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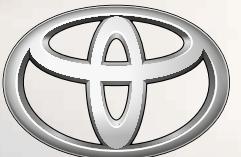
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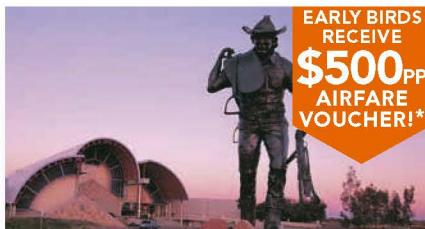
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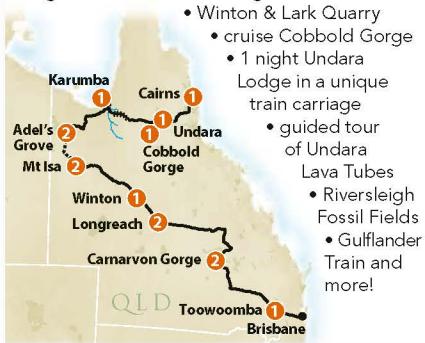
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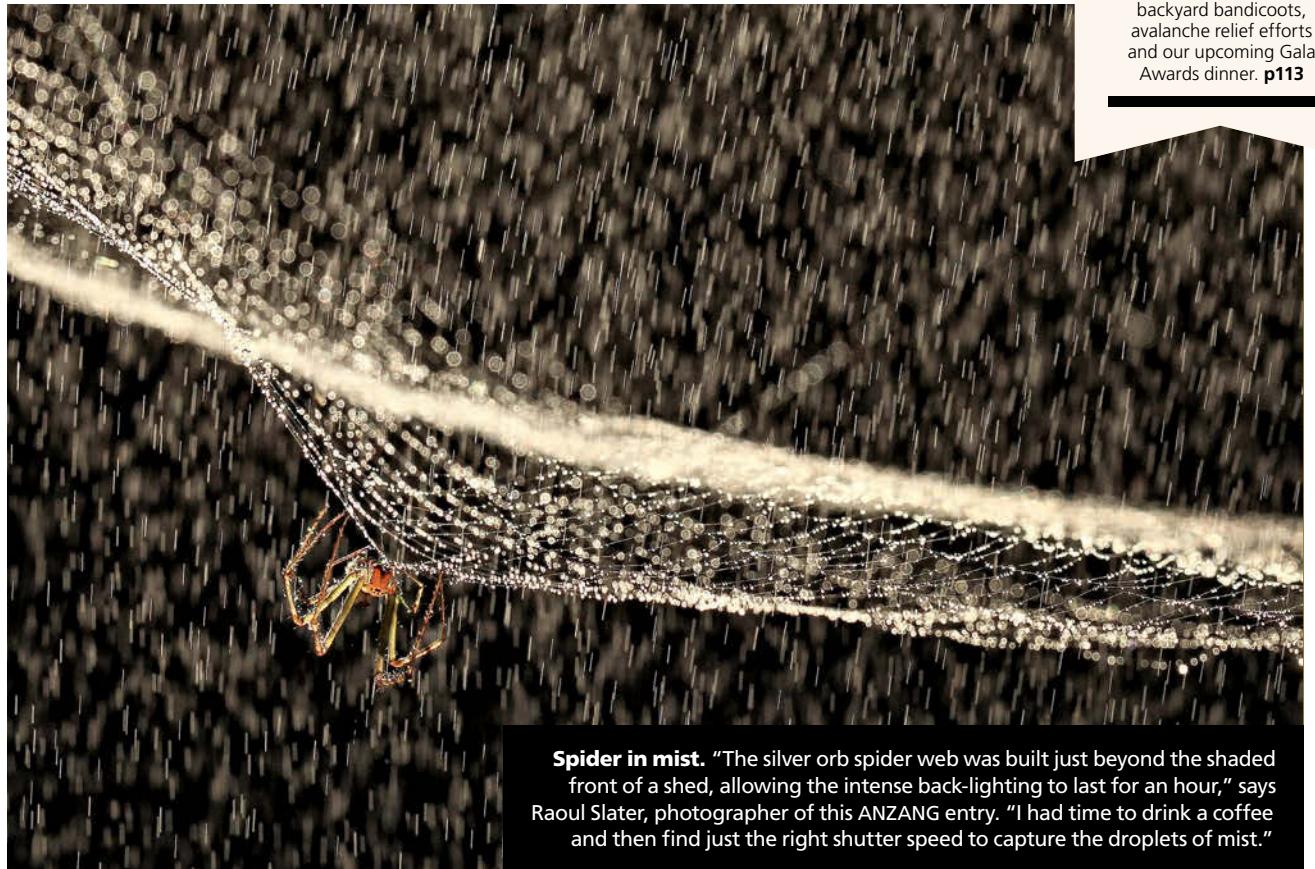


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AUSTRALIAN GEOGRAPHIC SEPTEMBER–OCTOBER 2014



**Spider in mist.** "The silver orb spider web was built just beyond the shaded front of a shed, allowing the intense back-lighting to last for an hour," says Raoul Slater, photographer of this ANZANG entry. "I had time to drink a coffee and then find just the right shutter speed to capture the droplets of mist."

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A hairy frogfish in the spotlight by ANZANG entrant Michael Gallagher. "Frogfish are ambush predators and often blend into their surroundings; this specimen resembles a bright orange sponge," says Michael, who took this while diving in Sulawesi, Indonesia.



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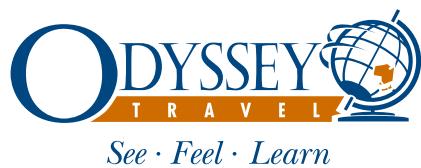
## Odyssey to Bhutan

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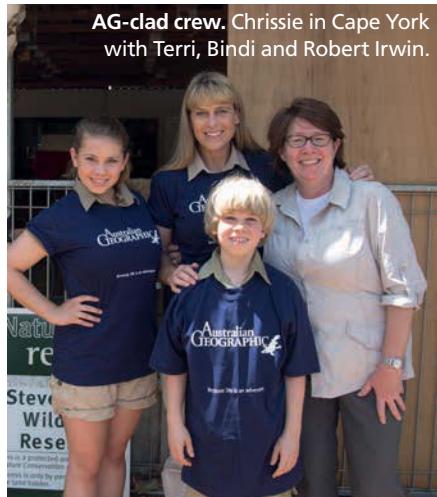
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# Springing into action

**A**S WE WELCOME spring, the year seems to gather momentum, and around the Australian Geographic offices lots of things are afoot. On 9 October the results of this year's Australian Geographic ANZANG Nature Photographer of the Year competition will be announced at the South Australian Museum.

We are relishing our second year of partnership with the museum, and have been hard at work producing three ANZANG publications, one of which is *Wild Australasia*, a gorgeous coffee-table book celebrating the first 10 years of the competition. In the next issue of the journal, we'll show you how to get hold of your free copy when you renew your subscription.

In the meantime, enjoy an eye-catching selection of this year's finalists, starting on page 42, and read about how winning last year's ANZANG title had a profound effect on photographer David



**AG-clad crew.** Chrissie in Cape York with Terri, Bindi and Robert Irwin.

Rennie's life, and helped focus attention on the mental health and conservation causes close to his heart.

Later in October we are once again hosting the Australian Geographic Society Awards in Sydney. This year's event on Wednesday 29 October will

feature fearless wingsuiters Heather Swan and Glenn Singleman as guest speakers, along with a host of deserving award winners in the fields of adventure and conservation. Each year the stories from our awardees inspire and uplift all present. It's always a great night with terrific food and wine, and, importantly, we raise much-needed funds for the AGS. We would love to have you, our valued members, join us there.

Go to page 30 to find out how you can get your ticket. You can also visit our wonderful website to book your spot directly and also check out all of 97 shortlisted photos from the 2014 ANZANG competition.

*Chrissie Goldrick*

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[twitter.com/chrissigoldrick](https://twitter.com/chrissigoldrick)

## Contributors



### Tim Cope

has spent the best part of a decade travelling through Russia, Mongolia and Central Asia. Born in Gippsland, Victoria, his

most famous trek was a three-year journey from Mongolia to Hungary on horseback (*Nomad spirit*, AG 89), which led to him being awarded the Australian Geographic Society Adventurer of the Year in 2006. Tim, also an author and filmmaker, is now leading once-in-a-lifetime trips across the Mongolian steppe for our readers.

RIDING INTO HISTORY, PAGE 100



### Lida Xing

is both a palaeontologist and a palaeo-artist based in Beijing, China. His science-based reconstructions of prehistoric species have featured in *National Geographic*, *Nature* and twice before in AG. He earned his master's degree in palaeontology at the University of Alberta, Canada; has done extensive fieldwork in China excavating feathered dinosaurs; and has published dozens of papers on dinosaur tracks. For this issue he created new illustrations of 12 species of Australian dinosaur.

FRONT COVER AND DINOSAUR POSTER



### Dr Susan Hayes

researches archaeological and forensic sciences at the University of Wollongong. She specialises in

reconstructing the features of ancient faces from skulls alone, as well as forensic facial identification. Her work on the face of *Homo floresiensis*, the tiny ancient human discovered in 2004, was partly funded by the Australian Geographic Society. Susan is now approximating the faces of other early humans excavated in South East Asia.

FACE TO FACE WITH THE HOBBIT, PAGE 88

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# BIG PICTURE

## DARWIN BOUND

BY DARREN CLARK

Drover David Summerville walks his mob to the stockyards through rising dust in the Barkly Tablelands of the Northern Territory. Photographer Darren Clark took this image while he was retracing the routes of legendary bushman Bruce Simpson, a drover from the cattle industry's 1950s heydays. This trip formed part of Darren's 12-year project to document outback Australian archetypes, which culminated in his recently released book, *Drover*.





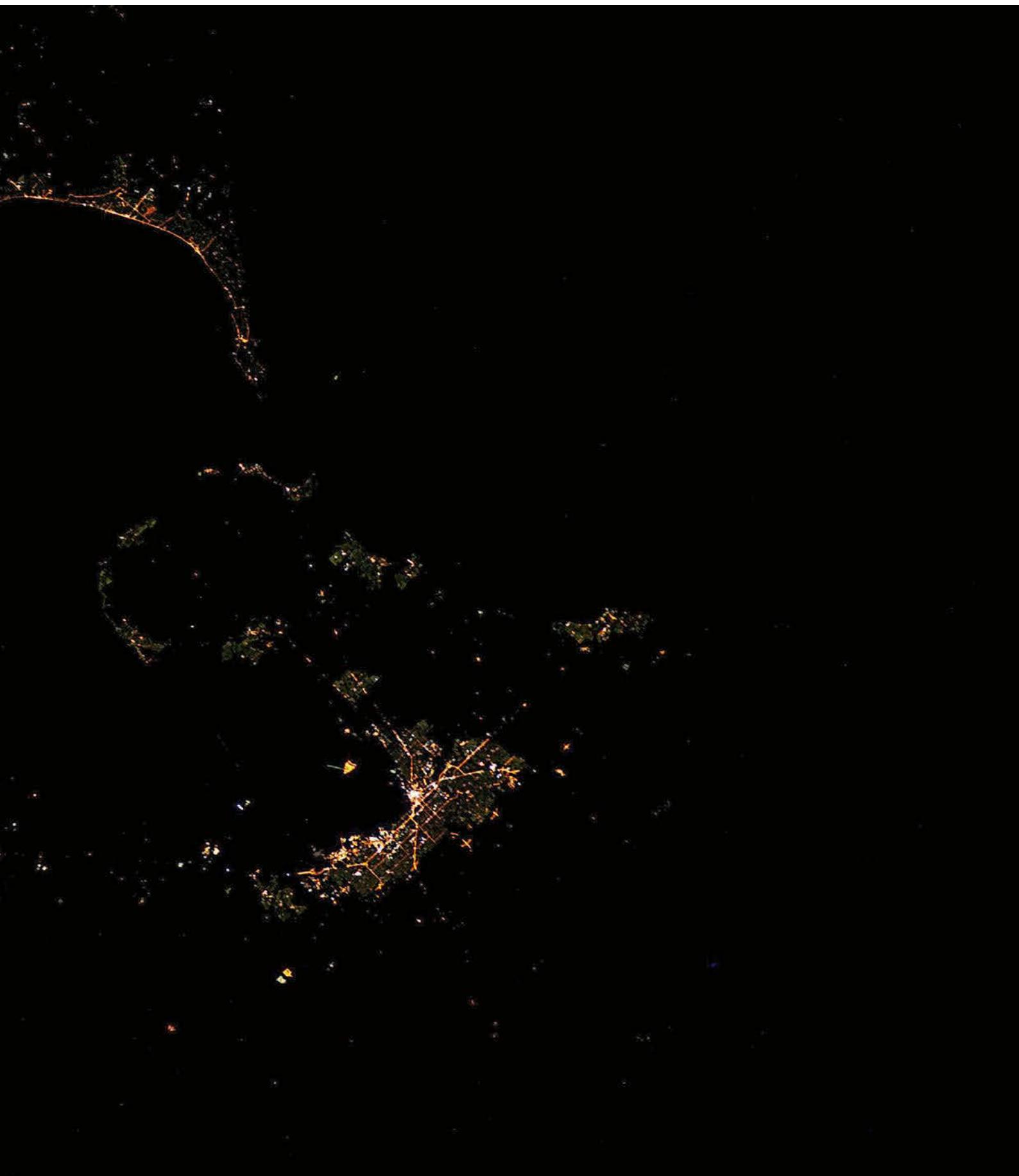
# BIG PICTURE

# CITY OF LIGHTS

BY ANDRÉ KUIPERS, ESA

From as early as the 1960s, astronauts have been photographing the planet. This image of Melbourne was shot from the International Space Station in March 2012, 400km above Earth, by European Space Agency astronaut André Kuipers. The Dutchman was a crew member on the long-duration PromISSe mission. The image now forms part of the 'Loss of Night' project, which uses astronauts' images to study the impacts of light pollution.





# El Niño: from fire to flood

El Niño and La Niña have a significant effect on the Australian climate, but how do they work?

STORY ÅSA WAHLQUIST ILLUSTRATION MICHAEL PAYNE

AUSTRALIA is a land “of droughts and flooding rains” – our climate cycles from one to the other, sometimes slowly, sometimes quickly. The El Niño Southern Oscillation (ENSO) is a major climatic influence on rainfall in Australia and is the result of air and ocean movements across the Pacific Ocean.

As warmer water flows eastwards, from Australia to South America, air currents carrying rain-bearing clouds move away from Australia out into the central Pacific. This leads to drier months and more droughts and bushfires. The warm water flowing along the coast of Peru displaces cold currents carrying plankton, the food of anchovies. Peruvian fishermen first recognised the pattern because they hauled in much smaller catches at this time. They named the event El Niño, or the boy child, because it occurred at Christmas time.

El Niño events occur every 4–7 years, and usually last 12–18 months, peaking in December–April. Higher air pressure over Australia is one of the indicators. The ‘Southern Oscillation Index’ (SOI) measures the difference between pressure in Darwin and Tahiti and turns negative during El Niño. The reverse pattern, La Niña, is linked to flooding rains: under this pattern warmer waters move back towards Australia, as do the trade winds and rain-bearing clouds.

→ Area affected by La Niña

## La Niña phase

This occurs when the Southern Oscillation Index (SOI), which measures the air pressure differential between Darwin and Tahiti, records sustained positive values (usually above +8). La Niña is associated with wetter conditions over much of Australia, particularly in the north and east of the continent.



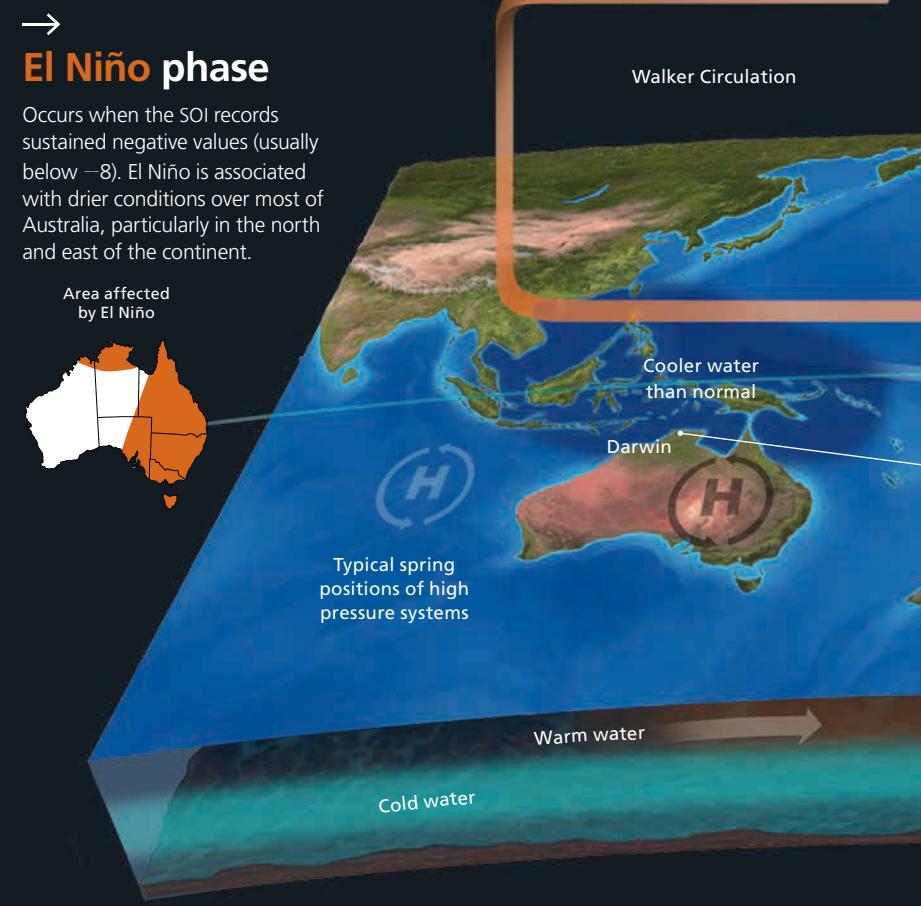
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## El Niño phase

Occurs when the SOI records sustained negative values (usually below -8). El Niño is associated with drier conditions over most of Australia, particularly in the north and east of the continent.



Area affected by El Niño



→

## Long-term patterns

The ENSO Tracker records El Niño and La Niña events using a three-tier system. It monitors sea-surface temperatures, winds, and the SOI, combined with climate modelling to forecast the oscillations.

LA NIÑA

NEUTRAL

EL NIÑO



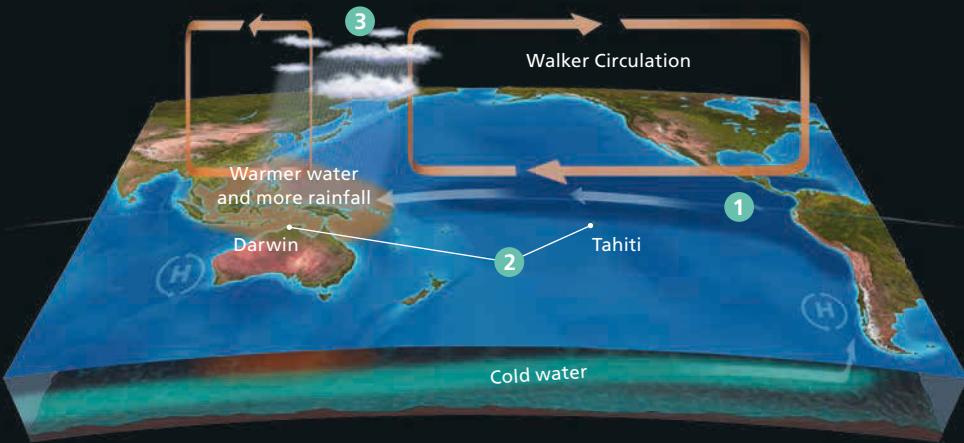
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## Extreme events

Is there a correlation between El Niño and extreme weather events? This graph plots Eastern Australia's most extreme weather events against the oscillations.



## ← How La Niña happens

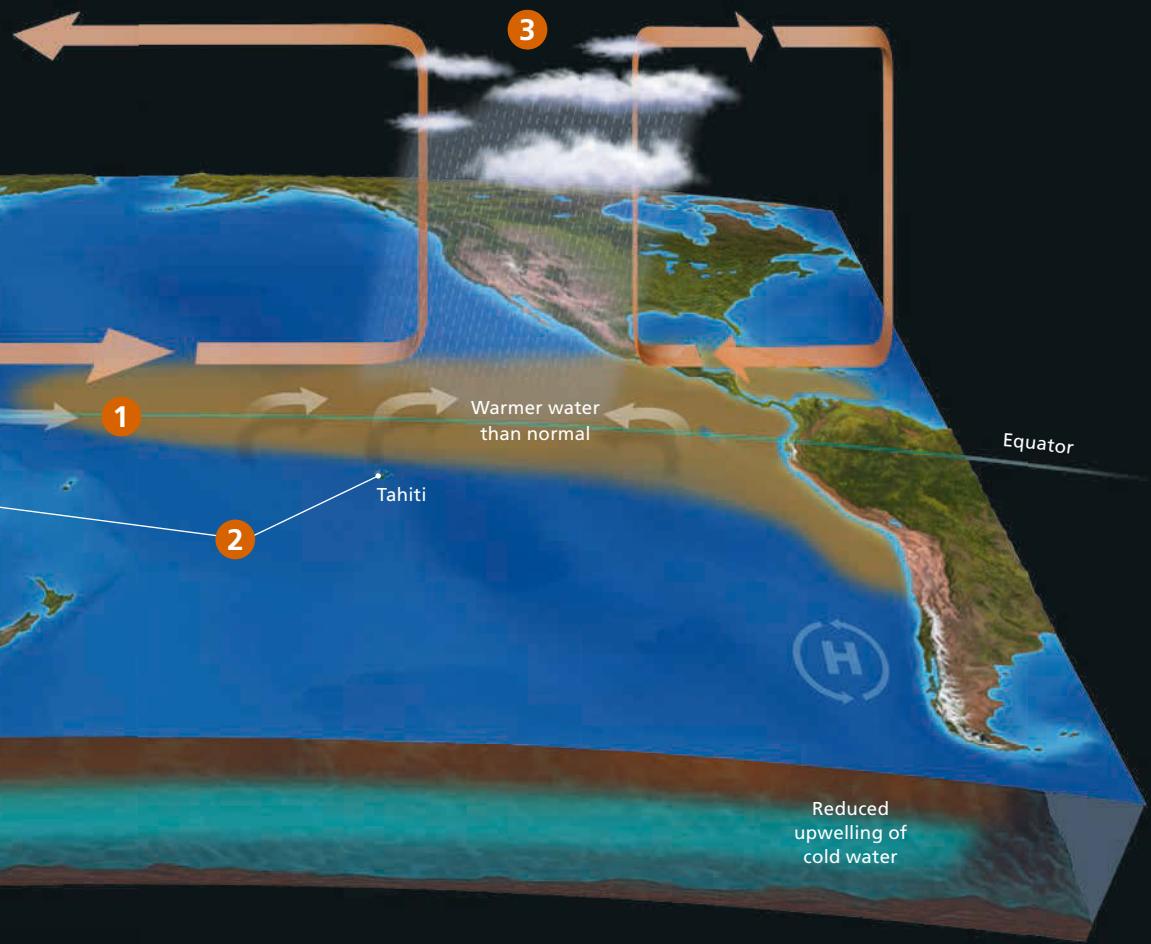


1 The prevailing Pacific trade winds blow to the west. When they intensify, they push warm surface water closer to the Asia than normal.

2 The SOI records positive values, the result of lower-than-normal atmospheric pressure near Darwin and higher than normal atmospheric pressure near Tahiti.

3 The east–west air circulation over the Pacific Ocean, the Walker Circulation, moves west, bringing increased cloud and rainfall to the western Pacific.

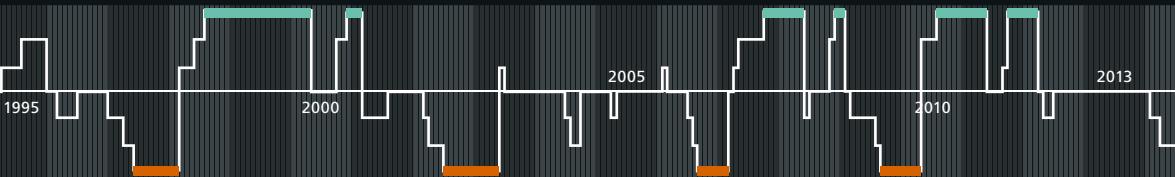
## ← How El Niño happens



1 Pacific trade winds weaken or reverse, allowing warm surface water to flow east along the equator towards the Americas, where it collects.

2 The SOI records negative values, the result of higher-than-normal atmospheric pressure near Darwin and lower than normal atmospheric pressure near Tahiti.

3 The Walker Circulation moves east, bringing increased cloud and rainfall to the eastern Pacific, while northern Australia, Indonesia, South-East Asia, India and even the east coast of Africa experience drier than usual conditions.



**50%**

Likelihood of an El Niño event occurring in the spring of 2014, as forecast in August by the Bureau of Meteorology.



- ⌚ Major drought (Sustained below-average rainfall)
- 🔥 Major bushfire (More than 2000sq.km burnt)
- 🌊 Major flooding (Sustained above-average rainfall)

# THE DIFFERENCE BETWEEN CATCHING A GLIMPSE AND HOLDING A GAZE.



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# Lost and found

Could the world's largest egg-laying mammal – thought long-extinct in Australia – be hiding in a remote spot of the western Kimberley? An expedition has gone to find out.

**I**T'S NOT OFTEN you get a positive lead suggesting a long-extinct Australian mammal may be hiding out in a remote spot, waiting for rediscovery. Although some people hold out hope that the thylacine is clinging on in some little-explored spot of Tasmania, experts agree this is unlikely.

A few species have been rediscovered in other parts of Australia. The scaly-tailed possum was found on an AG Society expedition into the eastern Kimberley in 2012, after it hadn't been seen in the area since 1917 (see AG 110); while Gilbert's potoroo was thought lost from the mid-18th century until a few animals were found at Two Peoples Bay near Albany, WA, in 1994 (see AG 108). But these are animals lost in recent history, since European colonisation – not animals thought to have gone extinct more than 10,000 years ago.

Excitingly, researchers on an expedition into the remote western Kimberley region are hoping to find evidence of the western long-beaked echidna (*Zaglossus bruijnii*). This is larger relative of the more common short-beaked echidna (*Tachyglossus aculeatus*), which is found right across Australia.

