the schools.

As the *Ilgarijiri* project developed further, a visit back to country was organised for Aboriginal artists, Elders and radio astronomers (including Professor Tingay) at Boolardy Station. This visit included an opportunity to view the night sky together with radio astronomers, to share stories, to listen to scientific views about the night sky and to use telescopes to observe 'deep space' objects. The appreciation of knowledge shared by radio astronomers is evident in the following quotes from Margaret Whitehurst, Wendy Jackamarra and Barbara Merritt respectively:

... and Mr Tingay showed us a lot of other things that he saw, that we can see up in the sky and what we never seen before. That's where I saw a lot in the sky that night. I can't remember all the names but, because they were, some of them weren't Australian, so. But really enjoyed Boolardy. A good trip. It was wonderful out there, yeh.

... (sitting) by the camp fire ... and Steve (Tingay) showed us with his laser, pointed all the different things in the sky to us, things that we didn't know were there.

... so, we had that opportunity for like, specialists, scientists, to give us more information on it. It was really good ...

Several of the artists commented on the Boolardy Station visit, and particularly the experience of interacting with the radio astronomers and sharing knowledge about the sky. For example, Kevin Merritt said:

I thought that was very positive, because we were able to relate our stories ... They were able to show close-up views of the constellations that we looked at over our life. We could see that even though we thought it was just a star, it was another constellation, you know. It just blows your mind away ...

To be able to have their (the astronomers) expertise tell us about all these things, and I think some of the older people learnt a great deal more than what they knew before, about the stars and the constellations, about where we fit in, our own little world, where we fit in this great cosmos we live in.

The experience of pointing out and recognising the Emu sky pattern drew Aboriginal and non-Aboriginal people together, and the impact of sharing this knowledge is clearly evident in the following comments by Margaret Whitehurst:

... and that night when we went home, back to the station, sat around a big campfire and we told stories, and we even pointed out the sky. They saw the emu in the sky that night. We pointed it out up in the sky, and the non-

indigenous people ... got so excited when they saw the emu in the sky. Yeh, they really ... couldn't believe it ... We'll show you the emu in the sky when it gets dark and we showed it to them ... they just couldn't believe it because we saw it plain as thing out there at Boolardy.

The use of telescopes to examine and observe 'deep space' objects was greatly valued, and for some, it was their first time looking through a telescope. Some objects, such as the Jewel Box star cluster, attracted a great deal of attention in terms of the colours of the stars, as described below by Barbara Merritt:

That's just amazing thing, sparkling pretty colours, so that's the first painting I drew, was the Jewellery Box [sic.], and that got sold very quickly ... it made a big impression alright ... As women, like, these are the things that we talk about, and do. Well, I do beading and things in my spare time and jewellery is in our lives, every day and then to see the Jewellery Box, ahh ...

The experience of observing the night sky using telescopes, and the sharing of Aboriginal and scientific knowledge of the night sky led to a shared experience that strongly inspired the participants. This experience provided a strong basis for the subsequent work by *Ilgarijiri* artists, such as the enthusiastic representation of the Jewel Box star cluster in the exhibition.

The artists also commented on the experience of creating artworks for the *Ilgarijiri* exhibition. As Barbara Merritt emphasized, the retelling of stories was a strong positive experience:

I think that they really felt like that they were in that painting because of the stories. And like, they were really glad that these stories have come out and so that everyone can learn about these stories about, you know, from our own culture, and the people, and that. Because we still have really cultural people, they're close, and we meet up with them, and talk with them, and they are really glad and happy about it and like to tell you more stories about it.

The artists experienced a wide range of positive benefits arising from the *Ilgarijiri* project, including intergenerational sharing of knowledge. Charmaine Green had this to say:

... there's the encouragement of artists, getting artists to come out of their shell and tell stories. It could be stories connected to the sky, or could be stories that are actually in the sky, or leaping from the sky onto the ground so that the activities we do because of something that happens in the sky. The artists just become really more confident, in saying yeh ... well I do have a story to tell, and I want to tell it via painting ... So there is those benefits ... You know, building our culture and getting the stories out there, and also that intergenerational type flow there as well with maybe Barbara and Margaret including their grand-