Scientists from the Australian Wildlife Conservancy and the WA Department of Environment and Conservation announced their plans in June to search for scats and analyse DNA within them to see if the creature is present.

The western long-beaked echidna is one of three species of echidna that's found only on the island of New Guinea, north of Australia across the Torres Strait. The species is pretty big, weighing in at up to 17kg and reaching lengths of 1m (about twice the length of a common echidna). It is critically endangered and found in relatively small numbers largely in the rainforests and high alpine meadows of the Bird's Head Peninsula of the West Papua province of Indonesia, that forms part of the western half of New Guinea.

The most recent Australian fossil evidence for the species, which is the world's largest egg-laying mammal, is about 10,000 years old, but Aboriginal rock art thought to feature the monotreme dates to about 5000 years ago.

The search for evidence of the animal in the Kimberley was prompted after Dr Kristofer Helgen, at the Smithsonian Museum of Natural History in Washington, DC, found

a skin and skull at London's Natural History Museum, which were collected in the western Kimberley area in 1901. Found at Mount Anderson, 90km south-east of Derby, by naturalist John T. Tunney, the specimens were overlooked because curators thought it was a short-beaked echidna. Although the confusion about the species was later clarified, the London-based experts didn't realise the significance of the region the animal had been collected from.

Perhaps more intriguing were reports collected by Kristofer and his colleagues – and published in the journal *ZooKeys* in 2012 – that a woman of the Miriwoong Gadjerong Aboriginal people remembered her grandmothers talking about hunting a much larger echidna in their youths. These pieces of evidence together suggested that the larger echidna might still be hanging on in the vast and largely undeveloped wilderness that is north-western WA.

"We hold out a small optimism that long-beaked echidnas might yet dig burrows and hunt invertebrates in at least one hidden corner of Australia's north-west. Such hopes are founded on the remoteness of this little-studied expanse of the Australian continent, and on the relatively late discovery of other medium-sized Kimberley mammals," the researchers said in 2012.

So now we await the findings of the ongoing research expedition. How exciting it would be to discover a new mammal as large as the long-beaked echidna in Australia – perhaps uncovering a creature approaching the size of the Tasmanian tiger isn't such a long shot after all.

**Big brother.** The western long-beaked echidna (left), currently only known from PNG, is a giant version of Australia's short-beaked variety (below).



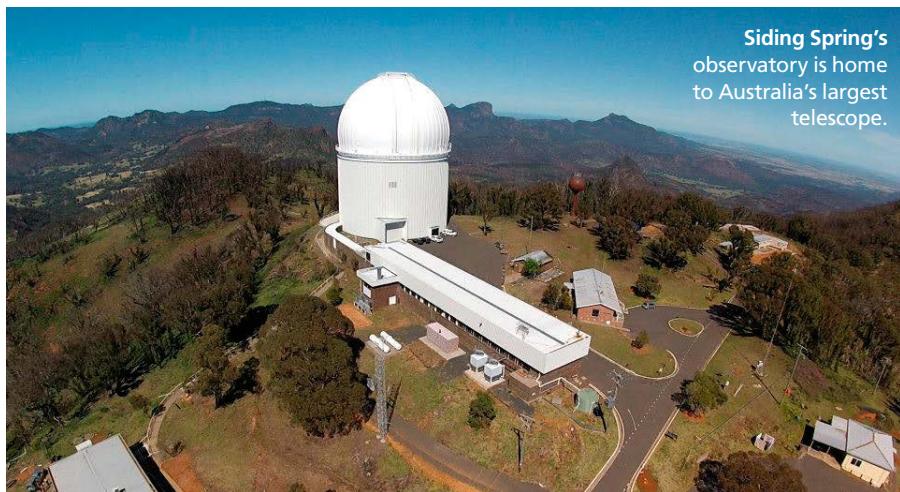
## JOHN PICKRELL

is the editor of AUSTRALIAN GEOGRAPHIC. Follow him on Twitter at: [twitter.com/john\\_pickrell](https://twitter.com/john_pickrell)



# Fifty years young

This year marks the 50th birthday of Siding Spring Observatory, Australia's biggest astronomy centre for research.



**Siding Spring's observatory** is home to Australia's largest telescope.

**H**ALF A CENTURY ago, Australian astronomy was a very different endeavour from that of today. With the recent completion of the Parkes Radio Telescope (1961), radio astronomy was in the ascendancy and optical (visible light) astronomy was mostly limited to the Australian National University's (ANU) facilities at Mount Stromlo in Canberra.

The observing conditions in Canberra were less than ideal, however, due to the gradual spread of the suburbs and light pollution. An ANU outstation at Mt Bingar, in the Riverina region of central NSW, had a small telescope used by Professor Bart Bok, director of Stromlo Observatory. And when Bart initiated the quest for a permanent dark-sky site in the early 1960s, he favoured Mt Bingar. However, extensive site-testing revealed that Siding Spring Mountain in the Warrumbungle Range, north-western NSW, boasted observing conditions at least as good as Bingar, and a nearby town – Coonabarabran – could provide infrastructure and homes for staff.

Thus it was that Siding Spring became Mount Stromlo's dark-sky site,

and, eventually, Australia's national optical observatory. The first telescope stationed there, the ANU 1-metre, was opened in February 1964, and was used by Bart and his wife Priscilla in their landmark studies of the Milky Way. Other smaller telescopes followed, but when the Australian and British governments decided to build a giant instrument in the 4m class, Siding Spring was the favoured site. This 3.9m Anglo-Australian Telescope (AAT) was inaugurated by Prince Charles on 16 October 1974, and is still in operation.

The AAT is now operated by the Australian Astronomical Observatory, which is also responsible for the 1.2m UK Schmidt Telescope. Other facilities on the site include the ANU's 'SkyMapper' telescopes, which are mapping the entire southern sky, and the 2m Faulkes Telescope South. They will be open to visitors on 3–5 October 2014 for 'StarFest' weekend to celebrate the 50th anniversary of the site. Visit the [www.starfest.org.au](http://www.starfest.org.au) site for details.

**FRED WATSON** is astronomer-in-charge at the Australian Astronomical Observatory.

## Fred answers your questions

**What is 'nothing'? If there is no matter or anti-matter, or any form of electronic activity, is it existence or non-existence?**

Mohammed, via email

A recent debate among leading philosophers and physicists at the American Museum of Natural History concluded that 'nothing' might always turn out to be 'something' as new discoveries are made. In particular, an empty universe without matter or energy can't be 'nothing', since the laws of physics still apply.

If you have a space question for Fred, email it to [editorial@ausgeo.com.au](mailto:editorial@ausgeo.com.au)

## Glenn Dawes looking up



**NAKED EYE** The constellation of Cygnus the Swan, looking more like a large inverted crucifix, lies low in the north. Aquila the Eagle is directly above. The Milky Way flows through these constellations before disappearing over the horizon.



**BINOCULARS** Look for two interesting asterisms, each consisting of four 4th-magnitude stars. Delphinus has 'Job's Coffin' shaped like a diamond on its side. The other is Aquarius' Water Jug with a central star surrounded by three in a triangle.



**SMALL TELESCOPE** Cygnus is home to a brilliant double star, Albireo (Beta Cygni). Looking north it forms the top star of the cross. It's famous for its colour contrast, the brighter component being a rich yellow.

**Glenn Dawes** is a co-author of *Astronomy Australia 2014* (Quasar Publishing).

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FAMILY TIES

# The Chandelier Man

Australian Geographic's Amy Russell looks back at a historic image that has a special meaning for her.

MY GRANDFATHER Fabian Russell spent much of his working life surrounded by the sumptuous curves and delicate prettiness of crystal chandeliers. Pictured here in 1977 at the Regent Theatre in Sydney, Fabian was an electrician, who worked in the lighting sections of Sydney department stores Mark Foy's and Grace Bros, before branching out on his own.

It was his love of chandeliers that drew him to restoration work, says Noeleen, his wife of 45 years and my step-grandmother. "It was the colours and crystals. He knew all about them."

Born in the Illawarra city of Wollongong, Grandpa Fabes grew up in Sydney's eastern suburbs, where he later became known for his deft handiwork. Dubbed the 'Chandelier Man', he "worked for many influential people, even a few prime ministers", says Noeleen, who recalls the time, in the late '80s, that he was called to the home of former PM William 'Billy' McMahon to quote on a job.

Although McMahon didn't hire him, Grandpa Fabes went on to restore thousands of chandeliers, including those adorning Sydney's State Theatre and Government House in Canberra, and two huge beauties from Adelaide Town Hall. "They sent them up on trucks," Noeleen says, "and he did them in the back garage."

The Regent Theatre job was a massive one, she says. This 3m-tall art deco

model was designed by Georges Chevalier, a master craftsman with Baccarat Crystal in France. It was the centrepiece for an exhibition in Paris in 1925, before it was shipped to Sydney. By the time Grandpa Fabes laid his hands on it more than 50 years later, it was in a sad state of disrepair.

"It was solid brass," Noeleen says, "and it had 24 arms hanging around the centre." Grandpa Fabes replaced thousands of broken crystals, the entire job taking more than a month.

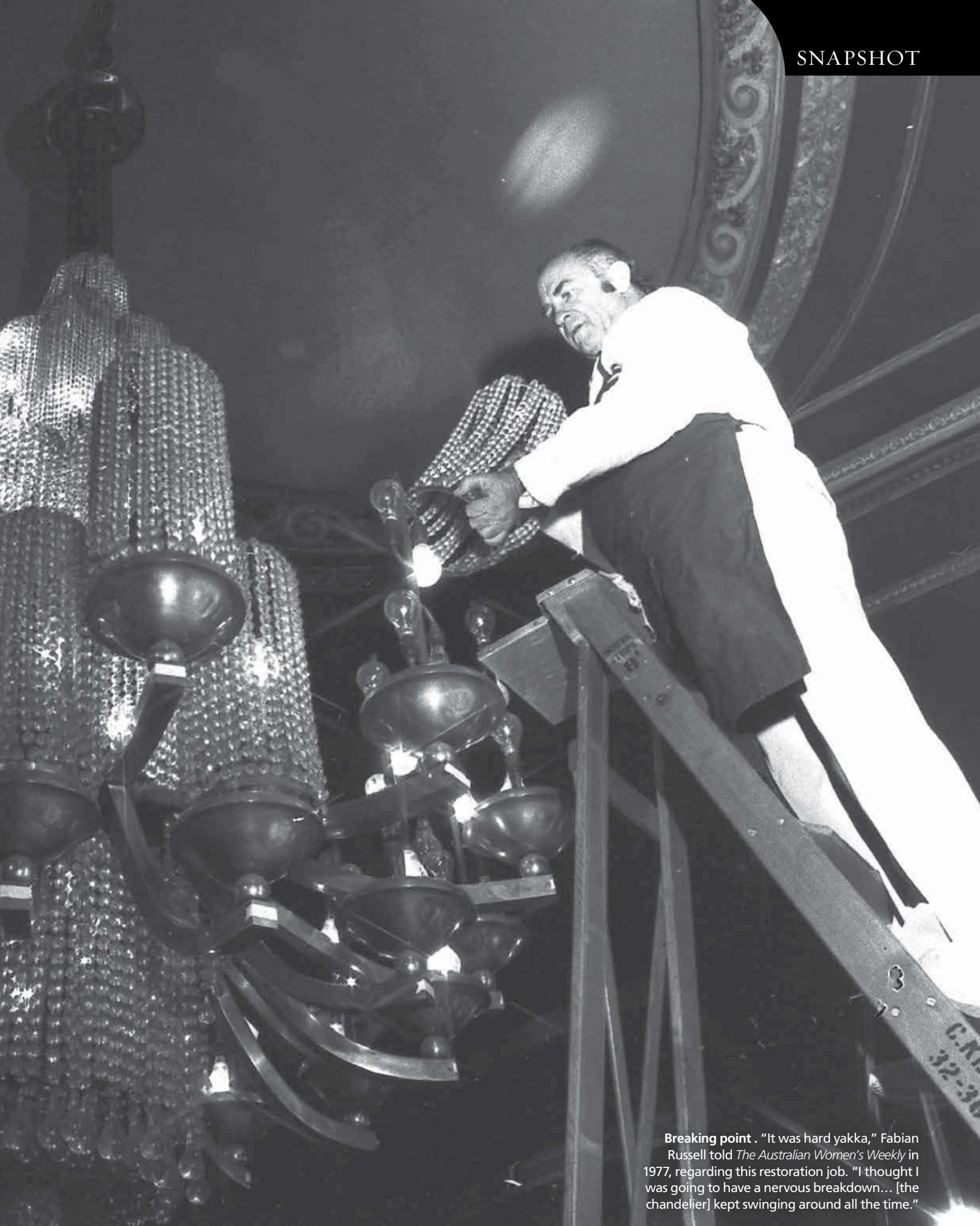
He had a secret, "magic" cleaning formula, says Noeleen, and they always came up "sparkling clean". A talented craftsman in his own right, Grandpa Fabes also salvaged parts to make chandeliers. "He'd go to auctions and junk shops," says Noeleen, "see the frames and think, 'I can do something with that.'" I remember sitting beside him in his garage when I was little, watching as he jemmed wire through the hearts of crystals, his fingers quick and nimble, his eyes as bright and speckled as the little sparklers.

And it was this eye for detail that saw him through to the end. Before he died in 2009 at the age of 79, he had Noeleen bring pliers into his hospital room, so he could make wind chimes for the nurses. "He was a rascal, that's for sure," she says. "But he got a lot of joy out of making people happy."

AMY RUSSELL is AG's chief sub-editor; her last piece was *The makers* (AG 121).



KEITH BYRON



**Breaking point .** "It was hard yakka," Fabian Russell told *The Australian Women's Weekly* in 1977, regarding this restoration job. "I thought I was going to have a nervous breakdown... [the chandelier] kept swinging around all the time."

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**Top shot.** Greg Mortimer (below), having just become one of the first Australians to summit Everest, holds up prayer flags. He arrived late, he says, at roughly 9pm. Prior to this, the team (right) had waited in Advanced Base Camp for a break in conditions as avalanches complicated their route up the snow-covered gorge, known as the Great Couloir (below centre).



LOOKING BACK AT AN AUSSIE FIRST

# Victorious few

This year marks 30 years since Australians first summited Everest. On the way they named 'White Limbo', one of the peak's diciest routes.



**Mountain men.** From left to right: Greg Mortimer, Andy Henderson, Geoff Bartram, Tim Macartney-Snape and the late Lincoln Hall. Here they are huddled around Swiss maps shortly before attempting the summit. On Everest's lower slopes Greg (above centre, at right) and Andy had time to chat. Aussie flags (right) were planted along the route.

**T**HIRTY YEARS AGO, in September 1984, a group of young men from the flattest continent on Earth gathered at the base of our planet's highest peak. It wasn't merely that they were attempting to be the first Australians to reach the summit of Everest – it was the method by which they intended to do so. Climbing from Tibet, they planned an audacious ascent directly up the North Face's most striking feature: the Great Couloir. The route had been attempted just once, two years earlier, by a team of the USA's best climbers. They'd failed halfway up.

The Americans returned in 1984, only to find one of the smallest expeditions ever to attempt 8848m Everest already on the way up. The Aussie team had five members: Greg Mortimer, Tim Macartney-Snape, Andy Henderson, the late Lincoln Hall and Geoff Bartram. None of the team had previously ventured above 8000m.

Moreover, they were eschewing supplementary oxygen. Just 10 climbers, including Sherpas, had at that stage summited Everest without oxygen and survived. It all added to the mission's outlandishness. Members of the USA team said that if the Aussies could pull this off, it would be the climb of the century.

"[The expedition] was unconventional," says Greg Mortimer, now in his 60s and living in NSW's Blue Mountains. "It was very small. It was lightweight. We were on a vegetarian diet. We didn't have porters. We did all our own carrying. And we didn't have much money." In fact, not using oxygen wasn't merely alpine ethics. It was partly, Greg has said, "Australian pragmatism", as oxygen was "very bloody expensive".

Yet being Australian had its advantages. "I've come to think with the passage of time it was something on our side," he says. "Unlike the Europeans, or perhaps British, [we weren't] burdened with the achievements of our forebears." Even the lack of funds had its positives. The expedition was

in serious financial difficulties until Channel Nine agreed to sponsor it in exchange for filming rights. When an avalanche buried supplies, the film crew's spare equipment was a godsend.

Howard Whelan was one of the cameramen. Long-time AUSTRALIAN GEOGRAPHIC readers will recognise the name; he was the journal's founding editor. "Up the mountain, we got a newspaper clipping saying Dick Smith wanted to start a geographic magazine. I wrote to Dick saying I'd like to be involved somehow. And I gave that letter to one of the yak herders who bought the mail up. He took it to base camp, handed it to our Chinese liaison officer, who then handed it to a German trekking group. They then took it to Lhasa and actually posted it."

## You can see the curvature of the Earth...

Returning to Sydney, Howard found a message saying Dick wanted to meet him; he stayed with the journal for the next 17 years.

Relentless storms pummelled the expedition. When the loaded snow inevitably shifted, avalanches ripped down the Great Couloir. The climbers hunkered down, retreating to Advanced Base Camp when necessary. Days turned into weeks. Weeks into a month. It required inordinate patience, especially, says Greg, "because of all the big unknowns. Time ticks by differently." They dubbed the route "White Limbo".

Meanwhile, the altitude took its toll. Suffering a likely cerebral oedema, Geoff Bartram abandoned his bid. On summit day, 3 October, soon after leaving high camp at 8150m, so too did Lincoln Hall, fearing frostbite. It was brutally cold, yet sunny and windless

– a perfect day for climbing. Right on dusk, first Tim then Greg reached the summit. "It was more than I expected," says Greg. "You can see the curvature of the Earth and the darkness of the upper atmosphere."

Andy Henderson, unfortunately, wasn't with them. Delayed by a broken crampon, he turned back agonisingly close to the top, just 50 vertical metres shy. "As far as I'm concerned, he climbed it," says Greg.

But Andy had more pressing concerns than summing: his hands were frostbitten. Greg, too, was in a poor state on the descent, semi-conscious at times. "I was a basket case," he admits. He fell at one point, tumbling 300m, and was lucky to survive.

Yet with assistance all made it down safely, although Andy's fingers required amputation. Today, he's sanguine about that. "If there's any significant emotion it's that we were extremely lucky and extremely privileged," says Andy, now living in New Zealand. "And it's shown me the power of friendship." Greg agrees: "What's happened with the passage of years is that the climbing has become less important, and the people more important."

Tim returned to Everest in 1990, walking 1200km to become the first to climb it from sea level. When he established an outdoor goods company – now one of Australia's largest – the name, fittingly, was Sea to Summit. Greg, also in 1990, became the first Aussie to scale K2. He went on to focus on Antarctica, where he now leads expeditions. "There's a commonality," he says, "between the Polar regions and high mountains: an otherworldliness, and a sense you shouldn't stay."

Nonetheless, with its violent extremes of altitude, avalanches and exposure, few places are more inimical to existence than White Limbo. In fitting testimony to the route's audacity, it has never been repeated. "It seems to have scared people off," says Greg. "With good reason."

JAMES McCORMACK



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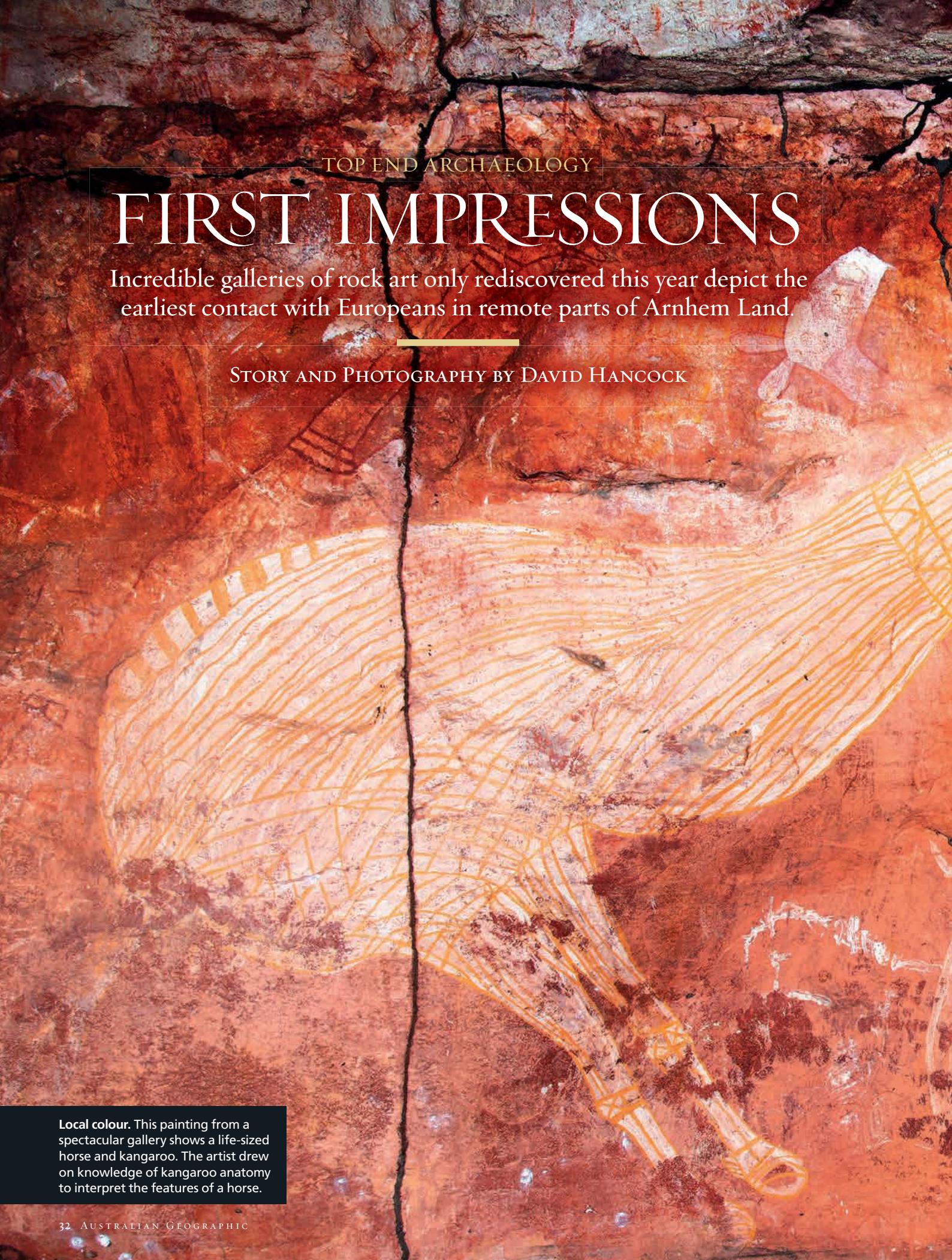
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TOP END ARCHAEOLOGY

# FIRST IMPRESSIONS

Incredible galleries of rock art only rediscovered this year depict the earliest contact with Europeans in remote parts of Arnhem Land.

STORY AND PHOTOGRAPHY BY DAVID HANCOCK

**Local colour.** This painting from a spectacular gallery shows a life-sized horse and kangaroo. The artist drew on knowledge of kangaroo anatomy to interpret the features of a horse.

NEW DISCOVERY



**A**T BULURR BERDNO, in western Arnhem Land, a crystal clear creek runs between layered grey sandstone, and a stubble of green tussock grass and nectar-laden mela-leuca flowers colour the landscape. Indigenous Australians have visited this remote wet-season refuge atop the Arnhem Land plateau, in the Northern Territory, for thousands of years.

Evidence of occupation is everywhere: polished sandstone benches on which families sat and socialised; charcoal from generations of cooking fires; and smooth hollows in the rock where artists crushed ochre and other materials for paint and women ground seeds. Like many areas of remote western Arnhem Land, the rock art of Bulurr Berdno dates back more than 30,000 years. Here, small dynamic figures of hunters and animals in flight, and spirit figures with dramatic head-dresses, survive in red outline because they were drawn in an iron-based compound that soaked into the rock.

Newer images show extinct creatures such as the thylacine, while others trace sweeping changes in climate and the appearance of new species, including fish, reptiles and birds. Some of these Aboriginal artists depicted scenes in great detail and used vivid colours to explain the natural and supernatural world they saw around them. The artworks were also used to instruct and entertain people in their family groups as they followed the seasonal cycles of wild food.

The most recent rock art at Bulurr Berdno is barely 100 years old and was painted when indigenous people from this area first encountered Europeans in the mid-19th century. Covering about 600ha, the site contains hundreds of rock paintings that were only recently rediscovered by Aboriginal rangers carrying out land management work of burning and feral-animal control. This 'contact' art, which has never been photographed before, contains indigenous first impressions of the ghostly white creatures who wore hats and boots,



**Sailing into history.** A craft with a triangular sail (above) and eight people on board could be a small vessel launched from a large sailing ship. Explorer Ludwig Leichhardt (left), who passed through in 1845, is thought to feature in several paintings.



**The art forms a kind of reportage – like a modern-day TV or newspaper report.**

smoked pipes, often arrived in sailing ships, rode horses and carried guns.

Many drawings were likely made by people who travelled to the coast, observed the newcomers and returned to the stone country to tell their families of the experience. And so the art forms a kind of reportage – it can be likened to a modern-day TV or newspaper report, but because the original artist is no longer alive, we can only speculate on their interpretation of the images.

Some of these indigenous artists were challenged in recording aspects of Western animals and lifestyle. For example, paintings of horses made them appear as though they had the anatomy of a kangaroo, emphasising a large rump and powerful hind-quarters, but with narrow bodies and

chests. Nevertheless, the horse paintings, and those of other large creatures such as buffalo, are often life-sized and spectacular.

The artists were sticklers for detail – their paintings of rifles, shotguns and revolvers are often so accurate it is possible to determine the model and make of the weapon – quite a feat considering many artists probably only observed guns from a distance.

Peter Cooke of Warddeken Land Management, the organisation responsible for the Arnhem Land plateau area, says the artists must have been greatly impressed by rifles as a hunting tool, and that is why they are recorded hundreds of times in the rock-art galleries of the stone country.

The artists also showed a sense of humour. On a relatively exposed ▶

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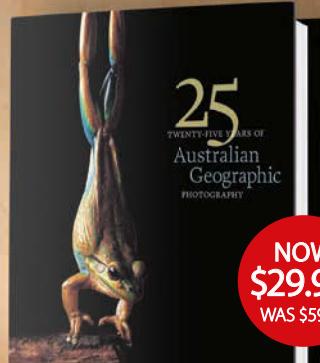


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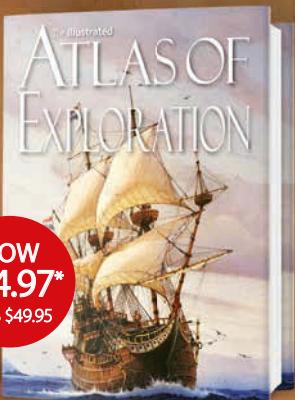
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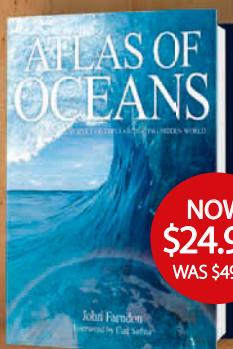


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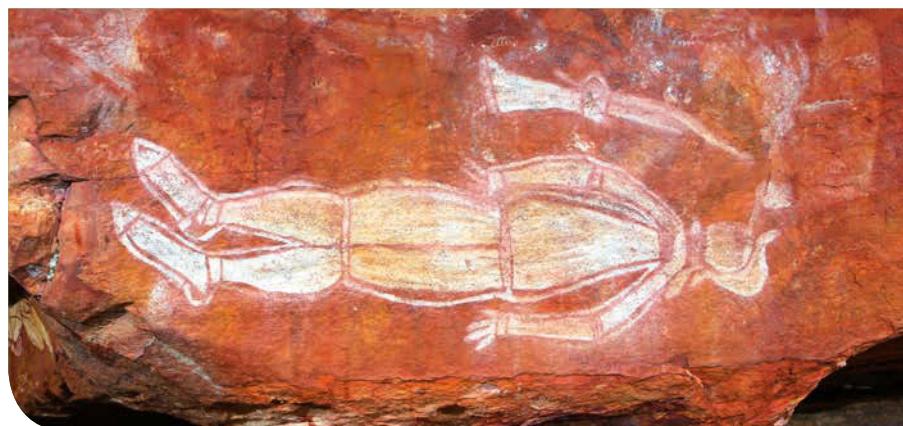
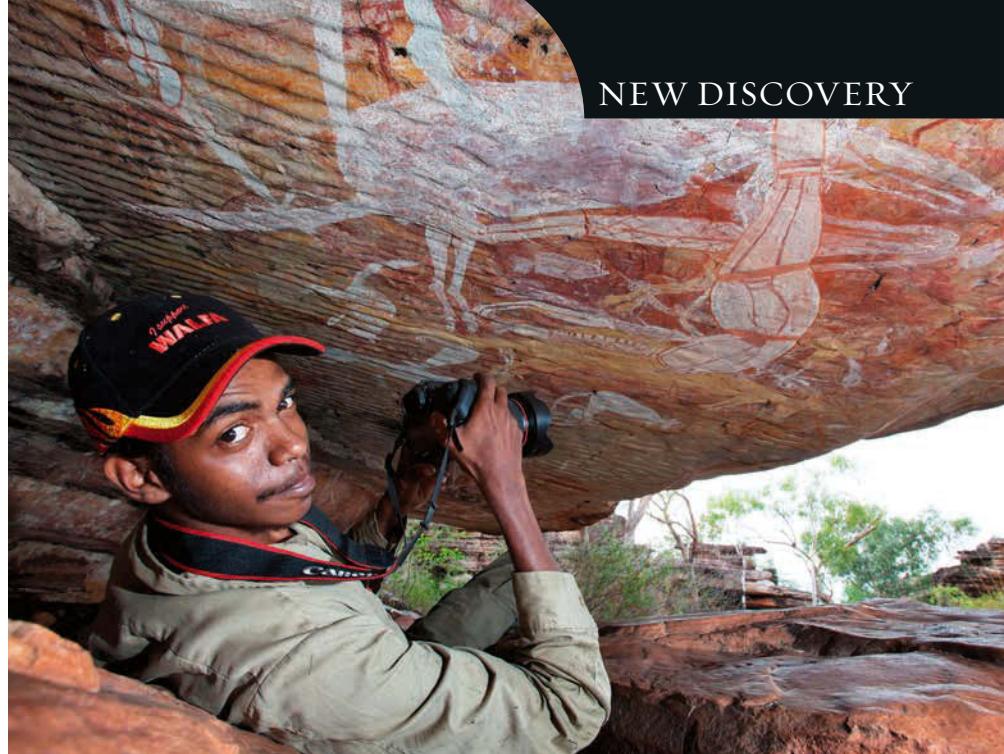
**Rocky relics.** Warddeken ranger Gavin Phillips (top) photographs artworks as part of efforts to document them. Rifles and European clothes (bottom) are some of the features carefully depicted in the rediscovered paintings.

rock wall at Bulurr Berdno there is a brilliantly composed picture, drawn more than 70 years ago, of a European bearing an axe and approaching an apprehensive rooster. "It is hard to look at the picture without hearing the laughter of an audience echoing down the decades as the tale is told and the illustration rendered," Peter said. "The novel and unusual use of perspective adds to the idea that this is indeed a 'rooster's-eye view' of an incident of life and death on the frontier."

At another site, painted on a rocky ceiling, is an illustration of a man wearing unusual headgear, atop a stiff-legged horse. The man is believed to be explorer Ludwig Leichhardt who passed through Arnhem Land en route to Port Essington, in 1845. Peter says there are at least two sites displaying interpretations of visits of Ludwig and David Lindsay (1883), and the drawings correspond neatly with entries from the explorers' diaries. "As we go along looking at these paintings and compare them to European records, some areas of the historical jigsaw come together nicely," he says.

"Leichhardt had lost his hat early in the expedition and was wearing a canvas bag as a head covering," Peter says. "The headwear in this image does not conform to usual ways of drawing European hats and the painting is not far from the route travelled by the expedition. The artist has chosen to show the horse, a mare, urinating – which explains the odd, stiff-legged stance."

Daryl Wesley, an authority on contact period rock art at Australian National University's natural history department, says the paintings are not only culturally and socially significant, but also have deep historical and heritage value. "They are a bridge between two cultures," he says. "This area is one of the leading regions of the world to show indigenous people interacting with another culture. It is a direct indigenous record that does not rely upon European records. The



paintings are a unique view of the Bininj [Aboriginal people of western Arnhem Land]. It is significant to them, and it should be to us."

Indigenous people drifted away from the Arnhem Land plateau in the early to mid-20th century, embracing aspects of European life in buffalo camps, mines and missions on the lowland and coastal areas and in townships such as Oenpelli and Pine Creek. The plateau was almost deserted until the 1970s and '80s, when some older people returned to their traditional lands.

Some, such as the recently deceased Lofty Bardayal Nadjamerrek AO, knew the country from their youth, but other traditional owners are now rediscovering the rock-art galleries and have taken on trying to preserve them, along with other land management responsibilities. According to Terah Guymala, CEO

of Warddeken Land Management, although many rock paintings have survived thousands of years, the most recent 'contact' paintings are critically endangered, because the soft, ephemeral pigments used to create them are the most fragile.

"We return to these places to clean the country up so fire and other things do not damage the paintings," Terah says. "Vegetation can rub against the paintings when the wind blows, and buffalo and pigs can cause damage as well. These are important places for our people; they tell the story from our point of view of what happened when Aboriginal people first met white people. I believe these paintings are very important to the whole of Australia." AG

► DAVID HANCOCK's exhibition, *Fragile First Impressions*, will be shown at The Gallery, Canberra Grammar School, 6–13 September.

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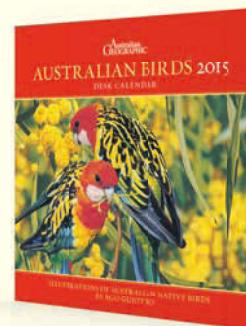


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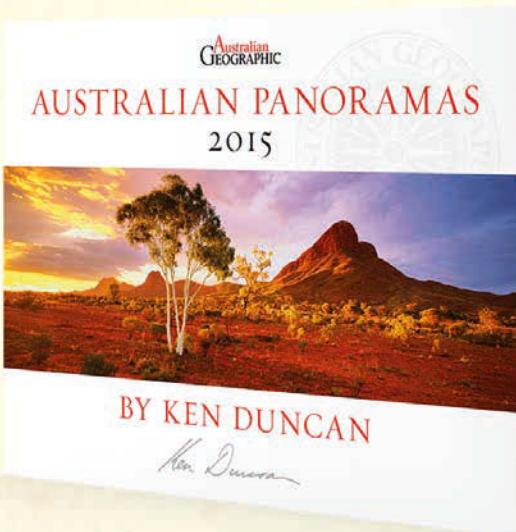
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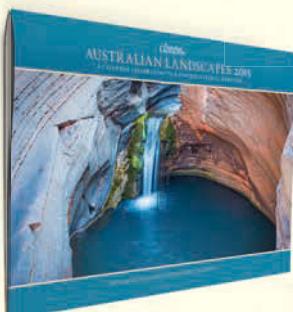


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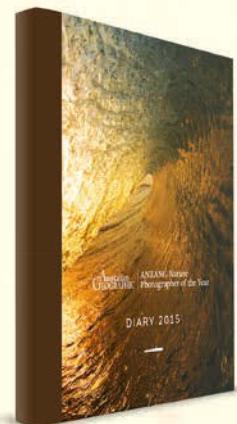


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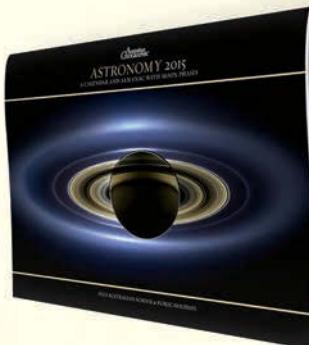


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THOMAS H. RICH

# Why so few dinosaurs?

Although Australia and Antarctica are contenders for the continent with the poorest record of dinosaurs, there is a unique opportunity for discovery Down Under.

**I**T IS NOT hard to understand why Antarctica has the weakest dinosaur record. After all, 98 per cent of it is now covered with ice. But why Australia should be a contender for that distinction is not so obvious.

A palaeontologist seeking dinosaurs prefers to go to rapidly eroding, hilly regions with little vegetation. High erosion rates mean that the chemical processes of weathering that otherwise might destroy bones may not have had sufficient time to do so. The topography means that if fossils are present, they can be readily seen. Much of Australia is both flat and ancient, and so benefits from none of these advantages.

The vast majority of Australia's 17 or so known dinosaurs have been found in three parts of the nation. Over the past 15 years, on the flat plains of central Queensland, the Queensland Museum, working with the Australian Age of Dinosaurs Museum, has developed a method of recovering dinosaurs that is yielding spectacular results. When fossil fragments sent to the surface by cycles of wetting and drying are discovered, a bulldozer removes about a metre of overburden to reveal the larger fossils beneath. This has resulted in the fantastic discovery of the partial skeletons of a number of larger dinosaurs.

In outback New South Wales and South Australia, isolated bones are found in the opal fields. Nowhere else on the planet can you find opalised dinosaur fossils, translucent enough for light to pass through them. These specimens are casts formed in cavities left by the bones of small dinosaurs and marine reptile that have dissolved away.

Coastal Victoria is the third place that yields Australian dinosaurs. Rapid erosion caused by pounding waves has exposed a strip of unweathered rock



about 20m wide and 150km long – a total area of only 300ha. But it has been sufficient to yield an assemblage of dinosaurs as diverse as Queensland's. The coastal outcrops typically consist of hard sandstone deposited in stream channels. The isolated bones and teeth found in them were washed there from the place the animals died and their skeletons fell apart.

One Victorian site slightly further inland, however, is quite different. Exposed in a road cut on the South Gippsland Highway east of Koonwarra, it has yielded half-a-dozen feathers, which are of the right age to be either from early birds or feathered dinosaurs.

In contrast to the coastal sites that primarily preserve isolated bones and teeth, Koonwarra was a quiet lake that potentially could yield entire feathered dinosaurs. It lay in a vast floodplain between Australia and Antarctica while they were in the process of separation 115 million years ago. Across this floodplain flowed massive rivers; ephemeral lakes such as that at Koonwarra came and went on the margins of those rivers.

As well as feathers, the fossil remains of small fish, insects, and plant material are found here. These are the same

kinds of fossils that are abundant in the lake deposits of Liaoning province in north-eastern China, which are of a similar age (125 million years old) and have yielded thousands of fossils of feathered dinosaurs (see our feature on page 68). The similarity in the ancient environment and the common fossils, as well as the rare occurrence of feathers at Koonwarra, suggests that it could become the first Australian site to yield feathered dinosaurs.

Provided \$400,000 can be found from private and public sources, I will lead a major dig in 2017 to determine whether this is the case. An exploratory excavation in 2013 gave us pointers on how to proceed, but we don't yet know whether the lake covered 10ha or 100ha, or if the existing fossils are from the centre or the shore. Finely preserved dinosaurs with soft tissues as well as bones would most likely come from shore deposits, so this may determine whether whole skeletons can be found there or their feathers only.

Elsewhere in Gippsland's Strzelecki Ranges, there may be dozens or even hundreds of similar ephemeral lakes, but trees and grass now obscure the deposits. In coming decades, as technology advances, methods such as ground-penetrating radar may advance to the point where the lake deposits can be detected without excavation, and the most promising parts investigated.

Even if Koonwarra itself does not yield skeletons of feathered dinosaurs, with persistence, perhaps by someone as yet unborn, a site with fossils as spectacular as those of Liaoning may one day be found in South Gippsland.

DR THOMAS RICH, at Museum Victoria in Melbourne, has been involved in the discovery of many of the state's dinosaurs.

Australian  
GEOGRAPHIC | ANZANG Nature  
Photographer of the Year

# BOLD, BRIGHT AND BEAUTIFUL

Enjoy these stunning shortlisted images from the 2014 Australian Geographic ANZANG Nature Photographer of the Year competition.

Each image is finely crafted, but there can only be one winner – the results will be announced at the South Australian Museum on 9 October.



#### WATCH

Use the free **viewa** app to scan this page to view all the shortlisted entries in the Australian Geographic ANZANG Nature Photographer of the Year competition, 2014.

ANIMAL BEHAVIOUR

PROBE  
ICHNEUMONID WASP

Jesse McCoulough, New South Wales

This wasp taps her antennae – which are sensitive to vibrations and scent – in search of a suitable host larva upon which she will lay her eggs using her long ovipositor. After hatching, her young will feast on the host while it is still alive.

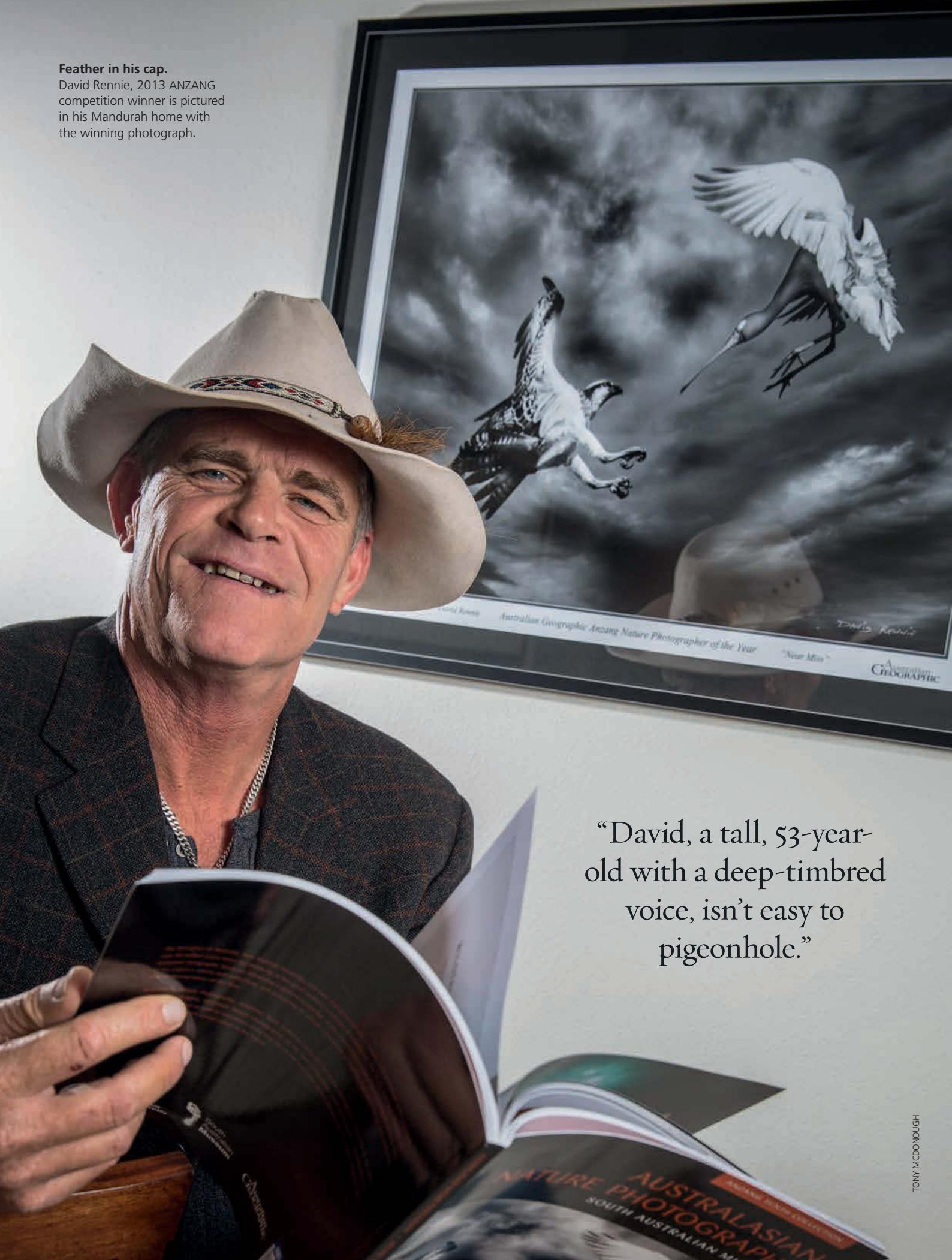
Centennial Park, Sydney, New South Wales

Canon EOS 400D, Canon 100mm f/2.8 macro,  
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**Feather in his cap.**

David Rennie, 2013 ANZANG competition winner is pictured in his Mandurah home with the winning photograph.



“David, a tall, 53-year-old with a deep-timbred voice, isn’t easy to pigeonhole.”

# WORTH A THOUSAND WORDS

David Rennie began photographing the fluttering birds of Mandurah's wetlands as a balm for his struggles with bipolar disorder. But winning ANZANG in 2013 changed his life and let him cast light on two very personal causes.

**D**AVID RENNIE, the 2013 Australian Geographic ANZANG Nature Photographer of the Year, would be a familiar name to wildlife photography lovers, but his winning image has made an impact well beyond those circles. It has also touched two other groups: Australian sufferers of bipolar disorder, and communities living near the 26,000ha internationally significant Ramsar-listed wetlands at Mandurah, 80km south of Perth, Western Australia.

When we spoke to David in July 2014, he had just arrived back from the eastern Kimberley region, having accepted an invitation from Jawun, an indigenous corporate partnership group, to shoot landscapes there. He had also just completed his prize-winning voyage in the Kimberley with Lindblad Expeditions. "It's been the most incredible year," he said. "You're not going to be able to cover it all in the space you've got."

David won the competition for his black-and-white image *Near Miss*, which depicts a startled spoonbill and a juvenile osprey barely avoiding a midair collision at Mandurah. After an ABC journalist saw David speak at the ANZANG awards night in Adelaide in October 2013, David's family was also put in the spotlight; *Australian Story* ran a half-hour segment on him in March. In it his brother, sister, and his wife spoke frankly about the fact that David had been diagnosed with spinal arthritis and bipolar disorder, causing him to cycle through phases of mania, (when he's highly active), and depression.

"The Rennies are very bright and each of the siblings is very different," said Belinda Hawkins, the *Australian Story* producer. "David, as his siblings say, was the 'black sheep' and so I think he was just dumbfounded that people would want to look at his pictures."

David, a tall 53-year-old with a deep-timbered voice, isn't easy to pigeonhole. He said his life began modestly enough on farms in WA's arid south-east and that's why he later fell in love with the lush wetlands around Mandurah. He's had a busy and varied life, which has included managing a lucrative car dealership and running a small-scale furniture manufacturing business. But the ultimate success of these ventures was often hampered by his mental health. David, who is now retired, settled in the Mandurah area 19 years ago with financial help from his brother, Michael, a former Rhodes scholar and a managing partner at a consultancy firm in Sydney.

With an intensity that's typical of his personality, David became captivated by Mandurah's wetland system in 2007 and

photographed there daily for three years. During his long stints at the site – sometimes 36 hours at a time – he became aware of environmental degradation, caused by local pollution. "One day I walked out in the shallows to the same spot where I'd stood on firm ground a year before," he said. "I was concentrating on an eagle, and suddenly I sank calf-deep into black mud."

When the ABC approached David last year, he and his family agreed to work with them in the hope the program would highlighted the conservation issues for Mandurah's Peel-Yalgorup wetlands. "It became apparent," Belinda said, "that there was...a big problem with those wetlands and that the quality of the water was impacting the fish and therefore the birdlife."

David had chronicled the degradation in some of his photography and this evidence was backed up by scientists who had studied the conditions at the site. On investigation, Belinda devoted one-third of her program to the creep of oxygen-depleted black ooze into the area.

Although he rarely photographs birds, now, due to complications with his arthritis, David works with the local Peel-Harvey Catchment Council, using his images to raise awareness in schools and the community. On the council's agenda, says CEO Jane O'Malley, is a proposal to establish an annual David Rennie Clean-up Day that would use his images to advertise the arrival of migratory birds in October every year.

As media attention grew around his ANZANG win, mental health organisations also began contacting David – after *Australian Story* aired he received roughly 3500 emails over four days. Mostly they said: "Thank you for having the courage to tell the truth." Because of the stigma attached to bipolar, David said. "I've had face-to-face meetings with [parents] and talked with them...about how they can nurture children with bipolar and allow them to be creative. I think it gave them an enormous amount of hope and new ways to look at things."

Belinda described David as thoughtful in his responses regarding the issue. "He's obviously had time to reflect on his life and upbringing and also his frailties," she said. "He speaks really beautifully about how concentrating on the movement of birds and the paths they might take...let him go into a world outside his own."

The program's reception also underlined his images' appeal. "I suppose that's something we hadn't anticipated," Belinda added. "How much wildlife photography does strike a chord."

NATSUMI PENBERTHY

## Australian GEOGRAPHIC

ANZANG Nature  
Photographer of the Year

AND THE WINNER IS?

ON 9 OCTOBER 2014,  
find the overall winner  
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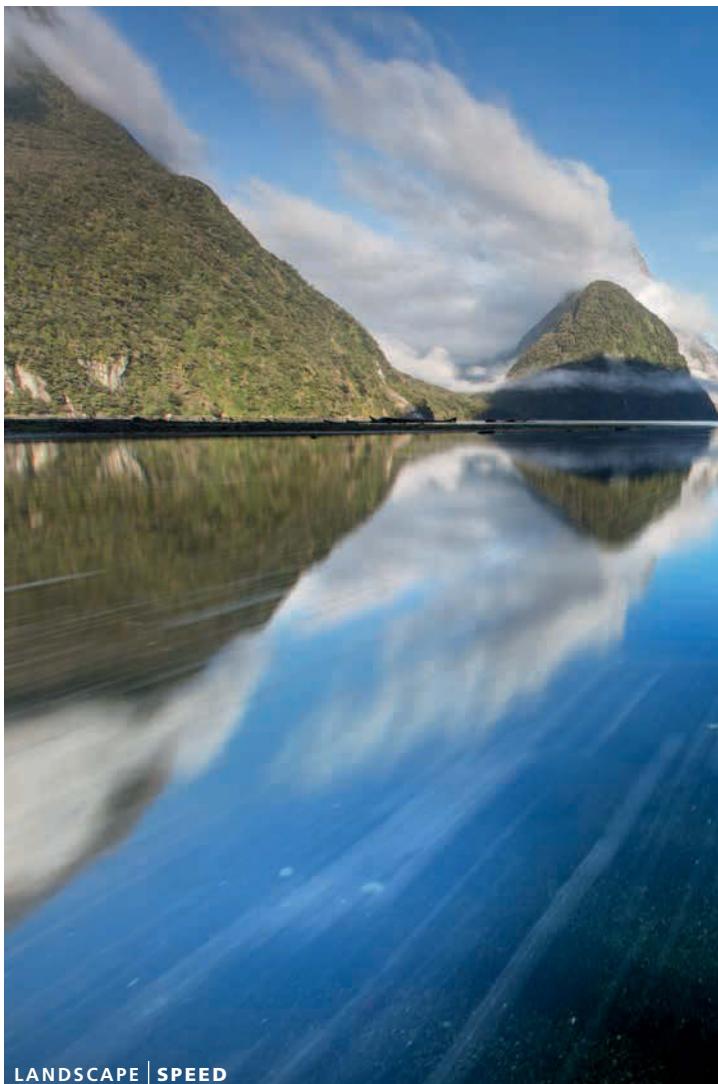
## SPEED

**Kah Kit Yoong, Victoria**

Finding a foreground that did justice to New Zealand's most majestic landscape has been an elusive task for me over the years. However, early one morning, standing in the midst of a rising tide, a long exposure provided a dynamic perspective to capture the motion in the water.

**Milford Sound, South Island, New Zealand**

Canon EOS 5D Mk III, Canon 16–35mm f/2.8L II, 4 seconds, f/22, ISO 50, Really Right Stuff TQC 14 tripod, BH-30 ballhead



LANDSCAPE | SPEED

## PHYSALIA PHYSALIS

**BLUEBOTTLE**

*Physalia physalis*

**Matthew Smith, New South Wales**

Despite its potentially dangerous sting, the bluebottle zooid is a beautiful creature. I wanted to demonstrate this with careful lighting and composition. On this particular morning a whole armada of them had been blown into this little bay and were trapped overnight.