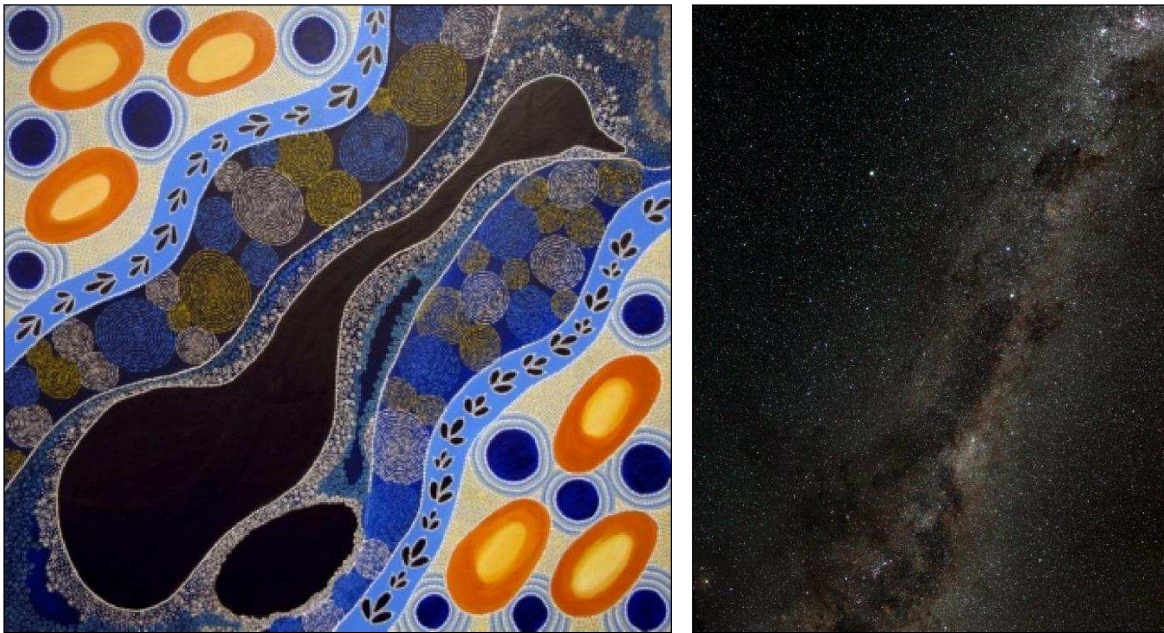


Figure 7: Two representations of the 'Emu' in the sky (painting: Margaret Whitehurst (Yamaji Art); .photograph: John Goldsmith).

children in looking at the sky, talking about the sky, and then painting and the grandchildren and the children painting with them, so that's been really fantastic.

Artists like Margaret Whitehurst also indicated that *Ilgarijiri* played a role in creating new opportunities for future stories and knowledge sharing:

Now I think I could do more stories of it, you know, tell more stories about it. Just looking ... through the telescope, into the sky, yeh. It's really given me a lot of things that I can go back, and well, I went back and told my kids and my Grandkids all about it, but they didn't believe me. They didn't believe there were that many things in the sky. Yeh ...

General impressions about the whole *Ilgarijiri* project were provided by the then Manager of Yamaji Art, Charmaine Green:

It's been a really fantastic project and it's part of us wanting to reclaim the right to tell stories from my perspective anyway, and this project's allowed this ...

An unexpected conceptual difference between scientific and Aboriginal views of the sky was encountered during one of the interviews, which only became evident because of the interview question. When asked about his views of 'deep space', Kevin Merritt explained that this concept is not one that he generally holds:

And you say 'deep space'. We don't have that con[cept] ... we don't see 'deep space'. As Aboriginal people, we just see what is around us, what's above us and 'deep space' is beyond anyone's comprehension. We just can't understand, you know, how all these things have been created, you know.

Kevin went on to explain that it is the visible cosmos that is most strongly related to:

... just what we see with our naked eye ... like the nearest stars that we see, the Moon, the Sun, some of the closest stars, that we see shining so bright in the sky, and we are a part of that. But beyond that we don't have any connection to that.

6.2 Astronomical Themes Featured in *Ilgarijiri*

Major astronomical themes evident in the *Ilgarijiri* exhibition include the Seven Sisters (the Pleiades) and the 'Emu' in the sky. The Emu is a widely-recognised Aboriginal sky pattern in Australia, which is formed by the dark areas in the Milky Way, between Crux (the Southern Cross) and Scorpius (see Fuller et al., 2014; Goldsmith, 1999; Norris and Norris, 2009). The head of the Emu is the Coal Sack nebula, located adjacent to the Southern Cross. The *Ilgarijiri* painting of the Emu sky pattern (Figure 7) is shown next to a panoramic astronomical photograph of the southern Milky Way, with approximately the same orientation, to show the distinctive prominence of the dark areas in the Milky Way when viewed in dark-sky conditions.