**Bushrangers Bay, Shellharbour, New South Wales**

Nikon D300S, Nikon 10.5mm f/2.8 fisheye, 1/320, f/13, ISO 320, Inon Z220 Strobe, Blusnoot Fibre Optic Snoot, Aquatica for D300S, Aquatica 8" Acrylic Dome Port, handheld

## WANAKA WILLOW

**CRACK WILLOW**

*Salix fragilis*

**Marc Lynch, New South Wales**

On my first trip to New Zealand, I travelled to Lake Wanaka specifically to photograph a willow in the lake. With a backdrop of snowcapped mountains, the lone bonsai-like willow stands in the stillness at dusk.

**Lake Wanaka, South Island, New Zealand**

Canon EOS 5D Mk II, Canon 17–40mm f/4L, 78 seconds, f/9, ISO 100, Manfrotto tripod

## DEVOTED MOTHER

**HUMPBACK WHALE**

*Megaptera novaeangliae*

**Vanessa Mignon, New South Wales**

Humpback whales migrate to Tonga every year to mate, give birth and nurse their calves. This mother whale is supporting her young baby close to the surface, possibly to help it breathe as it sleeps.

**Kingdom of Tonga**

Canon EOS 5D Mk III, Canon 16–35mm f/2.8L, 1/160, f/8, ISO 320, Nauticam



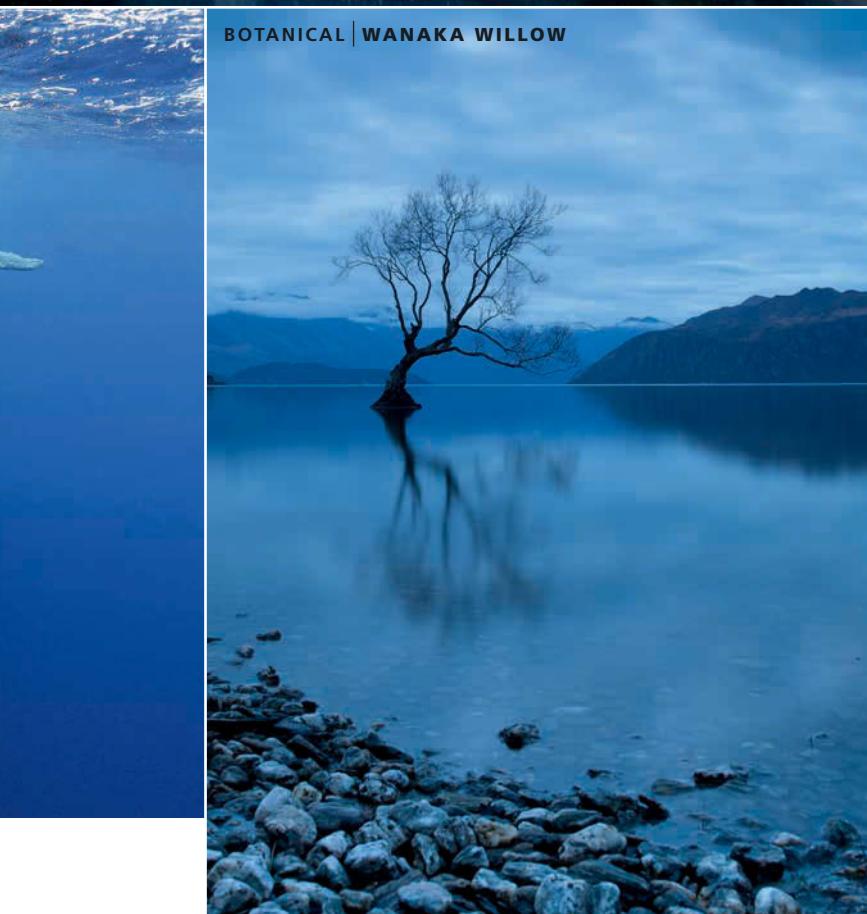
ANIMAL BEHAVIOUR | DEVOTED MOTHER



Australian  
GEOGRAPHIC | ANZANG Nature  
Photographer of the Year



ANIMAL PORTAIT | PHYSALIA PHYSALIS



BOTANICAL | WANAKA WILLOW



INTERPRETIVE

BATS IN BLUE  
GREY-HEADED FLYING-FOX  
*Pteropus poliocephalus*

Marc Lynch, New South Wales

Australia's largest bat, the grey-headed flying-fox, is listed as vulnerable on the IUCN Red List of Threatened Species. I wanted to capture the bats' fluttering frenzy as the colony left its roost after dusk to travel about 50km to feed.

Balgowlah, New South Wales

Canon EOS 5D Mk II, EF8–15mm f/4L fisheye USM + EF100–400mm f/4.5–5.6L IS USM, multiple exposures; 1/6–1 second, f/6.3–f/14, ISO 250–ISO 640, Canon 580 EX II Speedlite, Manfrotto tripod

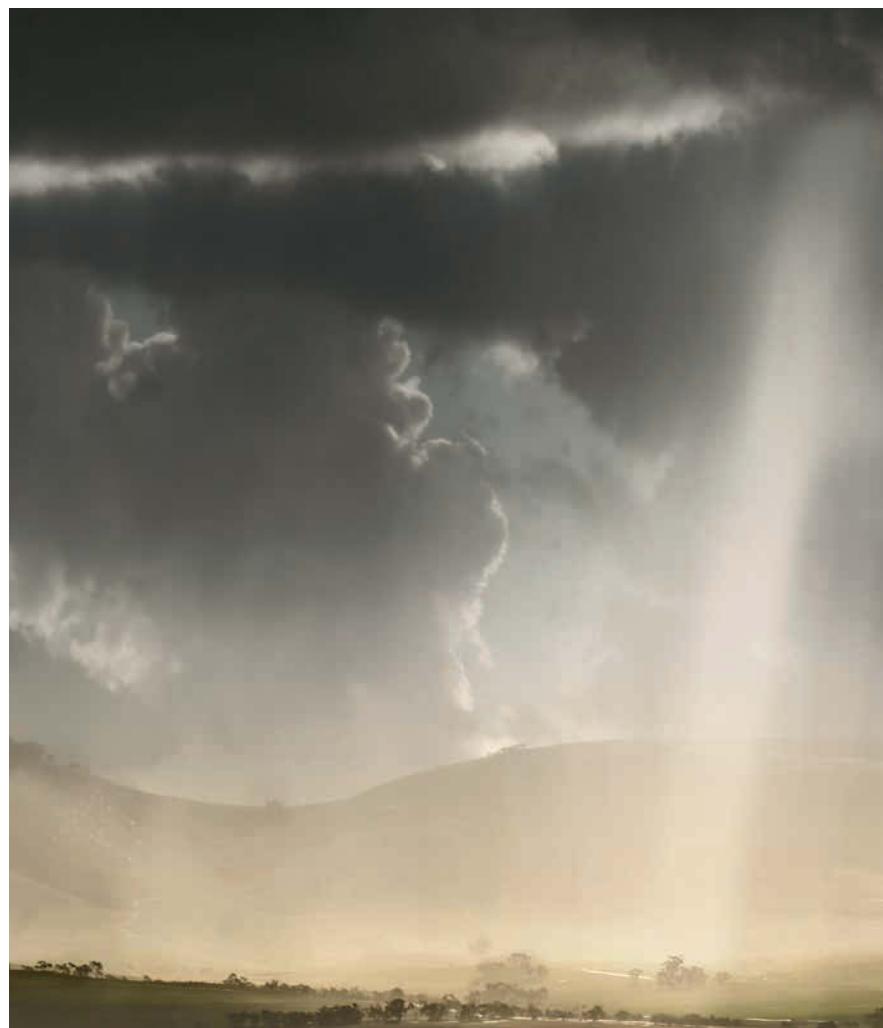
## SKY DRAMA

Julie Fletcher, South Australia

I was driving into Lochiel through some stormy weather when I saw the light shafts presenting nature at its best. I pulled off to the side of the highway to capture this image. If you look closely, you can see the shape of a person in the image.

Lochiel, South Australia

Nikon D800, Nikon 70–200mm f/2.8, 1/640, f/8, ISO 100, handheld



## REGENT FLIGHT

### REGENT BOWERBIRD

*Sericulus chrysocephalus*

Ofer Levy, New South Wales

This male regent bowerbird was photographed at O'Reilly's Rainforest Retreat, where these birds are familiar with people and offer great photo opportunities. Only the male has the beautiful bright colours. He typically builds a big bower where he tries to impress the females and mate with as many of them as possible during the breeding season.

Lamington National Park, Queensland

Canon EOS 1D Mk IV, Canon 300mm f/2.8L IS plus 1.4x extender 420mm, 1/3200, f/7.1, ISO 1250, handheld

## FROG FACE

### GREEN AND GOLDEN BELL FROG

*Litoria aurea*

Status: Vulnerable

Angela Robertson-Buchanan, New South Wales

Green and golden bell frogs were once common on the south-east coast of Australia, but populations are in a critical decline due to habitat loss, pollution, disease and introduced fish that prey on tadpoles.

Wild Life Sydney Zoo, Darling Harbour, New South Wales

Micro Nikkor 105mm 1:2.8G, 1/80, f/7.1, ISO 2000, handheld

LANDSCAPE | SKY DRAMA



BOTANICAL | TWISTED REALITY



THREATENED SPECIES | FROG FACE

## TWISTED REALITY

*Xanthorrhoea* sp.

Jason Freeman, Victoria

Rarely visited pockets of forest wilderness – such as this expansive patch of Australian grass trees in flower, near the eastern park boundary – are a welcome surprise in a park that's better known for its boating and camping.

Lower Glenelg National Park, Victoria

Nikon D600, Nikkor 16–25mm f/4, 1/500, f/8, ISO 800, tripod, circular polariser



#### BOTANICAL

#### MYRTLE GLADE UNIDENTIFIED SPECIES

Ted Mead, Tasmania

Deep in the Tasmanian wilderness remains some of Australia's most pristine forest. This beautiful myrtle glade cloaked in mountain mist is one of the finest representations of primeval vegetation, which is constantly saturated in life-filled moisture and rich in ambience.

Southwest National Park, Tasmania

Nikon 800E, 14mm, 1.6 seconds, f/18, ISO 200, tripod

Australian  
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## RED-BELLIED BLACK SNAKE

RED-BELLIED BLACK SNAKE

*Pseudechis porphyriacus*

Adam Plucinski, New South Wales

Although these venomous snakes are not aggressive and prefer to avoid humans, I was happy to be taking the portrait of this red-bellied black snake in a safe environment at Taronga Zoo.

Taronga Zoo, Sydney, New South Wales

Nikon D3S, Nikkor 105 f/2.8, 1/400, f/3, ISO 450

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## MAMMALS

HUMPBACK WHALE

*Megaptera novaeangliae*

Scott Portelli, New South Wales

The moment when a 40-tonne female and her calf glide by is a privilege to say the least. Each year humpback whales migrate to warmer waters to mate and give birth, and it is an honour to witness this miracle of nature.

Kingdom of Tonga

Canon EOS 5D Mk II, Canon 16–35mm, 1/200, f/6.3, ISO 250

---

## BEFORE HE SINGS

DOUBLE DRUMMER CICADA

*Thopha saccata*

Aysha Josephson, New South Wales, aged 17

Last spring my siblings and I spent a lot of time waiting for and watching cicadas. This double drummer was the first we saw, climbing up a tree still in its shell, and we got to observe it coming out. The process is fascinating – I never tire of watching it.

Wollombi, New South Wales

Panasonic DMC-TZ20 24mm, 1/125, f/4, ISO 100, handheld

---

## WHAT DREAMS ARE MADE OF

Kah Kit Yoong, Victoria

Australia's iconic peak captured under serendipitous conditions. On average, it rains every second day in these highlands, so I was fortunate to obtain a still lake with a crystal-clear reflection, a cloudless sky without the moon and the phenomenon of strong air-glow colours.

Cradle Mountain, Tasmania

Canon EOS 5D Mk III, Canon 16–35mm f/2.8L II, 30 seconds, f/2.8, ISO 1600, Really Right Stuff TQC 14 tripod, BH-30 ballhead



MONOCHROME | RED-BELLIED BLACK SNAKE



LANDSCAPE | WHAT DREAMS ARE MADE OF



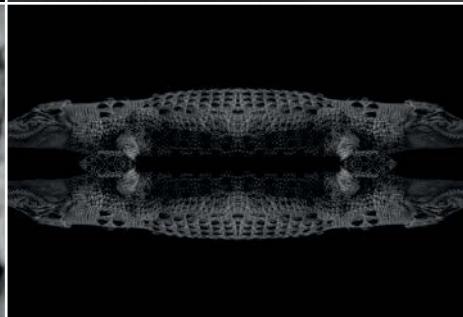
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MONOCHROME | MAMMALS



JUNIOR | BEFORE HE SINGS



#### INTERPRETIVE

#### CROCODYLUS POROSUS SALTWATER CROCODILE *Crocodylus porosus*

Oliver Sekulic, New South Wales

The saltwater crocodile represents both fear and beauty. Although it's one of Australia's most dangerous predators, it's impossible not to admire its ancient design and armour-like skin.

East Alligator River, Arnhem Land, Northern Territory

Sony Nex-5, 70–210mm at 210mm, 1/250, f/4.5,  
ISO 200, handheld



## SHARK NET SEAHORSE

WHITE'S SEAHORSE

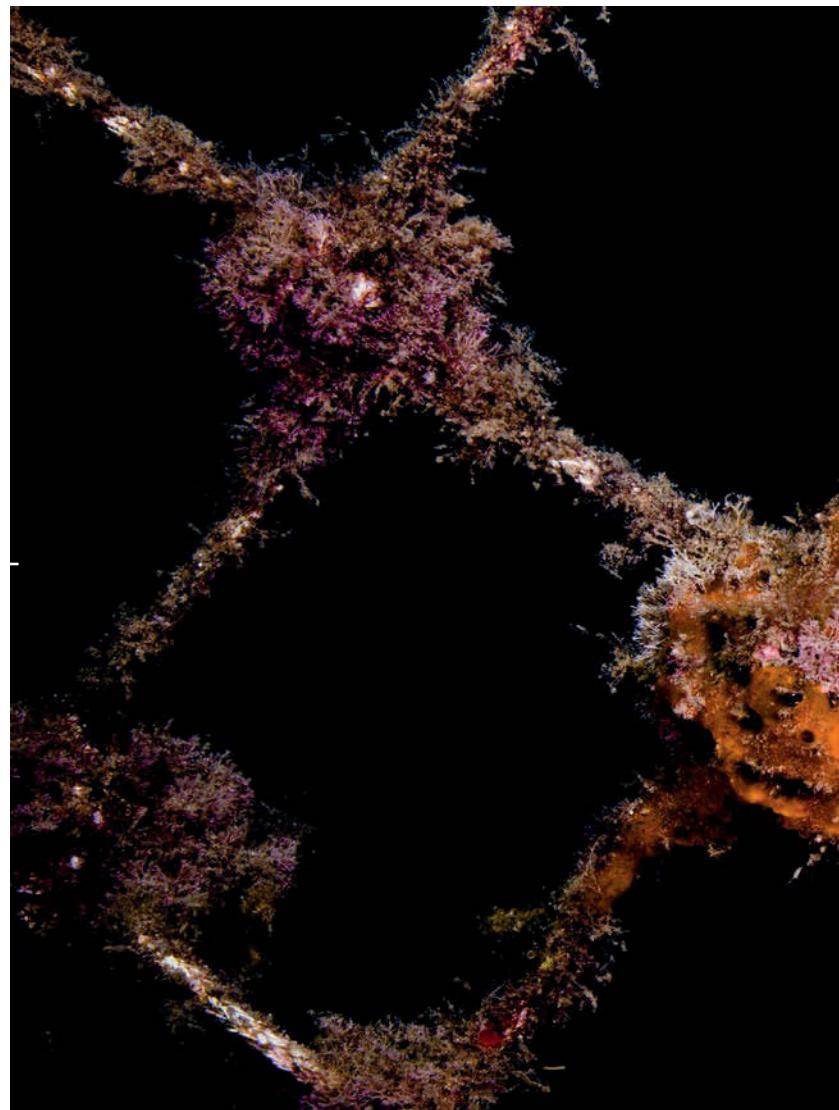
*Hippocampus whitei*

Michael Gallagher, United Kingdom

I took this photo while scuba diving in about 5m of water outside the shark net off Manly Cove. The nets are intended to provide a safe swimming area, but, at the same time, provide shelter to a host of marine creatures, including this enigmatic White's seahorse.

Manly Cove, Sydney, New South Wales

Canon EOS 5D Mk III, Canon 16–35mm f/2.8, 1/200, f/20, ISO 200, two Itron Z-240 strobes, Hugyfot housing, handheld



## MOVING HOUSE

Unidentified species

Alan Kwok, New South Wales

A few days before a storm, these ants started moving their nest to higher ground. They were carrying the pale, white, vulnerable larvae to the new home. Workers would preen the larvae with their mouthparts and antennae as they moved, seemingly to ensure they stayed free of debris.

Bensenville, New South Wales

Canon EOS 5D Mk II, Canon MPE 65mm 1–5x, 1/125, f/16, ISO 400, Canon twin macro flash, handheld

## BUSHFIRE BARREL

Darren Longbottom, South Australia

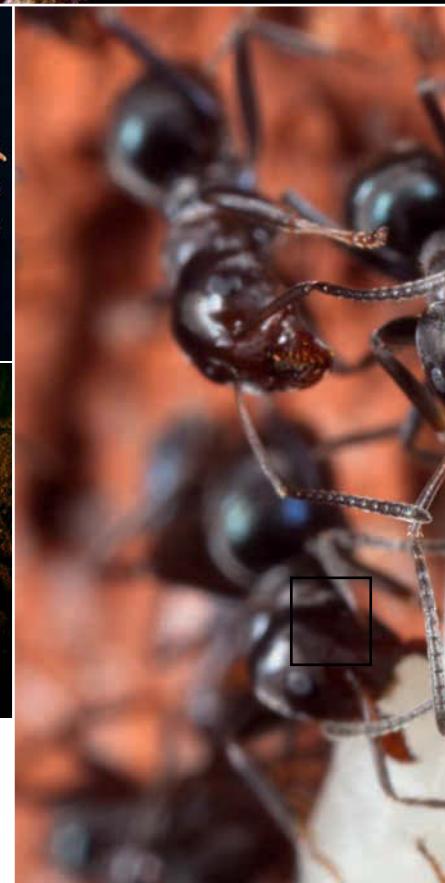
This blaze of gold in the sky, caused by a raging bushfire to the north, is an emblem of our times. There's a stunning yet unsettling tension between the hazy heat of the sunset and the soothing contours of the breaking wave.

Kirra Beach, Queensland

Canon EOS 7D, Canon 8–15mm f/4L USM fisheye, 1/1600, f/9, ISO 320, Essex surf housing with dome port



LANDSCAPE | BUSHFIRE BARREL



## A FLASH OF LIGHT

LONGICORN BEETLE

*Cerambycidae* sp.

Alan Kwok, New South Wales

There are more than 1250 species of longicorn beetle in Australia, most with elaborate antennae. The antennae of these species are usually dull brown; however, if light is flashed from behind, they become a stunning bright orange.

Bensenville, New South Wales

Canon EOS 1DX, Tamron 90mm 1:1, 1 second, f/16, ISO 200, two flashes, tripod



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**BOTANICAL**

**PARASOL FUNGUS  
IN THE MIST**

**PARASOL MUSHROOMS**  
*Macrolepiota procera*

**Raoul Slater, Queensland**

In early spring I found a pile of woodchip mulch covered in these delicate parasol mushrooms. Each morning for a week I was up early, pushing my macro lens through the fungal forest as the golden light of the sunrise bloomed behind.

**Noosa Botanic Gardens on Lake Macdonald, Sunshine Coast, Queensland**

Canon EOS 5D Mk II, Canon 100mm macro lens, 1/800, f/3.5, ISO 800, handheld



## ALCHEMY FLIGHT

### LITTLE RED FLYING-FOXES

*Pteropus scapulatus*

**Rob Smith, New South Wales**

I'd been captivated by a large colony of little red flying-foxes, camped along the Macintyre River at Inverell, NSW. The primeval, cacophonous scene – like something out of the film *Apocalypse Now* – prompted me to shoot stills of bats with backlit wings as they returned to roost.

**Macintyre River, Inverell, New South Wales**

**Olympus OMD EM-5, 50–200mm at 200mm + 2x teleconverter, 1/350, f/11, ISO 400, tripod**

## A MIDAIR DRINK

### BROWN HONEYEATER

*Lichmera indistincta*

**Steve Wilson, Queensland**

Southern Kimberley temperatures exceeded 40°C for weeks and the wildlife was severely stressed. For thirsty birds, a dripping tap was an irresistible attraction. Some timed their approach with enough precision to snatch drops in midair.

**Purnululu National Park, Western Australia**

**Canon EOS 30D, 300mm with 1.4x converter, 1/3200, f/5.6, ISO 800, tripod**

## MOUNTAIN PYGMY-POSSUM

### MOUNTAIN PYGMY-POSSUM

*Burramys parvus*

**Status: Critically endangered**

**Vincent Antony, Victoria**

This species is threatened by habitat destruction and fragmentation, climate change and predation by feral cats and foxes, as well as pressures on the bogong moth – its main food source.

**Mt Buller, North Victoria**

**Sony A77, 16mm fisheye, 1/250, f/5.6, ISO 100**

## SAND PATTERNS

**Mike Hollman, New Zealand**

I was drawn to these remarkable patterns in the sand created by the wind along the beach at Mangawhai Heads, New Zealand.

**Mangawhai Heads, Northland, New Zealand**

**Nikon D4, Nikkor 24–70 f2.8, 1/60, f/16, ISO 200, handheld**



ANIMAL HABITAT | ALCHEMY FLIGHT



THREATENED SPECIES  
MOUNTAIN PYGMY-POSSUM

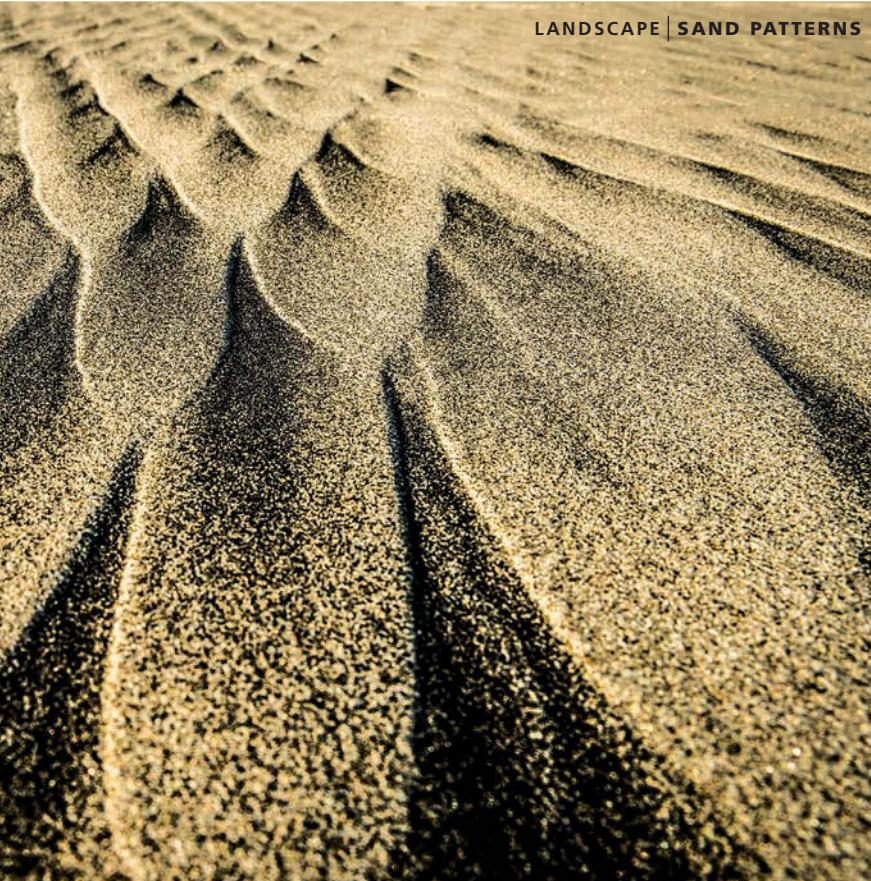




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OUR IMPACT | A MIDAIR DRINK



LANDSCAPE | SAND PATTERNS



BOTANICAL

TEMPORARY ART

Lemon-scented gum  
*Corymbia citriodora*

Murray Unkovich, South Australia

Lemon-scented gums shed their bark each summer. Little blisters appear, then burst and peel up, revealing shades of beetroot, caramel, asparagus and lime. Some of the outside bark hangs for a while, but in the end it all drops off to reveal a smooth creamy coat.

Urrbrae, South Australia

Pentax K10D, Sigma 17–70mm, 1/30, f/16,  
ISO 100, handheld

AG



# WALKING THE SOUTHERN CAPE

An east-coast gem, the Tasman Coastal Trail gives walkers access to Tasmania's highest sea cliffs and some of its most arresting views.

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STORY AND PHOTOGRAPHY BY IAN CONNELLAN AND GAIL MACCALLUM

**Sheer splendour.** Tasman National Park's east coast boasts tall cliffs and wave-washed bays. In the distance, Cape Hauy and The Lanterns are key waymarks on the 53km Tasman Coastal Trail.





**Y**OU KNOW IT'S QUIET when the loudest sound you hear is a whale breathing. We're less than a five-minute walk from the white sand of Fortescue Bay in Tasman National Park, about 55km south-east of Hobart. This is the midpoint of the Tasman Coastal Trail and the park's hub for day walks, camping and boat fishing.

Although the weekend weather is bright, we're alone here. That's if you don't count the 14m-or-so southern right whale and her calf, itself the size of a small car, circling in the bay near our lichen-daubed vantage point. This section of track heads east past campsites at Bivouac Bay, then north over 571m Tatnells Hill to Waterfall Bay. Tasmanian blue gums stretch their crescent-leaved branches overhead and drooping she-oak branchlets glisten with water drops, the legacy of an overnight shower.

But we're riveted by the mammals lolling in the bay. For two hours their distinctive V-shaped blows steam in the morning air. The juvenile is a livewire, rolling around, grumbling and occasionally taking a feed. Mum's mostly pretty calm and still, although she plays with her calf for 10 minutes, rolling to expose her 1.8m pectoral fins and then diving again, tail flukes up.

The experience is extraordinary for us but it's a standard

**Cliff-top cuppa.** Hobart Walking Club members Trish Colles and Malcolm Sherlock take morning tea at Waterfall Bluff. They're on a day walk from Waterfall Bay to the lookout on Tatnells Hill.

morning on the Tasman Coastal Trail. Just an hour or so from one of Australia's state capitals, we feel a million miles from care.

“**T**ASMAN NATIONAL PARK'S probably got the most spectacular coastline of any park in Tasmania,” says Luke Gadd, one of two Tasmania Parks & Wildlife Service (PWS) rangers stationed here. “There's a high biological diversity, as well, and a high number of recreational opportunities – and we've got some of the best day walks in Tasmania.”

The Coastal Trail was built in stages over many years with the help of Hobart Walking Club (HWC). It was officially recognised in 1998 and combines several day walks and additional track into a coast-hugging 53km trek, typically requiring 4–5 days to complete. Today we've joined Luke on the track's northern section – the 1.7km amble around Waterfall Bay to Waterfall Bluff – an easy stretch that provides a first taste of the track's high cliffs.

The sedimentary sea cliffs in this part of the park rise to an impressive 150m above the waves, Luke tells us. “And where



**Heath life.** A New Holland honeyeater. Below, this *Epacris* shrub grows only on the Tasman Peninsula.



**The geology and climate have created a diverse range of habitats in the park.**

**Easy access.** Only 100km by road from Hobart, the Cape Hauy Track is a day walk on the Coastal Trail, and it will be part of the Three Capes Track. Many Hobart-based walkers tackle the Coastal Trail in stages, as time and weather permit. Bushwalking mates (below, from left) Shane Hogue, Tim Respondek and John Kelly head back to Fortescue Bay from Cape Hauy.



the ocean meets the cliff, you get a whole range of features – wave-cut platforms, arches, blowholes and sea caves.” But the cliffs here are nothing compared with the dolerite drop-offs in the southern portion of the park, at Cape Hauy [pronounced “hoy”], Tasman Island and especially at Cape Pillar, which Luke says sports “some of the tallest vertical sea cliffs in Australia, if not the Southern Hemisphere”.

Dolerite – the ‘rock of Tassie’ – covers about two-thirds of the island. Originating as lava about 180 million years ago, it cooled under the Earth’s surface into columns, which are now exposed, and tend to weather vertically, thus explaining the sheer drops.

Differences in underlying geology and some particular traits of the climate – notably fierce southerly winds – have created a diverse range of habitats in the park, from patches of rainforest to buttongrass plains, coastal heath and tall eucalypt forests.

The park was proclaimed in 1999, a patchwork of previously logged former state forestry and reserve lands, but unusual species remain. They include three species of the flowering herb called eyebright, found only in this area, the distinctive heath plant *Epacris marginata*, and the wonderfully adaptable Cape Pillar she-oak (see “Durable customer”, page 66).

A small permanent human population of fewer than 2000 people, and the isolation caused by a single access to the peninsula by land (the narrow isthmus of Eaglehawk Neck), have encouraged strong numbers among mammals. These include pademelons, bettongs and Bennett’s wallabies; wombats, three possum species, quolls and Tasmanian devils. Echidnas are often seen during early summer and the smaller mammals include long-tailed mice, swamp rats and dusky and swamp antechinus.

“We’ve just heard some interesting news about the dusky antechinus on Tasman Peninsula,” Luke says. “There’s a genetic study being done and it appears that it might be a separate species.”

The park’s wildlife and other attributes have lately been an important consideration for Luke and his PWS colleagues, as they contemplate imminent changes. Three Capes Track, which is currently under construction in Tasman NP, is scheduled to open in late 2015 (see “Three Capes Track”, page 65) and it’s expected to attract up to 10,000 walkers a year, far more than the few thousand who currently walk the trail end to end.

Current trail maintenance is also a low-key affair – upkeep amounts to on-foot inspections once or twice a year, “with a chainsaw and a mattock, just to clear out drains along the way”, Luke says.

# TASMAN COASTAL TRAIL



## DIRECTORY

### TRACK DETAILS

THE 53KM TASMAN COASTAL TRAIL extends from Waterfall Bay to Cape Pillar, intersecting the inland Cape Pillar Track near Fortescue Bay and north of Bare Knoll, where they become one. Reconstruction of the section between Cape Hauy and Fortescue Bay was completed in 2012. This section will form part of the new Three Capes Track; work is currently being done on the section south of Cape Hauy and down to Cape Pillar. The third section of the track will be entirely new, from Denman's Cove south along the western coast, to join the Cape Pillar Track near Bare Knoll.

### WHEN TO GO

Most Tasman walkers are attracted to the long daylight hours and warmer weather of November–April. Winter overnight temperatures rarely drop below 4–5°C, but June–October has the highest annual average rainfall.

### GETTING THERE

Virgin, Qantas and Jetstar offer regular direct flights to Hobart from Sydney and Melbourne; Virgin and Jetstar also fly direct from Brisbane. Fortescue Bay is about 85km by road from Hobart airport and 100km from central Hobart. Tassielink runs daily bus services to and from the Tasman Peninsula (Port Arthur) during the school term.

### WHERE TO STAY

Bush campsites along the Coastal Trail are free if you have a park pass (see below). At the Fortescue Bay PWS camping ground, tent sites are \$13-plus a night (depending on number of campers) and bookings are advisable at busy times (tel: 03 6250 2433 or email: fortescue.fortescuebay@parks.tas.gov.au). Elsewhere on the Tasman Peninsula there are commercial camping and caravan parks, hotels, motels, B&Bs and holiday cottages.

### WALKER NOTES

A valid park entry pass is required for the Tasman Coastal Trail and popular Tasman NP day walks such as Cape Hauy, Cape Raoul and Shipstern Bluff; 8-week Holiday (\$60) or Backpacker (\$30) passes are the best value. Use the logbooks provided when you set out and return from your walk. Check with rangers about availability of water as streams can run dry in midsummer.

In the future, a booking and fee system will apply for Three Capes Track walkers (but bookings for Tasman NP day walks will not be required).

## Along the sheer cliffs, the safest way to get a view is to lie flat on your belly and peer over.

As if to prove the point, on the way to Waterfall Bluff he shifts a few wind-dropped branches off the track. At a lookout point, he wrestles with a large fallen limb just a few steps from the cliff's edge, where he'd rather people weren't tripping; he has to give up in the end – we've set out without a chainsaw.

"The easy parts of the Coastal Trail cater for those who wouldn't ordinarily go on a dirty-footed walk," Luke says. "The new track will hopefully provide an interesting opportunity for those who wouldn't ordinarily do an overnight walk."

**T**HE FIRST SECTION of the Three Capes Track to be finished was a 4.7km section linking Fortescue Bay and Cape Hauy, which was completed in June 2012. Buoyed by our whale encounter, we set out on it along bush-stone steps akin to those you'd find in a fancy suburban garden. Further along, benched gravel and raised duckboards keep our boots mud-free – not a luxury you'd have enjoyed here several years ago.

"Wide and dry, isn't it?" says David Ferris, one of the Osmiridium walkers, a mates' bushwalking group, who are exploring the peninsula. The group agrees, with a mixture of pleasure and regret, that it's not like the old days, when some bush-bashing was required and a pair of gaiters recommended. "Better for the bush though," says walker Tim Respondek, and it's been a great day out for the group. His mate John Kelly sums up: "It's raw, it's accessible, it's coastal – and it's spectacular."

That it is. In a dense grove of silver banksia, or honeysuckle, New Holland honeyeaters perch at high points, while crescent honeyeaters make their distinctive "idjit" call, and thornbills, wrens and finches circle the trees. All around the banksia buffet is evidence that yellow-tailed black cockatoos have devoured a meal.

The track might be new but the dizzying views out at the cape, to the north and east of Mitre Rock, The Lanterns and The Candlestick, and down at rock climbers' favourite – the Totem Pole – are unchanged. Those with vertigo be warned: from the narrow path along the sheer cliffs, the safest way to get a view is to lie flat on your belly and peer over. It's a narrow, finger- and toe-tingling vista; passing boats give a sense of how far it is down to the sea.

**T**HE PENINSULA'S FAMOUS cliffs are almost more impressive from the bottom looking up. On a crisp, late-autumn morning, Tasman Island Cruises skipper Ben Connor welcomes us aboard near Port Arthur with the practised ease of a ringmaster. Ben's worked the coastline since deckhanding for his uncle on a birdwatching voyage out to Cheverton Rock in 2008.

He realised then how special this coast is and he's explored it by sea and by land over the years since. He's currently building a home on the peninsula and says "a little passion can take you a long way".

*Continued page 64 ▶*



**Abrupt edge.** An aerial shot of the Cape Pillar peninsula showcases this spectacular coastline. Rock formation The Blade is pictured in the left foreground, to its right is Cape Pillar and Mt Fortescue can be seen in the right background.





**Founding fathers.** From left, HWC's David Pears, Naree Crane, Trish and Malcolm. HWC members helped create many Coastal Trail tracks before Tasman NP was proclaimed.

We cross into open ocean near Budget Head, in the shadow of Arthurs Peak, tracking along the "black shore" – the south-facing dolerite cliffs, which are renowned for their exposure to gale-force winds. Now, with the sun on its cool-season, northerly track, the cliffs are in shadow, mottled by lichen, thrusting upwards. "We get comments about things being man-made but...this is just nature; this is just awesome," says deckhand Yani Armbruster.

Wave-washed cliff-base rubble is a riot of colour and intertidal life, as University of Tasmania marine science research fellow Neville Barrett points out. "The offshore upwelling brings nutrient-rich Southern Ocean waters and there's more current and more invertebrate life," he says. "It's a real hotspot for marine endemism in south-eastern Australia."

Fabulous sea creatures seen here include salps and giant pyrosomes, which are both jellyfish-like invertebrates that belong to the group known as tunicates. "The continental shelf is only 7–8km away and they tend to be washed up against the cliffs by the currents, but not smashed, because of the deep water," Neville says. "There were so many salps earlier this year you could almost walk on the water."

The area doesn't get the fish species diversity of tropical waters but the fish here are often found in great numbers – which is

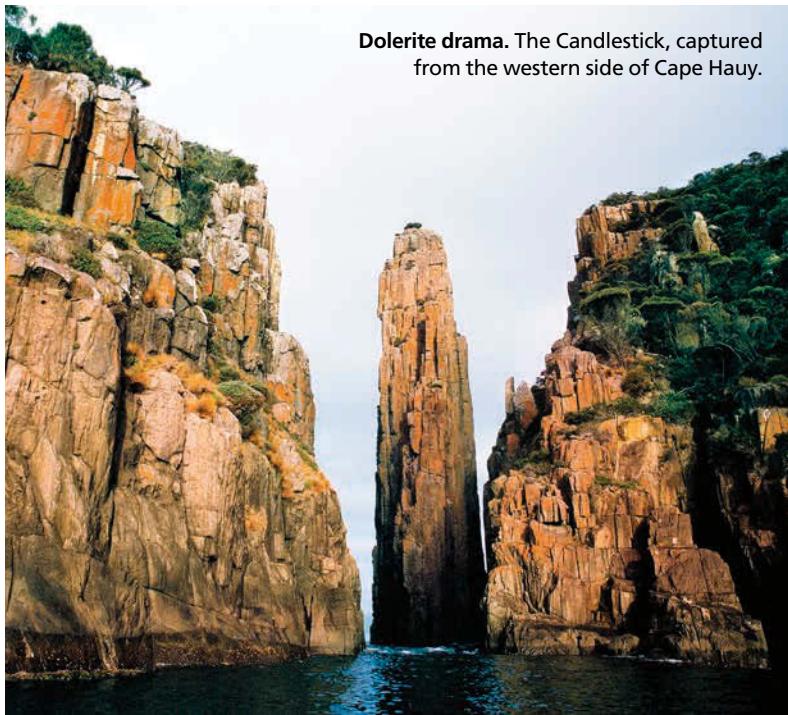
good news for piscivorous species. "In February and March we get a lot of bait fish active," Yani says. "So lots of albatross and a lot of feeding frenzies. It's just unreal sitting in the middle of hundreds of albatross, watching them grab fish."

We lap Tasman Island – where Sydney–Hobart race yachts famously turn to starboard and head for the finish line – and pay our respects to the resident fur seals, which slide into the water and gambol around the boat to check us out.

Afterwards, Ben stops at the base of the Cape Pillar chasm, and we gaze uncomprehendingly at sheer dolerite that extends up for about 260m – nearly twice the height of the Sydney Harbour Bridge arch. At the top is Chasm Lookout, which is so far up we'd have trouble making out any people peering down.

**M**ORE PEOPLE CAN see Cape Pillar's rock spires on a boat trip but the chance to see it at the cliff top – a glorious, isolated, windswept end-of-the-Earth spot – is the privilege of multi-day walkers.

They trek here from Fortescue Bay the longer, harder way – via Cape Hauy and the 490m summit of Mt Fortescue – or they take the short cut, on the mostly flat Cape Pillar Track, which travels inland through an impressively diverse range of



**Dolerite drama.** The Candlestick, captured from the western side of Cape Hauy.



**The trail is a mix of old, new and under-construction sections as it undergoes its transformation.**

**Hard yards.** Tom Burns (above, at right), a track worker with construction contractor Mountain Trails, places edging rocks by hand on a new section of Three Capes Track near Bare Knoll.

Tasmania's spiky shrubs, including bearded heath, prickly moses and dagger needlebush.

Near the junction of these tracks, the Coastal Trail is a mix of old, new and under-construction sections as it undergoes its Three Capes transformation. We turn off the old track before the descent to Lunchtime Creek and follow a scrub-cut alignment liberally decorated with helicopter-dropped 800kg bags of gravel and loads of duckboard timber, before pitching camp in an area earmarked for a Three Capes hut site.

East of here, the old and new tracks sometimes run two different courses out to Cape Pillar. One contentious section bypasses two of the old track's most famous places, Hurricane Heath and Perdition Ponds. At Hurricane Heath, scouring winds that have literally blown walkers off their feet have transformed normally 2m-high plant species into ground-huggers. Cairns mark the route across what resembles a Japanese garden, replete with bonsai, to the Ponds, the old track's easternmost campsite.

The further east you tread the more isolated it feels; the heath

## THREE CAPES TRACK

Stretching along the Tasman Peninsula for up to 82km, the track will lead walkers to picturesque Cape Raoul, Cape Pillar and Cape Hauy.

TASMANIA PARKS & WILDLIFE SERVICE hopes the Three Capes Track (3CT) will be seen as the coastal equivalent of the iconic Overland Track. The aim is to create an "achievable walking experience" for people of all ages and abilities and PWS is having a red-hot go at it.

With a budget of about \$25 million for its first (eastern) part, the 3CT will feature 90cm-wide paths of gravel, rock and timber. Up to 60 people a day are expected during the October–May peak season and they'll book online and pay a fee (still to be determined; the Overland fee is \$200 for 2014–15). It will be Australia's only hut-based walk where the huts have mattresses and cooking facilities; walkers won't have to carry tents, sleeping mats or stoves. A guided commercial walk will use private huts.

Buildings for accommodation, cooking and eating plus PWS staff quarters will be linked by decks or walkways. A prototype hut was installed at Lunchtime Creek this winter. "One of the design parameters was to try and produce something that's simple and elegant," says PWS hut project manager Andrew Wagg.

Designed to blend in with the environment and to be durable, the huts will be steel framed and finished with Colorbond steel, fire-resistant blackbutt timber and cement sheets. Their outward-sloping windows are to reduce the risk of bird strike.

The complete eastern part of the track is scheduled to open in late 2015.

hums with birdlife and the twisting path affords a symphony of views north to Cape Hauy and south to Tasman Island. The crescendo comes at Chasm Lookout and The Blade, from which, improbably, one looks down at Tasman Island's 200m-high cliffs.

Walking back to Fortescue Bay the next day, we're more conscious of Three Capes signs. Tag tapes mark the helicopter drop zones; garden stakes number the sections; diamond tags label zones around which the path must detour to protect endemic flora and create buffer zones for the carefully monitored wedge-tailed and white-bellied eagle nests.

It's a mammoth job, says Simon Wyatt, one of the owners of track construction company Mountain Trails, when we meet him and his crew near Bare Knoll. They've been out here on the 3.98km Separable Portion 5 (SP5) for several months already, with work due to be completed within the year. All the signs point to serious effort – there are track-width excavators, piles of rocks, power carriers and hand tools of all kinds.

The supply helicopter chatters overhead, dropping in gravel and timber on four-minute turnarounds from the Fortescue Bay base. It's hard work, but the crew agrees that it has rewards. "I like the bush and hate town," says Simon. Joel Hodson sums it up: "Living and working in this scenery is unbeatable." ▶

## DURABLE CUSTOMER

Although the Cape Pillar she-oak has a small range, it is present in large numbers, and will hopefully be around for centuries to come.

THE DISTRIBUTION of the Cape Pillar she-oak (*Allocasuarina crassa*) is limited to Cape Pillar and Tasman Island and it's classified as 'rare' under the state's Threatened Species Act. But it's relatively secure as there are about 100,000 mature individuals, some in pure stands, unaffected by bushfire. It is also a common cross-breeder and

large numbers of hybrids of Cape Pillar she-oak and a related species *A. monilifera* can be found. The Cape Pillar she-oak tolerates a wide variety of soil types and aspects in its small range and appears in forms from a small tree (in ideal conditions) to a ground-hugging plant in wind-prone areas such as Hurricane Heath.

**Unique resident.** Branchlets of a Cape Pillar she-oak (below); the little brown scales are fresh leaves.

Tasmanian pademelons (below left) do well in the park's relatively isolated habitats and feed at dusk and dawn beside the tracks.



SP5 carries around Tornado Ridge to rejoin the inland route to Fortescue Bay. Until now, there's been no track to the west from here where the coast curls around to Surveyors Cove, on Port Arthur. Now, among the forest and peaks, the Three Capes Track is appearing.

SOME OF THE NEW TRACK is still a canvas to be imagined, guided by tape markers – blue for track, orange for huts, yellow for helicopter drop zone – attached to plants arching over a flattened survey line that's barely more than a lick and a promise. But although the section of track joining Surveyors Cove to the Mt Fortescue junction via Arthurs Peak isn't due to open for more than a year, parts are complete, with glinting stone stairs and duckboards with non-slip chook wire too new to have dulled.

Actually, the idea for the Three Capes Track is nearly 10 years old in Stuart Lennox's book. Stuart is PWS's Director of Visitor Services, but worked at Tourism Tasmania when former state premier Paul Lennon walked New Zealand's Milford Track and returned enthusiastic about creating a similar experience in Tasmania.

"So I said, rather than us all just throwing a dart at the

map, why don't we try to understand what people are looking for?" Stuart says. "We were interested in the things that make something iconic. Why is the Milford iconic? Why has the Overland become iconic?"

Climbing to Arthurs Peak, Stuart reflects on the long process of surveying and research that brought them here.

"There were so many things...one being that it's an hour from Hobart airport," he says. "But that's not the only one: in terms of building an iconic experience this met more of the criteria than anywhere else."

"If you're going to put a walk in for lots of people, the landscape needs to be robust. And there's nowhere else you can get a view like this."

As we stand on the peak catching our breath, trying to take in a horizon that seems to curve with the Earth, another southern right whale surfaces 300m below. It spouts, then slides like a splash of silver beneath the water and resumes its journey north along the timeworn Tasman coast. 

 **AUSTRALIAN GEOGRAPHIC** thanks Matt Gee, Mark Johnston, Island Workshop; Ben Clark, Phil Duggan, Wanita Wells, Liz Wren, PWS; Rob Pennicott, Tasman Island Cruises; and all those mentioned in the story.



**Sheer drop.** Cape Raoul is on the western coast of Tasman NP and will be accessible via the Three Capes Track.



**Feathered first.** The little dinosaur that started it all. Found in 1996 in north-eastern China, *Sinosauropteryx* was the first feathered dinosaur discovered. In 2010 researchers showed it had been ginger in colour with white stripes around its tail, perhaps akin to a ring-tailed lemur.



# Colouring in the dinosaurs

A series of clever studies has painted prehistoric worlds with unexpected splashes of colour. For the first time we now know the hues of a range of dinosaurs.

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STORY BY JOHN PICKRELL



**Food on the fly.** Four-winged flyer *Microraptor* was a contemporary of Cretaceous-era birds and is likely to have preyed upon them, as depicted in this illustration by Australian palaeoartist Brian Choo. A series of studies has shown its plumage was blue-black and iridescent.

**N**INETY-FOUR MILLION years ago, a vast inland sea runs the length of North America from the Arctic Ocean to the Gulf of Mexico. Its waters are an effective barrier that divides the landmasses of Laramidia to the west and Appalachia to the east, and both are home to a diverse and unique fauna of early birds and feathered carnivorous dinosaurs. Predatory reptiles stalk the waterways too, and among their number is a lone ichthyosaur of a kind known as *Platypterygius*.

Shaped something like a fat dolphin, this 7m-long air breather is highly adapted to life in the oceans. She has massive saucer-shaped eyes that allow her to pick up traces of light in the depths where she hunts for squid; she also gives birth to live young in the water, so she does not need to venture onto land to lay eggs as turtles and crocodiles do.

Hunting deep-sea squid is not the only similarity she has with modern sperm whales. Like them, she is also a uniform jet black, which helps camouflage her in the inky depths and absorb as much warmth from the sun as possible when she comes to the surface for air. Normally she spends as little time near the surface as she can, because this is where she is most vulnerable to larger predators.

Today, though, she is lingering, because she is about to give birth. This *Platypterygius* is among the last of her kind. Ichthyosaurs have been enormously successful for 150 million years, but they have been on the decline for tens of millions of years and now they face a new threat in the form of larger marine reptiles known as mosasaurs. Little does she know it in her current agitated state, but a 15m-long mosasaur has been circling in the waters beneath her for some time now. Part of a group that will give rise to monitor lizards and snakes, mosasaurs have elongated bodies, four flippers and long tails with broad flukes on the end.

This predator is darkly pigmented on its upper side and lightly pigmented on its underside, making it difficult to spot from both above and below. Before the *Platypterygius* has the chance to give birth, the mosasaur shoots up from the depths, violently clamping her within its wide jaws and bringing nearer to an end the long tenure of ichthyosaurs in these prehistoric waterways.

This scenario is fanciful, but, thanks to a study published in January 2014 by researchers led by Johan Lindgren at Lund University in Sweden, we now have some good clues as to the



**Ocean-going hues.**  
In 2014 scientists at Lund University in Sweden used high-powered microscopes to determine the true colours of a prehistoric turtle, an ichthyosaur (centre) and a mosasaur. The latter two are both giant marine reptiles that were contemporaries of the dinosaurs.

colour of both ichthyosaurs and mosasaurs. The research was the first to reveal the colour of extinct marine creatures and it followed on from a string of recent papers that have revealed the colours of prehistoric birds and feathered dinosaurs by mapping pigment-bearing structures within fossilised skin and feathers.

"This is fantastic!" Johan told reporters. "When I started studying at Lund University in 1993, the film *Jurassic Park* had just been released... Then, it was unthinkable that we would ever find biological remains from animals that have been extinct for many millions of years, but now we are there and I am proud to be a part of it."



**Jurassic looker.** Found in China in 2009, 150-million-year-old *Anchiornis huxleyi* had long feathers on its hind- and forelimbs. Fantastically preserved fossils have allowed the feather colour to be reconstructed, showing it was black with white speckling and had a red head crest.

In the 1990s, any book, teacher or scientist would have told you we'd never be able to tell anything about the colour of extinct animals such as dinosaurs. The best we could ever do was make comparisons with living creatures, and often reptiles were deemed to be the best proxies. Most dinosaurs were painted in shades similar to those of crocodiles or monitor lizards – greys, greens and browns.

It seems puzzling now when you think about it. Birds and mammals – from fairy wrens, peacocks, parrots and cassowaries, to tigers, tree kangaroos, baboons and red pandas – boast a large range of vibrant shades and hues, and even many lizards – from chameleons to anoles – have striking patterns of colouration.

Since the discovery in China in 1996 of the first feathered dinosaur, *Sinosauropelta* (more than 40 feathered species have now been discovered, suggesting that most carnivorous dinosaurs had feathers), the assumption had been that dinosaurs might have had some of the same vast variation in plumage that birds do today, but few people believed such a thing would ever be confirmed.

That was until January 2010, when a remarkable paper in the scientific journal *Nature* suggested that *Sinosauropelta* had sported ginger and white stripes around its tail, perhaps something like the pattern found on ring-tailed lemurs today. "Oh no, it's Ginger-saurus! For first time scientists uncover colour of dinosaur and it was...a redhead" was one headline, in the UK's

*Daily Mail* newspaper. The report went on to say: "As if its short stature and ugly feathers weren't enough to give it an inferiority complex, one of the world's best-preserved dinosaurs now turns out to have been ginger."

A jaunty illustration painted by Chuang Zhao and Lida Xing, and released when the discovery was announced, depicts two cheeky-looking, ginger-fluffed *Sinosauropelta*. Their heads are thrown back and each is cavorting on a single leg with arms flung wide to impress or perhaps intimidate the other (Lida Xing is the illustrator of the Australian dinosaurs poster, which is free to subscribers with this issue).

The 2010 research study, from scientists in China and the UK, also revealed black, white and orange-brown colouration on the early bird *Confuciusornis*. Similar work has now revealed the feather colours of *Archaeopteryx* and of four-winged flying dinosaurs *Anchiornis* and *Microraptor*. These discoveries have opened up a novel field of research, allowing palaeontologists to delve back more than 100 million years and probe the lives of dinosaurs and early birds.

"Feathers are key to the success of birds and we can now dissect their evolutionary history in detail," Professor Mike Benton, one of the experts behind the work at the University of Bristol, told reporters. "The simplest feathers, in dinosaurs such as *Sinosauropelta*, were only present over limited parts of its body – for example, as a crest down the midline of the back

and round the tail – and so they would have had only a limited function in thermoregulation [maintaining body temperature].”

His team, therefore, suggested that feathers arose initially for colourful display purposes and later were co-opted for insulation and eventually flight. The idea that display and communication were the initial functions of feathers is interesting because most experts believed the first feathers were for insulation. If colourful feathers evolved for display, they might have played a much more integral role in the success, evolution and diversification of dinosaurs than has been supposed.

**H**OW ON EARTH can you find out anything about the colour of feathers from the fossil record? I admit to having been baffled by this when stories of the orange plumage of *Sinosauropelta* first broke in 2010. To answer that question, we have to look into a little of the science of how animals make colour in the first place.

The pigment that gives our hair and skin colour is called melanin (from the Greek *melanos*, meaning dark) – it’s the same substance that is produced when we sunbathe, causing fair-skinned people to become tanned.