The *Ilgarijiri* exhibition featured several paintings of the Seven Sisters (Pleiades), which was a very popular subject (see Figure 8). Despite the relative faintness and small size of this open cluster, the Seven Sisters features very prominently in many Aboriginal stories of the night sky. Stories and knowledge associated with this star cluster often refer to the hunter (man) pursuing the Seven Sisters, and the exploits of one of the sisters, who trails behind the group. In various



Figure 8: Two representations of the Seven Sisters (Pleiades) (painting: Christine Collard (Yamaji Art); photograph: John Goldsmith).

accounts, the male 'hunter' is variously identified as Orion, or the star Aldebaran (*Alpha Tauri*). The pursuit of the Seven Sisters by the hunter, in the story, matches the actual apparent movement of these astronomical objects as they move from east to west across the night sky.

6.3 Creating New Resources: The Exhibition Video and Virtual Tour

The video interviews with *Ilgarijiri* artists and the on-site 360° photography provided new material for the development of two new resources to support the *Ilgarijiri* project: an exhibition video (Figure 9) and a virtual tour (Figures 10 and 11). The exhibition video was developed in collaboration with Yamaji Art and accompanied the 2012 European tour of *Ilgarijiri*. The video features a

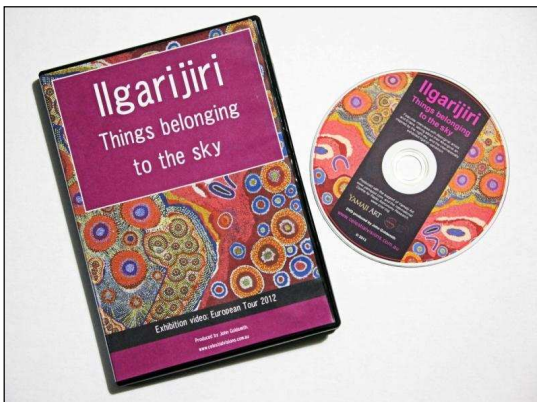


Figure 9: The *Ilgarijiri* exhibition video (photograph: John Goldsmith).

series of 17 interview excerpts (total run time of 12.5 minutes), in which the *Ilgarijiri* artists introduce the project and share their experiences and anecdotes.

The virtual tour was developed from the photographic site documentation at the Murchison Widefield Array site and the 2009 *Ilgarijiri* exhibition at Curtin University. The virtual tour also included various other Western Australian sites (as part of the broader scope of the Cosmos, Culture, and Landscape Project), such as Wolfe Creek Crater, Wave Rock, Mulka's Cave, the Cosmology Gallery and Horizon Planetarium. In collaboration with Yamaji Art, the virtual tour incorporates images from the *Ilgarijiri* exhibition and shows *Ilgarijiri* artwork that is directly related to the Murchison Radio Astronomy Observatory. The virtual tour was produced on DVD, but there is potential for the virtual tour to be available online at a later stage.

7 DISCUSSION AND SUMMARY

The *Ilgarijiri* collaboration brought together radio astronomers and Wajarri Yamatji people of Western Australia to share scientific and Aboriginal knowledge of the night sky. The project helped develop an understanding and appreciation of the night sky, and respect between radio astronomers, Aboriginal Elders and artists, and the wider Aboriginal community. The collaboration showcased the *Ilgarijiri* exhibition to local, national and international audiences.

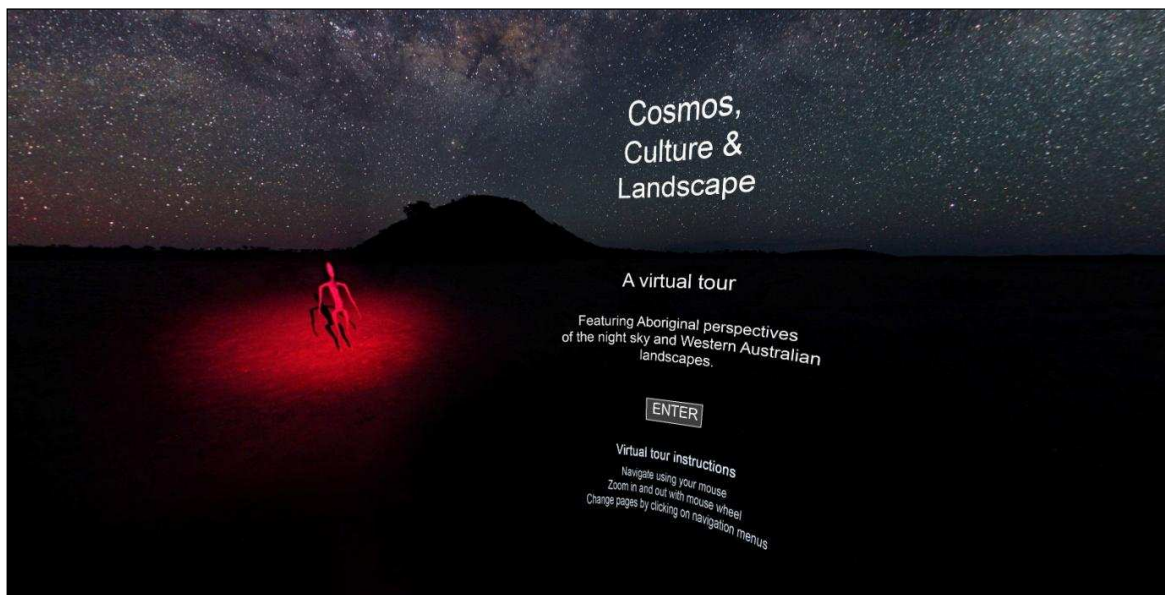


Figure 10: The Cosmos, Culture and Landscape virtual tour (image: John Goldsmith).

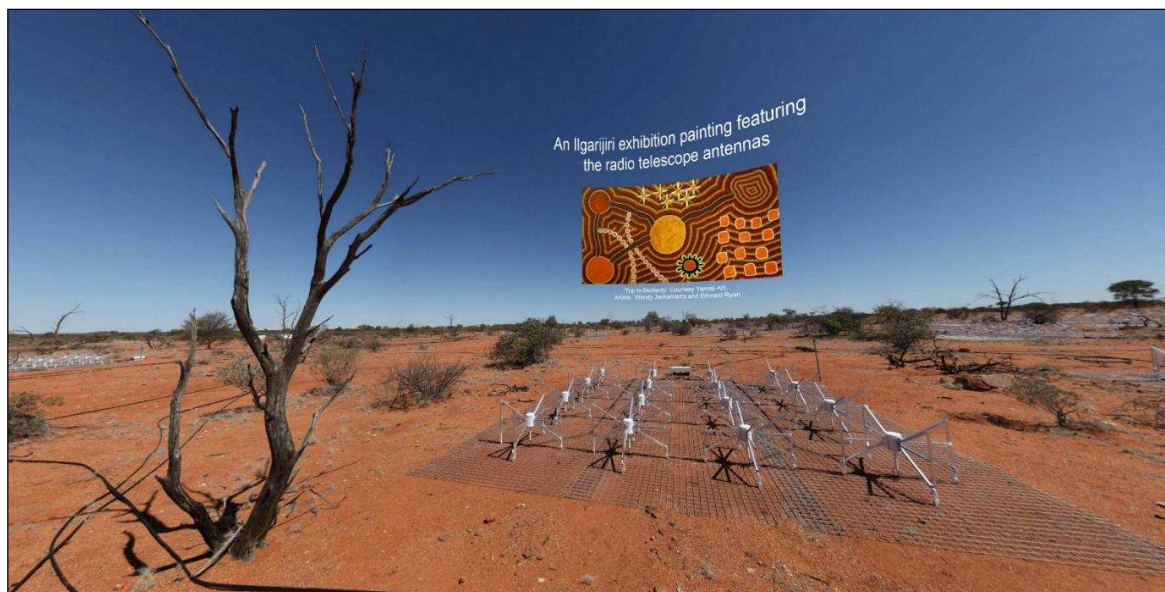


Figure 11: Virtual tour image of the Murchison Widefield Array and montaged painting by Wendy Jackamarra and Edward Ryan (image: John Goldsmith).