Like all pigments, melanin works by absorbing some wavelengths of light and reflecting others to produce specific colours. Inside hair and feathers, it’s wrapped in tiny packages known as melanosomes, which create shades of black, grey, orange and brown. When I say tiny, I mean really tiny; most are 200–600 nanometres (millionths of a millimetre) across. Two hundred of them can fit across a human hair.

Though diminutive, they are incredibly tough and actually form part of the strong protein structure of hair and feathers. They are so durable, in fact, that they can survive in fossils for hundreds of millions of years.

According to Mike, until very recently people just wouldn’t have believed melanin could be preserved. And it seemed even less likely after a series of failed, highly publicised efforts to recover DNA from dinosaur bones in the 1990s made people extremely cautious about attempting to retrieve proteins or any other organic molecules from fossils. But it turns out that melanin is a very tough chemical, and part of its function in hair and feathers is to make them strong.

“This is why, when you get older, and like me your hair gets grey, it actually gets weaker,” Mike explained. “But we’re not detecting the presence of melanin by chemical means in fossils; we’re doing it by physical means. It’s because it’s encapsulated in these melanosomes.” Keratin – the protein of which hair and feathers are made – is a plasticky kind of substance, so in order for the melanin to get into it, it needs to be encapsulated.

Dr Jakob Vinther, a molecular palaeobiologist based in Mike’s department at the University of Bristol, was the mastermind behind the colour-identification technique, in which different pigments, such as red, brown, buff, grey and black, are detected simply by looking at the shape of melanosomes in the fossils through a powerful electron microscope.

In modern birds, melanosomes that result in different feather colours are different shapes: although sausage-shaped ‘eumelanosomes’ contain the pigment ‘eumelanin’ and create black plumage, the spherical ‘phaeomelanosomes’ contain ‘phaeomelanin’, which creates orange plumage. These shapes are what Jakob first searched for in fossils of the early bird *Confuciusornis* while he was a graduate student at Yale University.

In mammals, pigment is the common way to produce and display a colour. Pigments in both plants and animals work by reflecting and absorbing different wavelengths of light. White reflects all wavelengths of light, black absorbs all wavelengths and colours in between selectively absorb some wavelengths but not others. Chlorophyll, which makes plants green, for example, absorbs all red light but reflects green; anthocyanins, found in red leaves, absorb green and blue light but reflect red and yellow.

In 2013 a study that simulated the fossilisation process cast some doubts over the reconstructions of dinosaur colour from melanosomes. Dr Maria McNamara, a researcher then in the same department as Jakob and Mike at Bristol, attempted to mimic fossilisation by subjecting modern feathers to great heats and pressures akin to those they might experience underground in the Earth’s crust. “A brief spell in

an autoclave can reasonably simulate the effects of temperature and pressure over millions of years,” she told *Nature*.

*Continued page 77 ▶*

“**Feathers are key to the success of birds and we can now dissect their evolutionary history.**”



**Winged wonder.**  
*Anchiornis* was among a number of feathered gliding dinosaurs that are now known to have had four wings.

# Fossil clues to the colour of feathers

By studying the fine details of incredibly preserved fossil feathers, scientists are able to look for structural clues to the original colours.

## MELANOSOMES

Melanosomes are tiny packages of pigment inside feathers and hair in living birds and mammals, and are responsible for making your hair black, brown, blond or ginger. It turns out that melanosomes are made from keratin, an incredibly tough protein, and under the right conditions can survive even for hundreds of millions of years in fossils. Two types of the pigment melanin are found in the feathers of modern birds and they are packed in different shaped melanosomes.



### 1 Phaeomelanin

Produces reddish colours, and is the pigment in ginger hairs in humans. This pigment is packaged in spherical phaeomelanosomes.

### 2 Eumelanin

Comes in black and brown varieties, and, depending on the concentration, can also produce light brown, blond and grey colours. This pigment is packaged in sausage-shaped eumelanosomes.

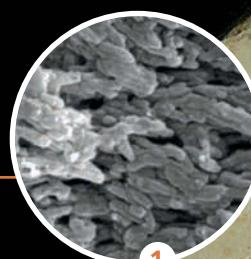
## MODERN BIRDS

When you look at the feathers of a living bird under a high-powered scanning electron microscope (SEM) you can see melanosomes of different types. For example, the feather of an Australian zebra finch (left) has spherical phaeomelanosomes 1 in the orange part of the feather and sausage-shaped eumelanosomes 2 in the black parts of the feather.



## CONFUCIUSORNIS

*Confuciusornis* is a 125-million-year-old bird from the Early Cretaceous of Liaoning Province in north-eastern China. Experts led by Professor Mike Benton at the University of Bristol, UK, and Zhang Fucheng at the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, China, used an SEM to look at its fossilised feathers. This revealed phaeomelanosomes 1 and eumelanosomes 2 and indicated this early bird may have had black, grey and red-brown feathers, perhaps something like a zebra finch.





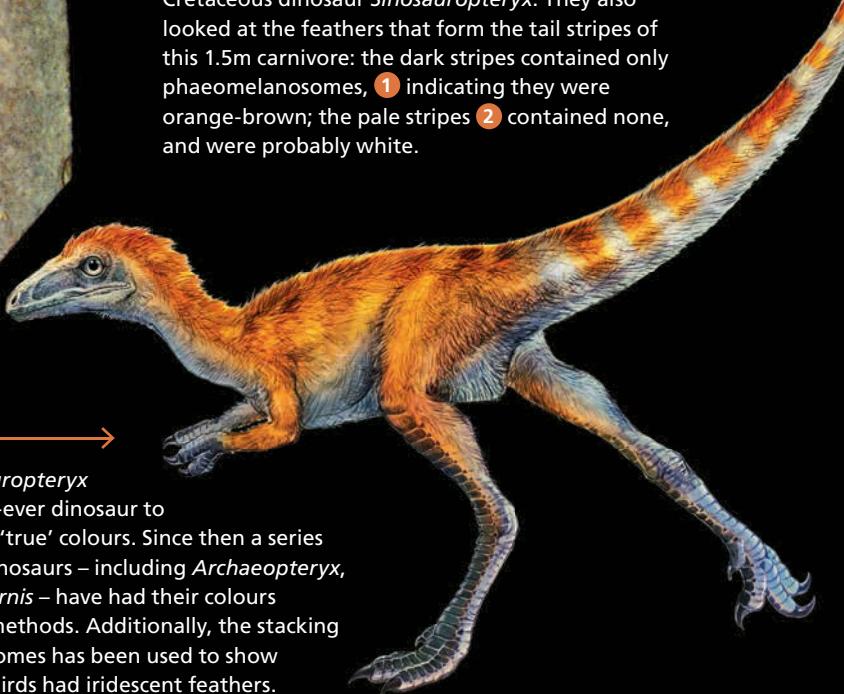
### BONUS POSTER!

Our Australian dinosaurs poster is free to subscribers with this issue, or can be bought by calling our subscriptions hotline on 1300 555 176. Call now to make sure you don't miss out next time around.



## SINOSAUROPTERYX

The researchers used the same method to look at the short, bristle-like feathers that appear along the head, neck and back on the fossil of Early Cretaceous dinosaur *Sinosauropteryx*. They also looked at the feathers that form the tail stripes of this 1.5m carnivore: the dark stripes contained only phaeomelanosomes, 1 indicating they were orange-brown; the pale stripes 2 contained none, and were probably white.



In 2010 *Sinosauropteryx* became the first-ever dinosaur to be illustrated in its 'true' colours. Since then a series of other feathered dinosaurs – including *Archaeopteryx*, *Microraptor* and *Anchiornis* – have had their colours determined using similar methods. Additionally, the stacking and organisation of melanosomes has been used to show that some dinosaurs and early birds had iridescent feathers.



## WILL WE EVER FIND FEATHERED DINOSAURS IN AUSTRALIA?

The majority of the 40-odd species of known feathered dinosaurs discovered since *Sinosauropteryx* in 1996 are from China and Mongolia, although a smattering have been found in the USA, Canada, Germany, Madagascar and Siberia. Could Australia ever yield dinosaur feathers? The answer is that perhaps it already has. A fossil site near the town of Koonwarra in Victoria's Gippsland has fine-grained sedimentary rocks and an unusual level of preservation. Starting in

1961, a series of 12 fossilised feathers (left) were found here, all dating to the Early Cretaceous between 118 and 115 million years ago. It was assumed these were bird feathers, but, in light of all the new discoveries from China, it is now just as likely that they are dinosaur feathers. Researchers led by Dr Tom Rich at Museum Victoria now have plans to return to the site to search for the remains of entire feathered dinosaurs (see 'Why so few dinosaurs?', page 41).

**Fossil gold.** In 2011 researchers at the University of Alberta, Canada, discovered an incredible series of Late Cretaceous feathers preserved in amber. Dated to about 78 million years ago, many of them once belonged to feathered dinosaurs. The structure of some matched feather types known from Chinese dinosaur fossils, but not seen in modern birds.



#### WATCH

Use the free *viewa* app to scan this page and see a video about how new techniques were used to determine that a 150-million-year-old feather from the 'first bird' *Archaeopteryx* was black, making it structurally strong.



RYAN MACKELLAR / SCIENCE / UNIVERSITY OF ALBERTA

## Birds, insects and fish have another trick besides pigment up their sleeves.

Her research indicated that melanosomes shrink during fossilisation, which might affect their shape and therefore the reconstructions of their colour. Jakob's response was that the melanosomes shrank almost equally in several dimensions, so his reconstructions of colour shouldn't be affected. Only time and more research will tell whether or not the fantastic new visions of coloured dinosaurs are accurate.

**B**IRDS, INSECTS AND FISH, however, have another trick besides pigment up their sleeves, and it allows them to be decorated in a much brighter, brasher range of gaudy hues than we comparatively drab mammals could ever hope for. Iridescence is so-called structural colour, which occurs when light bounces off physical features in the surface of feathers or scales and is split into different colours, in much the same way a prism splits white light into its constituent colours. Some birds – parrots with green plumage, for example – use a mixture of both yellow pigments and blue iridescence to create their colour.

The structural features that manipulate the light vary, but include wafer-thin stacks of translucent organic material that interferes with and reflects light. These films, made of chitin in insects, can reflect and amplify light of one particular colour or wavelength over and above others. This is how iridescent or metallic hues are produced, such as those that adorn the feathers of birds of paradise and peacocks, the wings of butterflies and a whole spectrum of beetles. Sir Isaac Newton, who shed much light on optics and refraction, was the first to reveal that minute layered structures were the cause of colour in peacock feathers.

In 2003 I first learnt about the possibility of structural colours persisting in fossils when I wrote a story about a 50-million-year-old beetle fossil that still had a brilliant blue iridescent sheen – in this case, the fossil was so incredibly well preserved that the 'multilayer reflector' that created the colour in the surface of its exoskeleton was still intact. At the time, the fossil was the oldest known to retain any bright colour and it may still hold that record. Australian palaeontologist Professor Andrew Parker said then that we might one day be able to study the physical features of dinosaur fossils to predict what colours their feathers might have been. It seemed like science fiction to me, so it was a thrill to see the idea come to fruition just seven years later.

Jakob, Mike and their co-workers at Bristol University have been able to find evidence of these structural iridescent colours in fossilised dinosaur feathers by looking at the density, orientation and stacking of the melanosomes. In some cases, melanosomes act to produce colour in two ways: through ▶

# Dinosaurs evolved a great array of ornamentation: crests, frills, horns and spikes.

the pigments wrapped up inside them, and also through their stacking and organisation, which interferes with and manipulates the light that hits them.

*Sinosauropelta* was just the start, and now a series of compelling papers has detailed the colours of *Archaeopteryx*, *Anchiornis* and *Microraptor*. *National Geographic* described *Anchiornis* as having “looked something like a woodpecker the size of a chicken, with black-and-white spangled wings and a rusty red crown”. The team behind that discovery, including Yale University feather expert Professor Richard Prum, analysed the colour on 29 different regions of the animal’s body, giving them a largely complete picture of the overall plumage pattern. *Archaeopteryx* would have been black, while a 2012 study of 130-million-year-old *Microraptor* revealed it would likely have had dark blue to black plumage with white dappling and an iridescent sheen – perhaps similar to a magpie or raven.

“Modern birds use their feathers for many different things, ranging from flight to thermoregulation to mate-attracting displays,” Richard’s co-author, Dr Matt Shawkey, from the University of Akron in Ohio, told reporters. “Iridescence is widespread in modern birds and is frequently used in displays. Our evidence that *Microraptor* was largely iridescent thus suggests that feathers were important for display even relatively early in their evolution.”

AUSTRALIA’S FAIRY WRENS are delightful little songbirds, some of which have brilliant blue and iridescent plumage. Recent studies have also shown that male fairy wrens of some species have patches of feathers that reflect ultraviolet (UV) light. This is invisible to us, but appears as another layer of colour to female wrens. Although humans have three types of colour-detecting rod cells in their eyes – red, blue and green – birds have a fourth, which detects UV light. This means they see the world in a much more complex palette of colours than we do. It illustrates just how important colour is to these animals, and that the ability to see a wide range of bright colours may have been spurred on by colourful plumage that evolved for display purposes in their dinosaur ancestors.

It would be no surprise to find that dinosaurs were as varied and colourful as birds, given they most likely shared the full colour vision of birds. Although some mammals are colourful, most tend to be fairly drab, in greys and browns and shades of black and white. This is because, aside from a handful of species (including chimps, orangutans, baboons and humans), they don’t see in colour, instead visualising the world in black and white. Mammals also have more of a need to be camouflaged than birds, because they often live on the ground and find it more

difficult to flee from predators. “Birds are brilliantly coloured because they do see in colour, and it’s likely that, because birds are a kind of dinosaur, the extinct dinosaurs also saw in bright, vivid colour,” says Dr Mark Norell at the American Museum of Natural History in New York City.

These colours might have helped them recognise other members of their own species, camouflaged them, or been used for defence to dissuade other animals from attacking them (in the same way that some poisonous frogs are thought to use bright colours as a signal that says, “Don’t eat me, I’ll make you sick”). Of course, in living birds, some of the most brightly coloured are the males of those species that use colour to woo and court females, such as peacocks and birds of paradise.

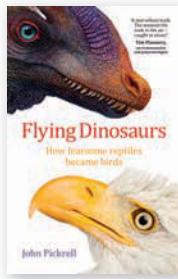
In dinosaurs there evolved a great array of ornamentation – including crests, frills, horns and spikes – to attract mates, warn off rivals and otherwise communicate. This surely means they used feathers for the same purpose, just as many brightly coloured birds do today. “Once dinosaurs had acquired feathers for insulation, what could be more natural than to adapt them into display structures?” asks Professor Phil Currie, a palaeontologist at the University of Alberta in Canada. “They are lightweight, strong, colourful, and can be shed and replaced.”

Could it even be that the success, diversity and longevity of the dinosaur family is attributable to the bright colours the evolution of feathers afforded them?

In combination, the variations in colour and structure can be a powerful tool for creating the differences among isolated populations that allow new species to form. The formation of new species is dependent on there being some sort of barrier to individuals of different populations mating. Feathers are a “perfect structure to provide such a platform”, says Professor Xing Xu at the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, China.

Although at this stage he says it’s just a crazy idea, he believes there may even be a way to test the link between feathers and evolutionary success in a group of animals. The first step is to confirm whether the different kinds of feather-, quill- and fluff-like structures seen in fossils of pterosaurs and dinosaurs (such as *Sinosauropelta*, *Caudipteryx*, *Beipiaosaurus*, *Tianyulong* and *Psittacosaurus*) all share a single evolutionary root, or if they evolved in separate instances. The next step would be to try to reconstruct feather colours and then compare the diversity of brightly coloured groups of dinosaurs and birds with that of groups without such a range of brightly coloured feathers.

Only more research will tell, but colourful feathers may have played a more important role in the evolution and diversification of birds and dinosaurs than anyone could have predicted. 



JOHN PICKRELL is the editor of AUSTRALIAN GEOGRAPHIC and a dinosaur enthusiast. This is an edited extract from his book *Flying Dinosaurs: How fearsome reptiles became birds* (NewSouth, 2014, \$29.95). Learn more about the book and feathered dinosaurs at: [www.flyingdinosaurs.net](http://www.flyingdinosaurs.net)



**Written in stone.** Crow-sized *Microraptor* was the first four-winged dinosaur discovered, in 2000. Hundreds of exquisitely preserved fossils of this species reveal long feathers on the tail as well as on the hind limbs and forelimbs.

**Tail streamers.** Cretaceous bird *Confuciusornis* was a contemporary of the feathered dinosaurs but was much more like a modern bird than *Archaeopteryx*, having lost its bony tail and teeth. It had long ornamental tail feathers.

**Still waters.** Below the calm surface of the Wenlock River is Australia's richest fish fauna; the water body is home to the endangered speartooth shark and vulnerable freshwater sawfish, as well as an abundance of crocodiles.





# WILD CROCODILE RIVER

On a remote nature reserve at the northern tip of Australia, Steve Irwin's memory continues to inspire efforts to understand and conserve his beloved reptiles.

STORY BY CRISSIE GOLDRICK  
PHOTOGRAPHY BY RUSSELL SHAKESPEARE  
AND CRISSIE GOLDRICK

MANY HANDS MAKE light work of hauling the heavy steel trap out of the Wenlock River and up a sandy bank. The cage clears the brackish water and scrubby shoreline vegetation, and, along the pull ropes, necks are craning to catch a first glimpse of its contents. But this is no time for gawking; the clock's ticking, the sun's warming fast and hearts are racing as a crack squad of khaki-clad wildlife workers launches into a well-practised routine.

Inside the trap, a huge estuarine crocodile appears docile, momentarily mesmerised by the unfamiliar sights and sounds. Ropes are threaded through either side of the trap and looped around the creature's top jaw. Once the chief wrangler is satisfied the ropes are correctly positioned, she crouches in front of the trap and issues the instruction to raise the gate.

A collective intake of breath hushes the small crowd of onlookers as we nervously watch Terri Irwin coax the creature out into the open. The lull is brief, for suddenly the crocodile springs from his metal prison and unleashes his fury, trying desperately to extricate himself from the ropes.

The ground beneath my feet vibrates with every roll as the hapless creature thrashes and writhes, binding the ropes ever more tightly around his snout. He expends all available energy in the effort and eventually gives up and quietens. It's the moment the jump crew has been waiting for. Once more, Terri issues the instruction, and they leap forward as one, landing on the crocodile's back, swiftly taping his jaws shut and fitting a blindfold over his eyes. It's time for the drama to cease and the science to begin.

THE ECOLOGICALLY significant Wenlock River flows through the Steve Irwin Wildlife Reserve (SIWR) in Cape York, one of four conservation properties in Australia Zoo's portfolio, all of which are in Queensland. It's here, since 2007, that the world's most comprehensive crocodile study has been taking place. I'm spending a few days with the team led by Professor Craig Franklin, director of research for the SIWR. The group, which includes Terri Irwin and her children, Bindi and Robert, spends a month here in the middle of the dry season each year to monitor the river's crocodile population.

The reserve was acquired in July 2007 after the federal government signalled its wish to honour recently deceased Steve Irwin by renaming a national park in his honour. Terri requested a more hands-on memorial to her husband.

"I said that, with all due respect, we would like to proactively manage a property so that instead of just setting it aside in Steve's name, we could do some positive things with it," she says. That property



**Khaki crew.** Terri, Bindi and Robert Irwin head west along the Wenlock River to attend the morning's first crocodile capture. Toby Millyard is on the tiller.

turned out to be Bertiehaugh station, a 1350sq.km pastoral lease in remote Cape York, 55km north-east of the bauxite mining hub of Weipa.

Barry Lyon, a seasoned Cape York park ranger, had tracked crocodiles in the Wenlock River previously, so when it came to deciding upon a property, Terri and Craig sought his advice. "It was very near and dear to Steve's heart because of the crocs, and Barry was the one who said it should be this place," explains Terri.

Once they had purchased the property, Barry came on board to help run it and to develop a management plan. This is a requirement under the National Reserve System program (see AG 94), which stipulates that conserved areas must meet certain scientific criteria and strategically enhance the national network of protected areas.

"Through Barry's hard work with a number of scientists, we've learnt that this place is so much more valuable than we ever anticipated," Terri says. It was the Wenlock's rich aquatic biodiversity, not least its high density of crocodiles, that originally drew Australia Zoo here.

Ultimately, though, it was a series of permanent freshwater springs associated with a bauxite (aluminium ore) plateau that will secure its status as a 'strategic environmental area' under the Queensland government's new Cape York Regional Plan. ▶



#### WATCH

Use the free **viewa** app to scan this page and see Terri Irwin and her team of croc wranglers and researchers jump onto the back of Juergen, a mammoth male estuarine crocodile.



**Routine capture.** In a faultless exercise, the team captures Juergen, a 4.7m male (above). His floating trap is hauled ashore (top) and once his jaws are secured with ropes, they jump on his back (right) and hold him in place while his mouth is taped shut (far right).



**Springs eternal.**  
Ranger Barry Lyon (right, at left) points out the direction of the waterflow at Bluebottle Springs. With him are Marc Leblanc, Bindi, Terri and Robert Irwin. Distinctive Kennedy palms (below) define the riparian corridor along the Wenlock's lower reaches.



**Red gold.** The special hydrological properties of bauxite (above) have created a series of perennial springs that sustain green oases among an otherwise arid savannah landscape (left).

The plan seeks to balance environmental protection with sustainable economic development on the peninsula, and the new designation effectively ends a pre-existing bauxite mining option spreading over approximately 15 per cent of the reserve, including the plateau.

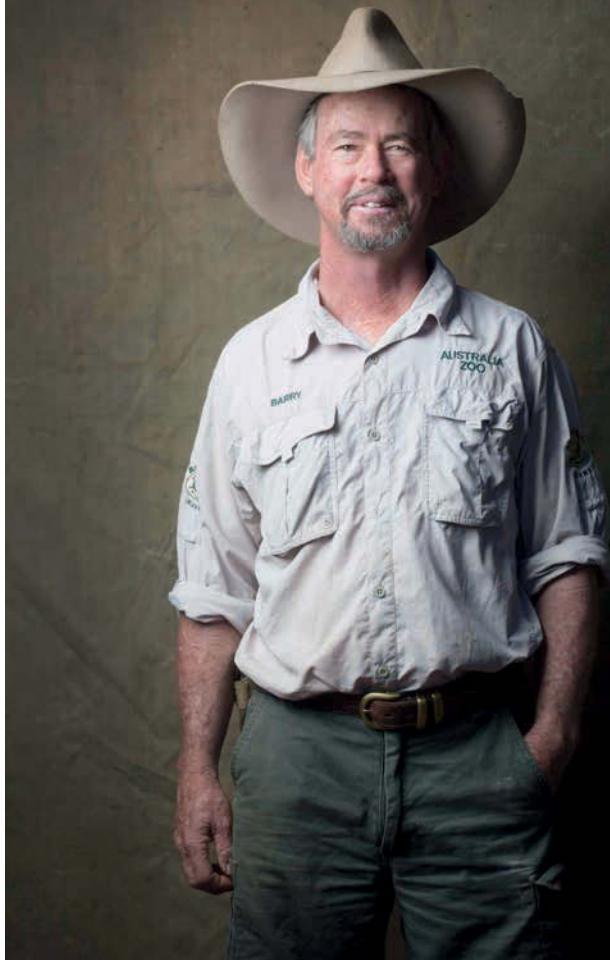
Not a great deal is known about the hydrology of the vast bauxite deposits that typify much of this remote area of Cape York. However, initial observations of the lush oases sustained by those perennial springs indicated that they might be a previously undocumented ecosystem type, found possibly nowhere else.

These cool, verdant havens among an otherwise dry eucalypt woodland landscape were the bitter battleground on which Australia Zoo fought for six years to halt a major project that would have seen a strip mine established across the plateau.

The eight springs, known locally as the Coolibah Springs complex, are inextricably linked to the geology of the plateau. It's here that the porous bauxite acts like a giant sponge, filtering rainwater down to a deep sandy aquifer during the wet season and transmitting it progressively throughout the dry season to the springheads, where it eventually flows down to the Wenlock River.

According to Dr Marc Leblanc, a French-Australian hydrologist who specialises in semi-arid regions: "It's pretty rare to find a large, permanent spring system in this climate, and very rare to have a spring that sustains such incredible ecosystems... all of them a little bit different, which makes it a very significant place in terms of what we call its eco-hydrology." The plant communities associated with each of the springs vary, but each hosts rare or threatened species.

David Fell, a visiting botanist who undertook floristic assessments here, described an entirely new rainforest type at one spring, which is dominated by the striking and rare tiger stripe tree. Crucially, the oases provide habitat, refuges and corridors for a wide range of mammals, birds, amphibians, reptiles, fish and invertebrates and are culturally significant to the Teppathiggi and Attambaya people of the lower



**Coolibah colleagues.** Cape York ranger Barry Lyon (above) worked alongside Steve Irwin on croc research for a number of years before coming on board to help manage the SIWR. Researchers (below, from left) Hamish Campbell, Craig Franklin and Ross Dwyer.

Wenlock basin. Certain springs served as women's birth places, and many plants here were important for food and medicine.

**T**HE ONGOING PROCESS of discovering and recording the area's special natural values brings a range of scientists from many disciplines here each year. During my visit, alongside hydrologist Marc, there's also a biologist studying a resident population of Australia's largest crested parrot, the beautiful palm cockatoo.

But at this time of year, it's typically croc researchers who are most conspicuous around Coolibah Camp. The airy tin shed serves as general HQ, makeshift lab, film-editing suite, amenities block and mess hall for a lively gaggle of scientists, rangers, volunteers, journalists, photographers and cooks.

Joining Craig Franklin in the field each year are brothers Dr Ross Dwyer – a colleague from the University of Queensland – and Dr Hamish Campbell from the University of New England. I sit with them around the refectory table the night before I'm scheduled to head out along the Wenlock to check crocodile traps with the rangers.

I'm excited by the prospect, but keen to ▶



understand the method and purpose of the research first. "It's the largest and longest telemetry study on crocodiles ever to be conducted," Craig says. "And, using acoustic telemetry, we'll be tracking more than 100 crocodiles here for the next 7–10 years."

The work is significant for the management of crocodiles that live close to human populations and therefore pose major safety risks. "In Queensland, problem crocodiles were translocated up until about 2008. Our research demonstrated that crocodiles will home and return to the same area once removed. Now translocation is no longer employed as a management strategy and crocodiles are removed permanently to farms," Hamish says.

How crocs navigate, how far they travel, whether they maintain permanent territories, and how social hierarchies operate are among the questions the researchers seek to answer. The team has mapped a detailed picture of the Wenlock River group.

"Correlating acoustic and satellite tracking results with environmental variables such as currents and tidal systems, we've shown that...not only do they home, but they've got quite a detailed understanding of how currents work and will only travel when they are favourable," says Ross. "They'll climb up on a riverbank and wait till the current turns in the direction they want to go and then they just swim out and hitch a ride."

The researchers have also observed that in pristine rivers such as the Wenlock, populations remain stable and balanced. Large, dominant males (longer than 4m) control movements in the river, and smaller males are forced to migrate, which accounts for some of the epic oceanic journeys recorded. This has important implications for the practice of removing the biggest crocs from waters close to human populations.

"We don't know the effect that removing these large males might have on the dynamics of a river," Hamish says. "If, from an area near people,

**Touching time.** Young Robert Irwin has to wait a few more years before he'll be allowed to join the jump team, but, in the meantime, he enjoys close encounters.



Larger numbers of highly mobile young males pose a greater risk to humans, and so it's vital to solve these puzzles quickly.

you remove a large male that was controlling the movement of smaller 2–3m males, it could cause more of these smaller animals to move into that area." Larger numbers of highly mobile young males pose a greater risk to humans, and so it's vital to solve these puzzles quickly.

**I**T'S WHY, the next morning, our big, beautiful saltie has been dragged from the river and is now lying under the weight of eight of us: Terri at the head and seven of us along the body. Craig works fast, assisted by Bindi, clearly relishing her role as technical assistant. First he scans for a tag. It's a recapture. Juergen has been trapped twice before. This is great news, because it helps to build a detailed picture year on year. He's measured, has blood taken and the acoustic tag that's been surgically implanted is checked and replaced under a local anaesthetic.

Meanwhile, I'm awestruck to be touching a wild crocodile. I'd imagined the scaly skin to be hard like armour so I'm surprised by the soft texture of the scutes on his back. Juergen doesn't move at all during the encounter, and, all along his massive 4.7m body, the jump team remains silent and respectful, trying hard not to disturb the creature more than necessary. Soon it's time to release him; it's by far the riskiest part of the process and those not directly involved, including me, are moved to a safe distance.

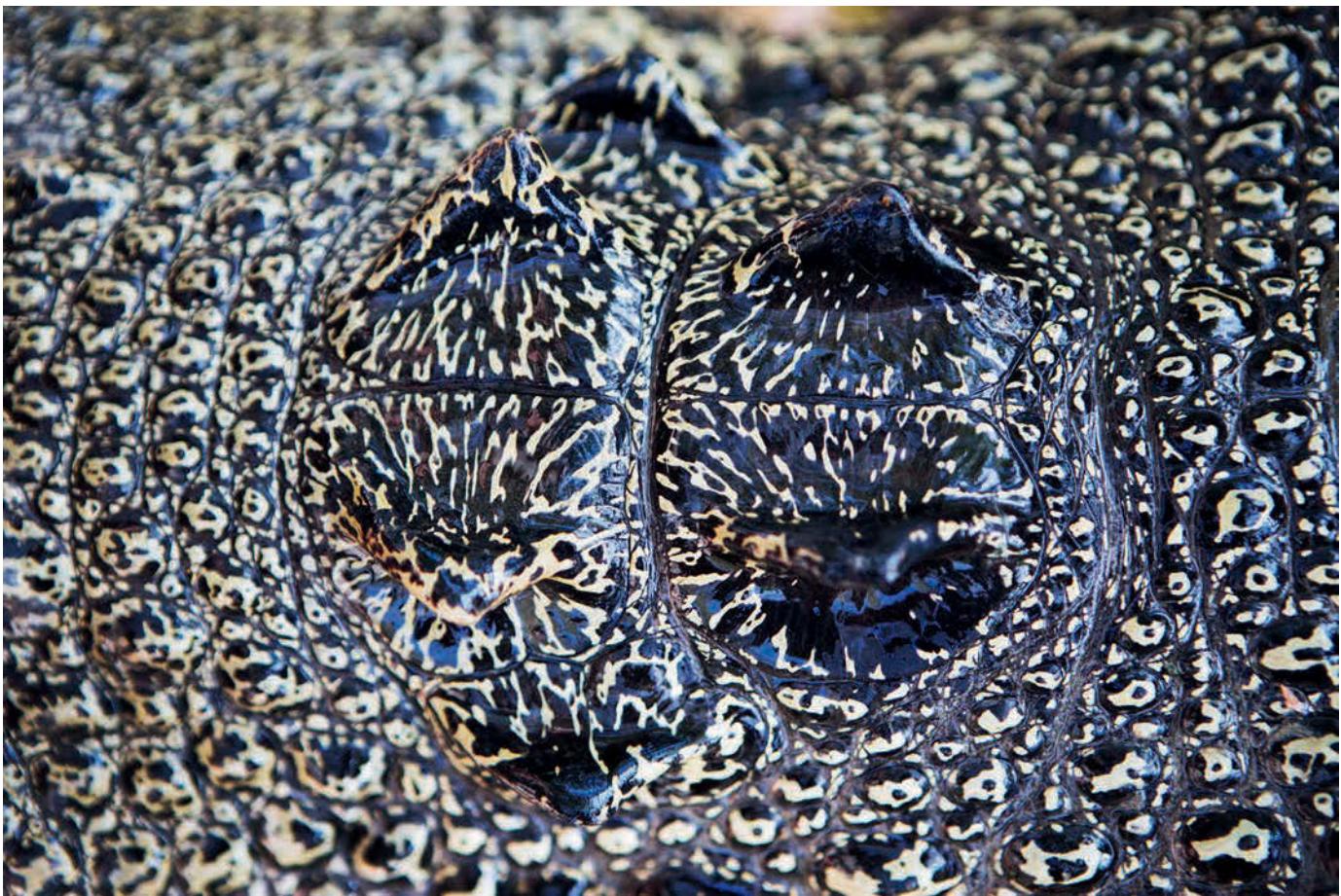
The blindfold and jaw tape are removed and the jump team gets ready to flee. Juergen, once free, will be at his most dangerous and could move like lightning in any direction. Hearts are once again pumping as everyone prepares for the call to release.

The order comes and the team scatters, the jaw ropes come away, and, after a brief hesitation, Juergen heads down the bank, disappearing with barely a splash beneath the coffee-coloured water. It's a textbook operation. Steve Irwin taught his people well. They have perfected a capture and release method that eliminates the need to tranquillise the animals, and it's a technique that has been adopted by other crocodile researchers around the world. **AG**

**FIND** footage of crocodile captures online at: [www.australiangeographic.com.au/issue122](http://www.australiangeographic.com.au/issue122)



**Thick skinned.** In 2013 the Australia Zoo team named one of their captures Aus-Geo, in honour of this journal. A satellite tracker (left) is attached to his neck.



**Perfect patterns.**  
The nuchal shields  
on Aus-Geo's neck  
(above) show off his  
distinctive markings.

A saltie's fearsome  
teeth are neatly  
aligned (far right).





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**Little lady.** 'LB1' was the first and most complete skeleton of the Hobbit found in 2003 at the Liang Bua cave by the University of Wollongong's Professor Mike Morwood and his team.



## FACE TO FACE WITH THE HOBBIT

The fossil of a totally unexpected tiny species of human was found in an Indonesian cave in 2003. AGS-sponsored scientist Susan Hayes looks at what we now know about the discovery, and explains her work to reconstruct the facial features of these ancient people.

---

STORY BY SUSAN HAYES





**WATCH**

Use the free **viewa** app  
to scan this page and  
watch a film about the  
discovery of the Hobbit.



**Home in the hills.** Liang Bua, which means 'cool cave' in the local Manggarai language. This site on the Indonesian island of Flores has been the source of 11 sets of *H. floresiensis* remains since 2003.



## EVERY SKULL IS EXCEPTIONAL.

Every skull has a quirk that doesn't quite fit the pattern. And every human skull was once a living person – someone with particular likes and dislikes, who had family and friends, who ate, who slept and who dreamed. Each and every skull is the only one of its kind, and all skulls demand respect for the lives they once lived. That being said, the skull of the 'Hobbit', *Homo floresiensis*, took being unique to a whole a new level. From the moment she was excavated, this ancient and totally unexpected new species of human turned what we knew about human evolution on its head.

My specialty is facial anthropology and forensic facial approximation, which, to the lay person, could be described as facial reconstruction. Many researchers in my field prefer the term facial approximation, because the results of estimating the 'average' appearance of soft tissues from fossils are, of necessity, always going to be an approximation. No-one is average, nor is their skull.

My job – with the help of research funding from the Australian Geographic Society – was to take the only skull we now have from the 11 or so known individuals of *H. floresiensis* and use computer software to attempt to reconstruct her facial appearance. More on this and the results later – but let's start at the beginning of this story with the remarkable and surprising discovery made in 2003.

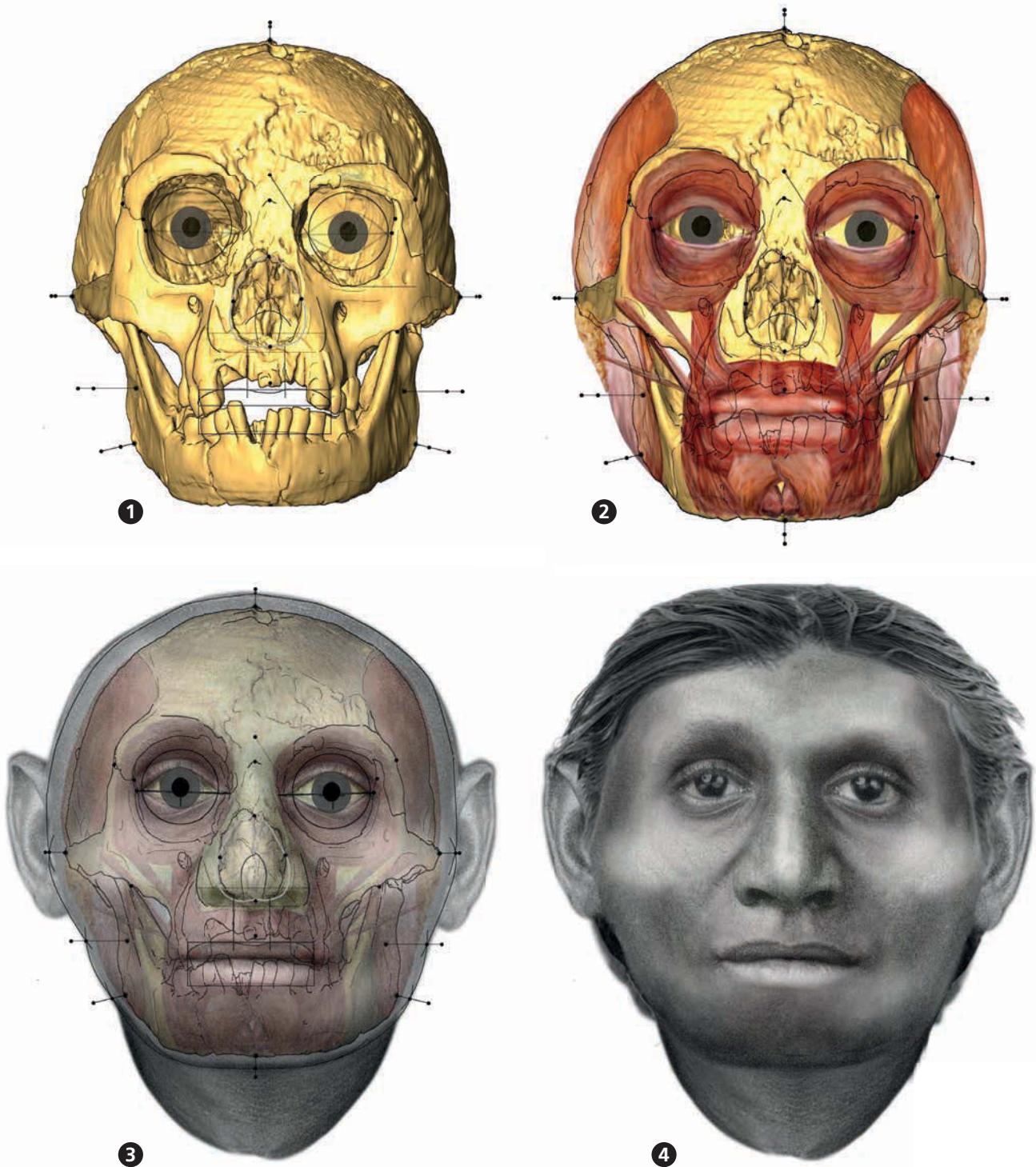
**W**HAT NOT MANY people realise is that the home of *H. floresiensis*, the Indonesian island of Flores, occupies a special place in the history of the planet. Ever since it began emerging above the sea some 10 million years ago, Flores – located about 500km east of Bali – has been an island. And the fossil record of vertebrate animals that it holds shows very little variation – a consequence of never being connected to a larger landmass.

The older inhabitants, those that lived on Flores more than 1 million years ago, include a 1m-tall pygmy elephant (*Stegodon sondaari*), a giant tortoise and the Komodo dragon. More recent inhabitants can be found within stratigraphic layers dated to 900,000 and 700,000 years ago. By this time, the pygmy elephant had been replaced by a 1.8m-tall dwarf species (*Stegodon florensis*), and a giant rat (*Hooijeromys nusatenggara*) had appeared.

To palaeontologists, fossil evidence of a limited number of endemic vertebrate animals, including dwarf and giant versions of mainland animals, is a clear indication that the bizarre phenomenon known as the 'Island Rule' is at play. Being small has distinct survival advantages on an island: smaller mammals need less food, which is often a restricted resource anyway. In such an environment, therefore, smaller individuals are likely to be physically fitter, live longer, and produce more surviving offspring.

Consequently, over long periods of time, large vertebrate animals become smaller in order to adapt and survive. In an interesting twist, some smaller vertebrates, such as the rat, then become bigger to fill the empty niche left by the shrinking large vertebrates (islands do not have many medium-sized mammals).

Flores is also unique because it is the only island, so far, to have yielded fossil remains and artefacts proving the presence of early human relatives. These 'hominins' include extinct ▶



#### Four steps to building a face.

To reconstruct a face ④ from the LB1 skull, Susan went through a series of steps. First she used a computer model to analyse the skull and repair any damage ①; she then built up underlying anatomy, including the muscles ②. Following this, the facial features were approximated ③. The result ④ appears hauntingly human-like. Some details, such as ears and hair, can't be determined from the skull and are speculative.

## This could mean that *H. floresiensis* is the human species to have most recently coexisted with our own.

humans such as *Homo erectus* and *Homo neanderthalensis*, as well as *Homo sapiens*. *H. floresiensis* was discovered on 7 September 2003, deep within an excavation against the eastern wall of a huge cave known as Liang Bua. A gaping limestone formation, Liang Bua has been an archaeological excavation site since the 1950s. The team who discovered her was searching for evidence about the migration of our own species (early *H. sapiens*) to Australia, via Indonesia, many tens of thousands of years ago.

Starting in 2001, Professor Raden Panji Soejono of the Indonesian National Centre for Archaeological Research, and legendary Australian archaeologist Professor Mike Morwood (see page 95), led a series of Indonesian-Australian excavations in Liang Bua, employing a new technique enabling them to excavate safely to depths of more than 10m. The focus of these excavations was a search for fossil evidence of the first early humans to arrive on Flores. Although stone tools clearly show hominin occupation from about 1 million years ago, the bones of early toolmakers of our own species were proving elusive.

No-one was expecting to find a new hominin species of only 1m (3.5 feet) tall, but this is exactly what happened. Embedded within a matrix of silty clay 6m down, and displaying disproportionately large feet for such a small frame, 'Hobbit' was announced to the world in 2004 as Liang Bua 1 (LBI), and she has held international scientific attention ever since.

Although her bones were demineralised and soft (often described as having the consistency of wet blotting paper), LBI's skull and skeleton were very well preserved. One estimate later dated her to 18,000 years old, which indicates her species overlapped with our own in time. But they may or may not have lived with them on Flores itself, as modern humans did not arrive until an estimated 11,000 years ago.

If this dating holds true, it could mean that *H. floresiensis* is the human species to have most recently coexisted with our own on the planet – Neanderthals, for example, were extinct by perhaps 30,000 years ago.

Puzzlingly, LBI exhibits a mixture of skeletal features both primitive and modern, complicating our understanding of how she fits into the hominin family tree. This mix of features is also present in the other 10 *H. floresiensis* fossils, although these later finds – which are up to 38,000 years old – are not as complete.

Many international scientists are trying to solve the puzzle of where *H. floresiensis* fits within human evolution. According to some researchers, the species is a dwarf version of *Homo erectus*.



**History of habitation.** About 800km north-east of Australia, Flores has yielded fossil remains and artefacts proving the presence of early human relatives, such as *Homo floresiensis*, discovered here in 2003.

Fossils of *H. erectus* have been excavated from the much larger Indonesian island of Java (the famous 'Java man', for example), and the evidence shows they lived there between 1.5 million and 150,000 years ago.

According to this hypothesis, a small population of *H. erectus* became stranded on Flores. Big tsunamis occur in the Indonesian region every 100 years or so, and it is possible a tsunami washed a small group out to sea and carried them to the island's shores (during the 2004 Banda Aceh tsunami, for example, some people were flushed many kilometres offshore and were found alive, days later, clinging to rafts formed from plant debris).

Finding themselves completely isolated on the small island of Flores, this group of *H. erectus* could have then become subject to



**Hold your breath.** The Hobbits of Flores faced threats from crocodiles and Komodo dragons, one of which is shown here stalking a small group hidden in the foliage.

the Island Rule – across thousands of generations and 1 million years they gradually shrank to the size of *H. floresiensis* – similar to what happened on islands with other large-bodied mammals (such as the dwarf elephants) stranded there. In other words, a selective pressure towards smaller body size would have been continuously acting on a *H. erectus* population on Flores.

Moreover, because the fossil evidence shows that the island did not have large mammalian carnivores such as hyenas, tigers or wolves, the advantage of being bigger to defend oneself from large predators was not necessary. Nor would this group of hominins have needed a large body size to travel long distances in search of food – the island is only 60km at the furthest from north to south, and 300km from east to west. Being big,

therefore, was not necessary for the survival of either *H. floresiensis* or the pygmy elephants, whereas being smaller meant living well on limited resources.

But nobody, at present, can rigorously test this hypothesis. Although skeletal body remains of *H. floresiensis* (LB1 is the only specimen found with its skull) are comparatively plentiful, this is not the case for *H. erectus*. So far no *H. erectus* fossils have been excavated from Flores, and, despite many of their fossil crania (mostly just skull-caps) having been found on Java, few other skeletal remains have been unearthed.

So a thorough comparison between the skeletons of both species – which would help determine the ancestry of Hobbit – is not yet possible. The search, however, continues. ▶

**Facing history.**

Dr Susan Hayes, at right, with Penny Williamson.

A researcher at the University of Wollongong, Susan was originally a forensic scientist. Her focus is now archaeological, and she specialises in approximating the faces of ancient human species.



MY ROLE IN the *H. floresiensis* story began when I joined the Centre for Archaeological Science (CAS) at the University of Wollongong in 2012. Professor Richard Roberts, CAS director and Australian Laureate Fellow, introduced me to Professor Mike Morwood, and I started work with Mike and Thomas Sutikna, an archaeologist from Indonesia, on the facial approximation of LB1. Thomas and Mike had worked together for many years, and Thomas (together with Wahyu Saptomo, Rokus Due Awe, Jatmiko and Sri Wasisto from Arkenas) was instrumental in the discovery of *H. floresiensis*.

Working with Hobbit was certainly challenging, but Mike and Thomas were great collaborators, and I knew they were the two people with the most experience regarding this strange little hominin. Our experiment aimed to discover what would happen if we applied what we knew about forensically approximating the faces of modern humans to an archaic, extinct hominin.

I had never worked with such an archaic human fossil before, so, although there is always extensive background research before starting to approximate a face, this project also included a steep learning curve about the relevant palaeoanthropology (the research that has been undertaken with *H. floresiensis* has been extensive since 2004). To make the approximation, we used CT scans of the skull, 3D imaging and computer modelling.

We found that Hobbit herself (she's the only individual of *H. floresiensis* for which we have a skull) looked more like us than many people might have expected. And, although by today's standards of human evolution she's not exactly what you'd call pretty, she is certainly distinctive. Hobbit doesn't have those hyper-feminine, modern-human features such as big eyes, nor is there much of a forehead, and she doesn't have a chin at all.

Our results do show a more modern facial appearance than some Hobbit faces produced by palaeo-artists.

But our results show that she looks a lot less like a chimpanzee than some of the illustrations created by many palaeo-artists.

At the Australian Archaeological Association conference in late 2012, the response to our results was, for me, astounding. Mike and Thomas were well used to all the attention, but I was not. Within hours I was receiving emails from all over the world, and our Hobbit face was all over the internet.

My worry was that we had not yet submitted our research for publication, and, in the sciences, international peer-review is essential. Mike's response to the paper we submitted in early 2013 was that it was too focused on the technical process and not easily understood by the wider community. As ever, he was right.

Sadly, Mike died in July 2013 with projects yet to do (see box opposite). This was shortly after our research appeared in the international *Journal of Archaeological Science*, so he never knew how we were received by the media – which was that we thought Hobbit had a very modern face. To be fair, our results do show a more modern facial appearance than some Hobbit faces produced by palaeo-artists. This is probably because our approach



**Initial impression.**  
An early illustration of *H. floresiensis* appears much more apelike than Susan's reconstruction.



## THE GIANT WHO DISCOVERED A PYGMY

This legendary archaeologist left an indelible mark on our understanding of the past.

**N**EW ZEALAND-BORN archaeologist Professor Mike Morwood became well known worldwide when his team discovered *Homo floresiensis* in 2003. The significance has been compared with the discovery of the Neanderthals in the 19th century, and it caused archaeologists and palaeoanthropologists to redefine what they thought they knew of human evolution.

"His unconventional and at times bull-headed nature led him to think bigger and dig deeper than anyone else," the University of Wollongong's (UOW) Dr Adam Brumm wrote in the UK's *Times* newspaper in September 2013 after Mike's death. "He inspired devotion in his students and younger researchers and revolutionised the field with his simple but inexorable principle of deep-trench excavation: do not stop until you hit bedrock."

Mike was based at UOW and is fondly remembered for contributions to knowledge about Australian archaeology and Aboriginal rock art. He completed his PhD on the rock art and archaeology of Queensland at the Australian National University, Canberra, in 1980, and went on to take up positions at a number of universities, including the University of New England. He also collaborated with the University of Western Australia (UWA), where he focused on Kimberley rock art.

Professor Alistair Paterson of UWA says, "Mike Morwood was an exceptional archaeologist and researcher, and a generous expert in rock art, human evolution and Australian archaeology. In the areas on which he chose to focus he was inevitably a game changer; one of a rare group of Australian researchers who made an extraordinary contribution to their field."

JACQUELINE OUTRED

was based on evidence, and because we applied knowledge of faces derived from large numbers of modern humans. That was unavoidable, because we know very little about the soft tissues of ancient hominins.

Our research paper concluded with a comparison of our results with nine other facial reconstructions of Hobbit's skull, produced by international palaeo-artists. Most of these faces are on display in natural history museums around the world. Because every artist was working from the same skull, we thought it would be interesting to see how our face compared with the rest.

We used statistical methods to analyse the common facial landmarks (eyes, noses, mouths, etc.), and the results were surprising. All nine facial reconstructions are very, very different. The eyes, mouths and noses are different widths and lengths – even though Hobbit's skull clearly shows where these features sit, each of the palaeo-artists have arranged them in different places.

This could be due to how, or if, the damaged parts of the bones of the *H. floresiensis* skull were 'reconstructed' by each artist. Every fossil is distorted by being in the earth, and, because Hobbit's bones were like butter within their silty clay encasement, further inadvertent damage occurred both during and after excavation. The first thing we had to do, therefore, was try to 'repair' the bones – some were twisted out of shape, which is common ▶



#### Meet the family.

Models reconstructed from fossils. In the foreground is an early modern human (*Homo sapiens*) based on the remains of Mandal Man, excavated in North Korea. To the left is *Homo floresiensis*. In the background is a group of other humans, including some archaic and hairy hominins.

## What happened to these people and did they overlap with the first modern humans?

with fossils, some surface areas were missing and some bones were broken. Naturally, our 'repairs' were undertaken on the CT scans of Hobbit's skull, not the actual bones.

Another issue with some reconstructions is that many, if not most, of the methods used don't yield scientifically accurate results. The scientific methods for approximating facial appearance are relatively new, and are published in academic journals, not popular science books, so they are not easily available.

This is unfortunate because these visually compelling displays of evolution attract public interest to archaeological science, and, by association, support less exciting areas of research. I'm now thinking about producing a guide for palaeo-artists to inform them on what's new, what still works and what methods to avoid.

My next project is with the only South-East Asian *Homo erectus* fossil to still have his facial bones (a specimen known as Sangiran 17). Preparation for this project was completed with AG Society sponsorship, and later this year I hope to experiment with my Indonesian colleagues from the Geology Museum in Bandung, Java, in producing a 3D model of his face (currently my results are two-dimensional computer models).

**N**OW THAT WE HAVE A more accurate facial approximation of Hobbit, it helps us to understand this species as being people that in many ways were like us, despite their diminutive size. But what happened to these people and did they overlap with the first modern humans to arrive on Flores?

Evidence of the presence of Hobbits in the form of stone tools and butchered pygmy elephant bones is found in layers of earth at the Liang Bua cave dated from 95,000 to 13,000 years ago. While the 11 fossils themselves date from 38,000 to as early as 18,000 years ago, if this dating is correct.

Current thinking from some experts is that a volcano – ash from which is found at Liang Bua – on Flores sent these people to extinction about 12,000 years ago. To further complicate the matter, there are legends in Flores of small, hairy cave-dwellers known as 'Ebu Gogo', which some people see as roughly fitting the description of Hobbits.

But many of the world's cultures have legends about 'little people', and, being human, Hobbit was probably not very hairy – or so the evidence suggests. The conclusions we can draw from these legends, therefore, are not at all clear cut.