Indications of the success of *Ilgarijiri* are evidenced by the number of Aboriginal artists who participated in the project; the number of artworks created; the number of exhibitions held, both in Australia and overseas; the number of artworks sold; and the accounts, experiences and opinions of the artists. Yamaji Art led the management of *Ilgarijiri* artists and addressed a variety of issues, ranging from the management of intellectual property to practical logistical and travel issues.

The use of video-based interviews with *Ilgarijiri* participants proved to be particularly effective, enabling an in-depth exploration of topics. These interviews also provided considerable insight into the experience of the various partici-

pants in the collaboration. The videos indicate initial perceptions by participants regarding the project, how the project was valued as a means of learning about the night sky, interaction with the radio astronomers, and the importance of creating new artistic representations of stories via the exhibition. Issues and matters of sensitivity were recognised, carefully considered and addressed by Yamaji Art and the participants of the *Ilgarijiri* collaboration.

The *Ilgarijiri* collaboration clearly demonstrated that the night sky can help to bring Aboriginal and non-Aboriginal people together. The artists indicated a positive sense of renewal of stories arising from the creation of the *Ilgarijiri* artworks, based on their shared experience of the night

sky, and maintaining and passing on valued knowledge through their artworks. Their interaction with radio astronomers was viewed very positively, and in particular the use of telescopes generated a lot of enthusiasm and inspiration. This led to the creation of artworks featuring 'deep space' objects, such as the Jewel Box star cluster. This particular cluster attracted a great deal of attention with Aboriginal artists, in part due to the colour of the stars and the cluster's name. Discussions regarding 'deep space' revealed a different conceptual understanding, with an emphasis on what is directly observable with the naked eye in the night sky.

Key principles derived from the experience of the *Ilgarijiri* project have the potential to help shape future collaborations that explore Aboriginal cultural knowledge, art and science. These principles include:

- *Leadership and motivation*: Leadership provides the direction and overall guidance and support for collaborative projects, ideally led by Aboriginal organisations.
- *Consultation and collaboration*: These create an inclusive and shared experience of the night sky that can inspire both artists and scientists.
- *Interdisciplinary skills amongst the project team*: Projects that combine art and science are necessarily multidisciplinary, so they have considerable scope and flexibility to use a wide range of scientific, creative and technology-based skills.
- *Recognition and appropriate addressing of management issues*: Some examples include intellectual property management, cultural issues, research ethics, and sensitivities regarding Aboriginal persons who have passed away. Adequate resourcing and practical support is of primary importance.
- *Project scale*: Projects that engage multiple participants (e.g. artists) are more likely to benefit from such diversity.
- *Orientation towards education*: Whether formal or informal, an orientation towards education can engage a wide range of people.
- *Alignment with big issues*: Aligning projects with high-profile issues such as the Square Kilometre Array and the International Year of Astronomy, etc., can leverage results and benefits.
- *Harnessing emerging technologies*: Digital imaging provides an important way to visually document sites and landscapes, while 360° imaging provides opportunities for virtual tour development.
- *Producing multi-format productions*: Exhibitions, web sites, catalogues, films and virtual tours facilitate different ways of engaging with audiences.

The accounts recorded by the video interviews of *Ilgarijiri* artists support the hypothesis that collaborative, cross-cultural projects can act as an important catalyst in encouraging the appreciation and respect of Aboriginal and scientific astronomical knowledge. The *Ilgarijiri* video interviews have been successfully applied to document and communicate contemporary astronomical knowledge arising from the *Ilgarijiri* collaboration in a culturally-appropriate manner. The use of 360° site photography demonstrated its application as a virtual tour. Key principles assist in guiding future projects involving Aboriginal cultural knowledge, art and science.

8 NOTES

1. <http://astronomy.curtin.edu.au/ilgarijiri/>

9 ACKNOWLEDGEMENTS

This research was made possible by the support of the International Centre for Radio Astronomy Research, and the Curtin Institute of Radio Astronomy, Curtin University, Western Australia. This paper was originally presented at the 13th Australian Space Science Conference (2013) held at the University of New South Wales in Sydney, Australia. The presentation received the award for best student postgraduate presentation. Special thanks to all Yamatji artists and Elders who participated in this research (credited within the text), and for Yamaji Art, in granting permission for the use of *Ilgarijiri* images. I am grateful to Professor Steven Tingay (ICRAR, Curtin University), Kevin Cameron (Associate Supervisor & Aboriginal Elder) and Professor Ray Norris (Associate Supervisor, CSIRO) for supervising my Ph.D. The World at Night (www.twanight.org) is acknowledged for its role in representing digital image resources derived from the research. Research Ethics approval (RD 10-15) was provided by the Curtin University Research Ethics Committee. CSIRO and ICRAR are thanked for their support during fieldwork and site visits to the Murchison region and the Murchison Radio-astronomy Observatory.

10 REFERENCES

- Australian Broadcasting Company (ABC), 2009. *Before Galileo*. Message Stick TV program. Aired Sunday, 1 November 2009, 13:30 on ABC1. URL: <http://www.abc.net.au/tv/messagesstick/stories/s2730570.htm>
- Australian Institute of Aboriginal and Torres Strait Islander Studies, 2011. *Ilgarijiri - Things Belonging to the Sky*. Canberra, Australian Institute of Aboriginal and Torres Strait Islander Studies website. URL: <http://www.aiatsis.gov.au/events/ilgarijiri.html>
- Brophy, L. 2009. Opening the skies to the past and the future. *University of Western Australia (UWA) News*, 28(14), 1, 8–9.
- Dewdney, P.E., Hall, P.J., Schilizzi, R.T., and Lazio,

- T.J.L.W., 2009. The square kilometre array. *Proceedings of the Institute of Electrical and Electronics Engineers*, 97, 1482–1496.
- Drok, K., 2009/2010. Paint the sky with stars. *CITE - The Magazine of Curtin University of Technology*, 15 (Summer 2009/2010), 12–13.
- Fuller, R.S., Anderson, M.G., Norris, R.P., and Trudgett, M., 2014. The Emu sky knowledge of the Kamilaroi and Euahlayi peoples. *Journal of Astronomical History and Heritage*, 17, 171–179.
- Goldsmith, J., 2011. Documenting natural and cultural places with 360° spherical images, panoramic and timelapse digital photography. *Rock Art Research*, 28, 123–127.
- Goldsmith, J., 1999. The emu in the sky. *Australian Geographic*, 55(July/Sept), 19.
- Johnston, S., Bailes, M., Bartel, N., Baugh, C., Bietenholz, M., Blake, C., Braun, R. et al., 2007. Science with the Australian square-kilometre-array pathfinder. *Publications of the Astronomical Society of Australia*, 24, 174–188.
- Lonsdale, C.J., Cappallo, R.J., Morales, M.F., Briggs, F.H., Benkevitch, L., Bowman, J.D., Bunton, J.D., et al., 2009. The Murchison Widefield Array: design overview. *Proceedings of the Institute of Electrical and Electronics Engineers*, 97, 1497–1506.
- Norris, R.P., and Norris, P.M., 2009. *Emu Dreaming: An Introduction to Aboriginal astronomy*. Sydney, Emu Dreaming.
- Norris, R.P., 2010. Australian Aboriginal astronomy in the IYA2009. *Communicating Astronomy with the Public Journal*, 9(Oct), 5–9.
- Russo, P., and Lindberg, C.L. (eds.), 2010. *International Year of Astronomy 2009 Final Report*. United Nations Educational, Scientific and Cultural Organization. International Astronomical Union. URL: http://www.astronomy2009.org/resources/documents/detail/iya2009_final_report/
- Tingay, S.J., 2011. Ilgarijin - things belonging to the sky: connecting Australian indigenous artists and astrophysicists. *The International Journal of the Arts in Society*, 6, 203–211.
- Tingay, S.J., Goeke, R., Bowman, J.D., Emrich, D., Ord, S.M., Mitchell, D.A., Morales, M.F., et al., 2013. The Murchison widefield array: the square kilometre array precursor at low frequencies. *Publications of the Astronomical Society of Australia*, 30, e007, doi: 10.1017/pasa.2012.007.

Dr John Goldsmith's Ph.D. research at the Inter-



national Centre for Radio Astronomy Research, Curtin University in Perth, Western Australia, investigated cultural astronomy and the documentation, communication and sharing of Aboriginal sky knowledge. He studied collaborations with radio astronomers with the Square Kilometre Array radio telescope project in the Murchison region of Western Australia and Wolfe Creek Crater. John is an astronomical landscape photographer (see www.celestialvisions.com.au) and is a member of The World at Night (www.twanight.org).