It could be that other skeletons of *H. floresiensis* were discovered many years ago, and that they now form part of the cultural memory of Indonesians there today. In much the same way that now-extinct animals such as the marsupial lion and other Australian megafauna probably relate to some of the legendary creatures in Aboriginal lore across our continent.

Future research will surely unveil more fascinating details about *H. floresiensis* – an unexpected species that has captured the world's imagination. **AG**

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**Cup contenders.** As the light fades over Alice Springs, the corral at Blatherskite Park buzzes with excitement. Handlers, jockeys and their steeds are preparing for tomorrow's race – the annual Lasseters Camel Cup.



## Join us next issue

What is right and wrong with Australia's national parks? And how can we better manage these natural treasures? Read our special report to find out. Also in this issue, walk in the footprints of Australia's early inhabitants as we celebrate the 40th anniversary of the discovery of 42,000-year-old **Mungo Man**; learn how plants talk with sounds, chemicals and other surprising means; look back over **Dick Smith**'s incredible life of adventure; and come with us to the **Lasseters Camel Cup**, an annual fixture in the Alice Springs racing calendar. Out early November.

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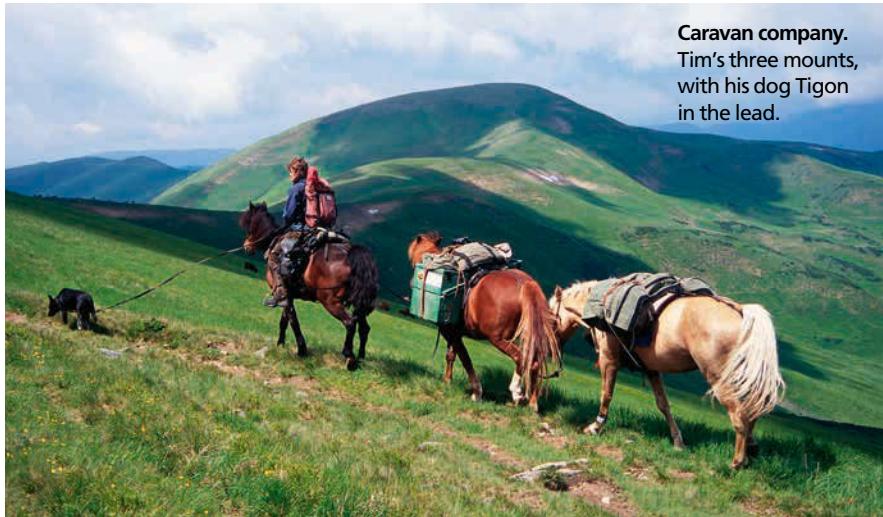
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HERON ISLAND  
RESEARCH STATION  
An idyllic home for turtles and scientists.

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FROM THE FIELD  
Go behind the scenes on assignment with our photographers and writers.

**130**  
LINE IN THE SAND  
Tracing Goyder's divide between arable and pastoral land.

# OUT BACK

TRAVEL & DESTINATIONS, YOUR SOCIETY, YOUR AG



**Caravan company.**  
Tim's three mounts,  
with his dog Tigon  
in the lead.

## DESTINATION HIGHLIGHT: REMOTE MONGOLIA

# Empire of the horse

Horses were domesticated on the Eurasian steppe; from here Genghis Khan's nomads took them to the world.

**W**HEN AGS-sponsored adventurer Tim Cope set out to cross from Mongolia to Hungary in 2004, travelling by horse was the logical decision. The nomads of the steppe were the first people to tame and ride horses, and it was this advancement that brought them to the edges of Europe and into conflict with its inhabitants in the 13th century. This horsemanship, which initially gave nomads the military edge over Europe, may be considered their greatest contribution to the modern world.

The horse still plays a central role in the lives and culture of all steppe societies, and travelling with his caravan of three mounts allowed Tim to discover the heart, mind and soul of the steppe nomads. In addition,

horses gave Tim a long-craved sense of adventure and, importantly, offered an opportunity to be a participant in the communities he passed through, rather than just an observer.

Although Tim had almost no experience with horses, he did research through an organisation called The Long Riders' Guild. During his 2004–07 expedition, Tim often had three horses: two for carrying grain and equipment, and one for riding. In some areas of rough terrain, walking by foot or using camels was also essential. Few tours offer the opportunity to trek across parts of Mongolia with horses or caravans of camels, but the Australian Geographic Society is offering just one such trip, led by Tim Cope in October 2015. Turn to page 107 for more details.

## 5 OF THE BEST

### AUSSIE HORSEBACK EXPERIENCES

#### 1 KIMBERLEY HERITAGE CATTLE DRIVE

During a six-day drive along the Barclay Stock Route in the east Kimberley, WA, the drovers of Home Valley station teach punters horsemanship skills.

#### 2 THE BICENTENNIAL NATIONAL TRAIL

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#### 3 COAST TO VINES RAIL TRAIL

This 37km track in southern Adelaide, SA, winds from Marino Rocks, through the foothills of the McLaren Vale wine region to Willunga.

#### 4 SCONE AND UPPER HUNTER HORSE FESTIVAL

In early May, the Hunter Valley, NSW, is awash with activity, such as the King of the Ranges Stockman's Challenge.



#### 5 TOM QUILTY GOLD CUP

The Quilty is an iconic 160km ride. Starting at midnight, racers have 24 hours to finish a route that changes yearly, moving from state to state. It will next be held in NSW, in June 2015.



AUSTRALIAN GEOGRAPHIC SOCIETY UPCOMING EXPEDITION

# RIDING *into* HISTORY



TIM COPE returns to the lands of western Mongolia where authentic nomadic culture remains a living testament to a pivotal chapter of human history. Join him in 2015 and help to raise money for the AG Society.

---

STORY AND PHOTOGRAPHY BY TIM COPE



**On the move.** Tim Cope's nomads of western Mongolia expedition includes a three-day camel trek.



**Asia on high.** Large parts of mountainous western Mongolia still appear untouched by the outside world.

**O**N A REMOTE grassy shelf, perched high above the roiling marble-green waters of the Shivreen River gorge in western Mongolia, I let my backpack fall to ground before settling in for a moment of reflection. It is early summer, 2014, and before me, casting an evening shadow like a lone shepherd, stands a tall stone that has become the site of a kind of annual personal pilgrimage.

There are no inscriptions to be found on this anonymous monument, and neither, to my knowledge, are there written records of it, but the chiselled outline and implanted rocks encircling its base are a giveaway. It is a type of grave marker broadly known as a 'deer stone'. It probably dates back some 3000 years to the reign of the

Xiongu people – legendary horseback nomads against whom the Chinese built their famed wall, and who, some historians believe, later became known as the Huns.

**D**URING MY three-year horseback journey from Mongolia to Hungary, which began in 2004, I chanced upon many unheralded relics such as this, as well as some of grander design, which evoked the memory of the myriad nomad societies that once spanned the breadth of the Eurasian steppe. They ranged from the pre-Bronze Age Scythians more than 2000 years ago, right through to Genghis Khan's 13th-century Mongols, who created the largest contiguous land empire that the planet has ever seen.

Yet what draws me time and again



**TIM COPE** spent three years travelling 10,000km by horse from Mongolia to Hungary on the trail of Genghis Khan. Tim, who was the 2007 Australian Geographic Adventurer of the Year, has since completed an award-winning film series for ARTE in Europe and ABC TV in Australia. He has also written a book, *On the Trail of Genghis Khan: An Epic Journey Through the Land of the Nomads*.

to this particular stone – now part of a trekking route I've been guiding since 2009 – is not so much its archaeological value, but the vista it overlooks. Here, in Mongolia's isolated Altai Mountains, the continuum of nomad life, so broken elsewhere by the pressures of the modern world, carries on. ▶

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**Nomad heritage.** Kazakh men have used birds of prey to hunt in western Mongolia since the 15th century. Although threatened by modernisation, it remains an honourable tradition and rite of passage. Eagles are trained to seek marmots, foxes and wolves.

**Beasts of burden.** Domesticated at least 3000 years ago, the two-humped Bactrian camel is native to Mongolia. It is one of the tavushorshoo, or 'five snouts' – the five domesticated animals of Mongolia (horse, yak, sheep, goat, and camel) on which the country's herding economy depends.





## WESTERN MONGOLIA



### AREA OF MONGOLIA

**1,564,116 SQ.KM**

### POPULATION

**2.95 MILLION**

### BUDDHIST POPULATION

**53%**

### GEOGRAPHY

Mongolia is a landlocked Central Asian nation of high elevation, wedged between Russia and China. It is mountainous and dry, peppered with peaks, ranges and valleys. Features include the vast Gobi Desert of the south; Lake Khövsgöl, one the largest lakes in Asia, which is home to 2 per cent of the world's fresh water; and Khüiten Peak in the far western corner, which is the nation's highest point at 4374m.

### RELIGION

The predominant religion is Buddhism, which was revived following the lifting of the communist ban on religions in 1990. Historically, Mongolia has had close ties with Tibet through the Buddhist religion, and many similarities exist in the culture and lifestyle of these two countries. Mongolian religion and their nomadic lifestyle is depicted in their music, literature and artwork.

As I lift my eyes beyond the stone, they're met with a panorama that has probably changed little since man is thought to have first domesticated the horse on the steppe about 5500 years ago. To the north rise the fluted, glaciated tips of the 4000m Kharkhira-Turgen massif – a range, which in summer becomes a magnet for nomads in search of its rich alpine grasses. To the south, the Shireen River descends into a cavernous V-shaped gorge beyond which the

waters splay out on to arid, sandy plains. Framed by these two broad features are grass foothills peppered with herds and flocks of horses, yaks, sheep and goats. On closer inspection, tell-tale flecks of white – nomad tents known as gers in Mongolian, and more commonly in English as yurts – can be seen in the clefts of slopes and by the slivers of streams and gullies. Moving between them, riders sit high in the saddle, cantering along barely perceptible tracks.

As I watch, increasingly mesmerised, I realise that the absence of roads, fences and mechanisation makes the same impression that it did during my first visit here on my epic journey across the steppe 10 years ago (see *Nomad spirit* AG 89). Back then I was left particularly spellbound by an encounter with a family migrating down from the high pastures.

The caravan, snaking its way down with heavily laden camels, was led ➤



by a woman dressed in a magnificent silk cloak and riding a silver-coin-encrusted saddle. Upon greeting me she dismounted, brought a camel to its knees, and pulled back a sheepskin on a side-basket to reveal a tiny newborn baby.

I was humbled by the thought that this woman trusted her animals with what was most precious to her. The meeting left me with an enduring image of the symbiosis with which nomads live with the land and its creatures – a kind of camaraderie that helps ensure a sustainable way of life in a climate that can range from  $-50^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  in a single year.

**M**ONGOLIA IS A vast nation, dominated by the steppes to the north and the Gobi Desert to the south. It is landlocked

## Even in the face of change, elements of Mongolia's nomadic lifestyle prevail in the urban landscape.

and has an average altitude of 1580m, making it one of the world's highest countries. Between the deserts are lakes, both salt and freshwater.

In the decade since my encounter with the caravan family, I have watched the nation's capital, Ulaanbaatar, transform beyond recognition from a relatively quiet, Soviet-era town, to a heaving series of traffic jams and an expanding

**Steppe empire.** Today some three billion people – such as these Kazakhs in Bayan Olgyi – live in lands conquered by Ghengis Khan and the Mongols. The Mogol empire stretched from China to Iraq and from Poland to Indochina.

thicket of high rises. This is a result of Mongolia's unprecedented mining boom, which has seen its economy become the world's fastest growing in 2011. Although, even in the face of this rapid change, elements of Mongolia's nomadic lifestyle prevail in the growing urban landscape around Ulaanbaatar, where gers are found between the crumbling Soviet-style buildings, I can't help but feel nervous for the future of the nomadic ways in western Mongolia.

Then again, only two or three days ride south from my favourite deer stone lies the semi-autonomous



# MOUNTED NOMADS of WESTERN MONGOLIA

Discover the ancient nomadic cultures of western Mongolia on this unique journey with Tim Cope in 2015.

Kazakh province of Bayan Olgii – a place and people that have shown a remarkable ability to weather radical, and sometimes cataclysmic, change. The Kazakhs, a Turkic people of nomad heritage whose lands stretch from the Altai to the Caspian Sea, were violently uprooted in the 1930s by Stalin, and forced to settle in villages and collective farms.

Nowadays, Kazakhstan is a highly urbanised country with only a fraction of society living according to nomadic ways. But in Bayan Olgii, perhaps by virtue of its isolation, nomadic society has remained relatively unscathed. The Kazakhs there have even preserved the art of hunting on horseback with eagles – a skill that Mongolians themselves lost centuries ago when they converted to Buddhism.

Every year these hunters gather during the first weekend of October to celebrate a tradition that has perhaps been unbroken for millennia; the best hunters from across Bayan Olgii assemble, mounted on decorated horses and in their full regalia, for a one-of-a-kind spectacle. It is estimated that 80 per cent of the world's eagle hunters live in this province, and the festival offers the opportunity for them to compete for a variety of awards.

**A**S I CONTINUE TO sit by the deer stone, eventually a breeze begins to turn my sweat cold. Carrying my expedition group's equipment, my own camel caravan approaches, and so I stand up to continue on to evening camp. Before I leave, however, I glance over my shoulder and pause once more. I can't help but feel that if the day comes that I pass this deer stone and the 'humanised' backdrop of gers and horsemen is gone, it will be very sad indeed. Right now at least, in these parts of Mongolia, there exists a significant living chunk of human history that I believe we can all learn from. **AG**



TRAVEL WITH TIM COPE into the heartland of an ancient horseback nomad culture. The tour will take you from remote desert landscapes to glacier-capped peaks and the bustle of one of the most isolated, yet vibrant, towns in Central Asia: Olgii, the capital of Mongolia's semi-autonomous Kazakh province of Bayan Olgii. Highlights of the journey include a three-day trek accompanied by nomads and their animals, and attendance at the annual eagle festival, which is the largest gathering of its kind in the world. Tim will be joined by veteran local guide Tseren Enebish to provide a unique, exploratory style journey with a focus on cultural encounters.

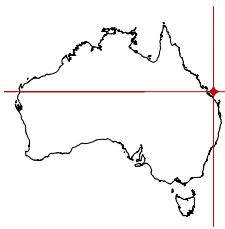
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## ITINERARY:

- Day 1:** Join the tour in Mongolian capital Ulaanbaatar.
- Days 2–4:** Fly to Uliastai, and take a 4WD journey through remote Zavkhan Province.
- Days 5–7:** Trek through the mountainous Kharkhiraa Turgen massif.
- Day 8:** Drive to Uureg Nuur, a vast alpine lake near Russia.
- Day 9:** Travel to Olgii, the capital of Bayan Olgii, a semi-autonomous province with a majority Kazakh population.
- Days 10–11:** Enjoy the Kazakh eagle festival in Olgii.
- Day 12:** Drive to Tsambagarav in the great Altai mountain range.
- Days 13–14:** Explore broad slopes and open valleys of this region.
- Day 16:** Drive to Hovd.
- Day 17:** Fly to Ulaanbaatar.
- Day 18:** Trip concludes.



LAT LONG: 23°27' S 151°55' E



# HERON ISLAND RESEARCH STATION

Cut off from the mainland and surrounded by ocean, a group of scientists enjoys the perks of working in paradise.

STORY AND PHOTOGRAPHY BY KARA MURPHY

**S**OMETHING LIKE 21st-century castaways, 10 people call tiny Heron Island, in the south of the Great Barrier Reef, home. I've joined them here, 80km north-east of Gladstone, Queensland, to visit their workplace – a high-tech research facility open all hours for scientists to study the reef surrounding them.

Owned and operated by the University of Queensland (UQ), the Heron Island Research Station (HIRS) is the largest on the Great Barrier Reef. The centre was built in 1951 on land leased from the Queensland Parks and Wildlife Service. However, most of its current facilities – including indoor and outdoor aquaria, wet and dry labs, and separate research and education facilities – were formally opened in 2009, after a devastating fire forced a two-year rebuild.

Today, the station caters for up to 150 visitors, and in September–October, its busiest months for research, 5–10 projects are typically running concurrently.

On the weekend of my visit, four projects are underway. The first is an ongoing experiment to forecast the impact of climate change on the reef. Then there's a UQ filming project for a course covering tropical coastal ecosystems; an experiment to determine the mineralogy of crustose coralline algae (CCA), which builds and binds the reef; and a project examining how coral larvae of different species compete during settlement.

A 27-strong group of high school students has also just arrived. I watch as some clutch pillows to their chests while they amble hesitantly off the catamaran towards their week-long educational adventure.

The station employs 10 staff members: two each in boating and diving, scientific services, administration, maintenance and housekeeping. All live on-site and everybody works for 10 consecutive days, with four days off. With the exception of Maureen Roberts, the finance and administration officer, and boating and diving officer Isaac Ashton, Heron's residents tend to remain on the island during breaks.

Those with their own boats often escape to some of the other islands in Capricornia Cays National Park to

**Girt by sea.** The Heron Island Research Station, right, is the largest island research centre in the Southern Hemisphere. The Heron Island Resort is the island's only other tenant.



**Hands-on work.** Postdoctoral Research Fellow Eugenia Sampayo (above) observes her coral larvae experiment, while Collette Bagnato (centre), a volunteer researcher, comforts a shearwater covered in sticky pisonia seeds.

dive, snorkel and fish. During turtle breeding season (November–March), staff members will also often observe as female turtles dig pits and egg chambers. A former employee even once helped to save a whale calf. And, says Geraldine Bessone, a housekeeper for the past two years, "When you finish work you can just walk 30m and go for a snorkel with sharks and turtles. It's a very nice life."

It is idyllic, but there are minor hiccups of the kind you'd expect at remote facilities. Heron Island Resort, the research station's neighbour, supplies the utilities, and when I wake one morning, a system breakdown ▶



**Teeming with life.**

From its base on Heron Island, the research station is perfectly positioned to run experiments on the Great Barrier Reef, which harbours 1625 fish species and more than 3000 species of mollusc, including the giant clam (below).



**Reef in miniature.** Technician Aaron Chai (above) with an experiment that uses climate change predictions to determine the future health of coral. Analysing the vitality of the reef will hopefully help to protect habitats for marine creatures, such as the green turtle (left).



## BEARINGS: HERON ISLAND RESEARCH STATION, QLD

**How to get there:** catamaran, helicopter or seaplane

**Size of island:** 8ha

**Great Barrier Reef Committee ran the station:** 1951–1970

**University of Queensland acquired full ownership:** 1980

**Destroyed by fire:** 30 March 2007

**Visitor accommodation:** three researcher accommodation blocks, two houses and three student dormitories

**Research vessels:** six

**Climate change experiment began:** 2010

**For more information:** [www.uq.edu.au/heron-island-research-station](http://www.uq.edu.au/heron-island-research-station)

**Multi-tasking.** Station staff fill other roles when needed: maintenance officer Sam Chapman, above at right, operates a vessel, while production manager Matthew Peterson prepares for a dive.

has temporarily caused potable water to stop flowing. This prompts several research staff to race around the property, distributing water to guests.

Disruptions “are part of remote living”, station manager Dr Elizabeth Perkins tells me. “At times there are no disruptions and then at others you can get a couple in a few days.” Fortunately, these hiccups don’t affect researchers’ experiments. The station pumps up salt water for its aquaria facilities and has a small generator that keeps it running during power failures.

The station has a history of getting on with business despite obstacles. In the two years following the 2007 fire, researchers and educational groups continued to visit, with the boatshed housing laboratories and temporary tents used for accommodation, says Elizabeth. “Obviously it was harder, not just because buildings were missing but because the place was essentially a construction site.”

The remote location poses other challenges. Although housekeeper Geraldine appears cheerful and content, she says island life might be testing for some. “It’s so isolated, so not everyone can live in this kind of place and be happy,” she says.

Maureen agrees. “I think anyone who works here has to be fairly self-sufficient... If they’re needy people, they couldn’t stay here, stay sane, and do their job properly.”

Some researchers visit the island repeatedly, over

many years. “There are some long-term coral quadrats out on the reef flat that researchers have returned to every year for over 50 years,” Elizabeth says. “It’s one of the world’s longest, regularly surveyed, individual-based field observations of coral.”

It’s also common for researchers to work odd hours. Members of the CCA team, for example, rise early, spend part of the day collecting samples on dive sites, and then analyse the data into the night. Nevertheless, researchers and staff still find time to socialise.

“I’ve known [some of the researchers] for nearly 13 years now,” Maureen says. “And especially with ones that come a few times a year, you regard them as friends.”

For Elizabeth, seeing researchers run their experiments and obtain results is the most rewarding aspect of her job. “I’ve seen students work through their entire PhDs,” she says. “You see how much they learn and grow and change.”

During my visit, the drinking-water drought ends about midday. A couple of hours later, I join Elizabeth and other staff as they make their way to the busy jetty, where we bid farewell to the UQ filming team.

One team member, Professor Ove Hoegh-Guldberg, Global Change Institute director and former HIRS director, has just finished speaking to students about the effects of ocean warming and acidification on coral reefs. The young visitors have had a chance to experience the reef’s wonders firsthand, and their responses to Ove’s talk reflect the positive relationship between research and education. Overwhelmingly, they want to know: “What can we do to help?” **AG**



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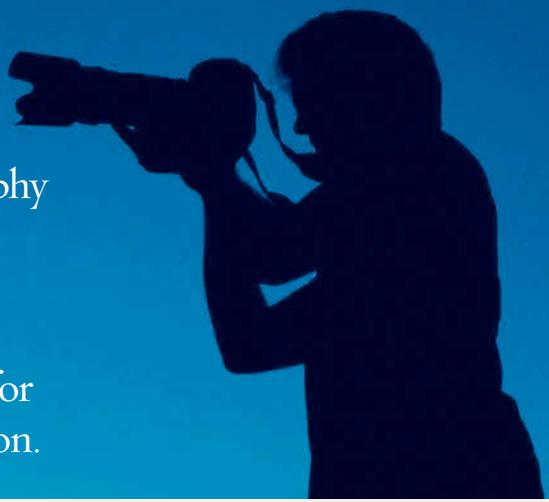
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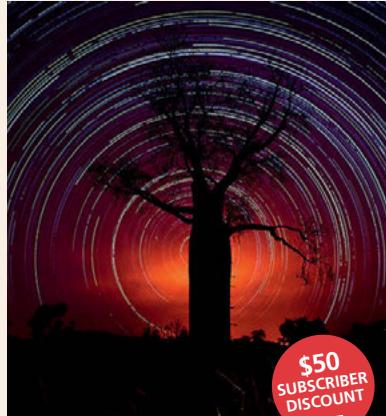


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AUSTRALIAN GEOGRAPHIC SOCIETY NEWS & INITIATIVES



**Local heroes.** Tree-roo champions and 2013 winners Jean and Jim Thomas, with Dr Karl Kruszelnicki.

## OUR BIG NIGHT

## The 2014 AGS Awards

Celebrate with Australia's finest conservationists and explorers at this year's Gala Awards Night.

**C**OME JOIN US at the annual Australian Geographic Society's gala awards dinner, which will be held on 29 October at The Ivy ballroom in Sydney.

First presented in 1987, the awards are Australia's longest-running gongs for adventure, and, with the addition of the conservation awards in the 1990s, they celebrate several fields of Australian endeavour.

The AGS is a not-for-profit organisation supporting scientific research, conservation and the spirit of adventure. For more than a quarter of

a century, we've urged those fighting to preserve our environment or breaking records of exploration to come in from the bush, the outback or the mountain range to mingle with and inspire our readers for a night. Among the guests this year will be wingsuiters Glenn Singleman and Heather Swan, freshly returned from the Grand Canyon leg of their Flying Icons project (see Your Society, AG 121).

We'll also be raising funds for next year's AGS-sponsored programs. Join us to congratulate Australians doing extraordinary things (see page 30).

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## AGS CHAIRMAN'S REPORT



## Our illustrious alumni

Last year's AGS awardees keep soaring.

**I**T HARDLY SEEMS a year since our 2013 awards – that is, until we look at what our awardees have accomplished. In the past 12 months, Clean Up Australia's Kim McKay (who, with Clean Up co-founder Ian Kiernan, won the 2013 Lifetime of Conservation award) became director and CEO of Sydney's Australian Museum. She is the first woman to do so in its 180-year history.

No less impressive are Jim and Jean Thomas, who were the 2013 Conservationists of the Year for their Tenkile Conservation Alliance (TCA) work with tree kangaroos. We were pleased to see Jim breaking new ground in the PNG highlands in June, when TCA and Deakin University released images of three possibly new mammal species. We're always so proud to watch our alumni dream on.

Gregg Haythorpe, AG Society Chairman

**Patron:** Dick Smith **Advisory Council:** Chris Bray, Ian Connellan, Chrissie Goldrick, John Lucey, Kerry Morrow, Greg Mortimer, Jo Runciman, Todd Tai, Howard Whelan  
**Chairman:** Gregg Haythorpe **AGS Administrator:** Rebecca Baker/Tatiana Pentes

AGS MAJOR SPONSORS



**Altitude specialists.** Tenzing Sherpa (left, at left) and Naryan Shrestha in 1984, assisting on the first Aussie Everest expedition. Pete Wells (above, at left) and Kami Rita on an AGS-sponsored expedition in 2010.

#### AGS DONATIONS

## Everest's human element

By donating to those affected by the April avalanche, the AGS is supporting the porters and guides who have helped our climbers.

**O**N 18 APRIL, as dawn approached, an avalanche swept down the slopes below Everest's Khumbu Icefall and killed 16 Sherpa porters – the worst accident in the history of the mountain.

At least nine people have climbed Everest with AGS funding and Nepal's Sherpa guides and porters have almost always been part of those climbs.

Pete Wells led an AGS expedition to the summit in 2010. Although he hoped to be the first to digitally film at the top, the environment proved too tough for the filming equipment.

Pete vividly remembers puffing his way up to Everest's Camp II. Exhausted and with a splitting altitude headache, he could barely make out what looked to be an ant trail

ascending into the clouds, way above on the Geneva Spur.

"It was our Sherpa porters taking loads up to Camp IV," he says. Throughout the climb he was in awe of their strength and relied heavily on their instincts and experience. "If it weren't for Kami Rita Sherpa I may never have reached the summit of Everest," Pete says, "or made it down alive."

Greg Mortimer, the director of the Australian Himalayan Foundation and former long-time AGS trustee, also remembers friends who helped him on the first Australian expedition to reach the peak in 1984 (see page 28).

"Our '84 expedition was almost unique in that we did not have paid Sherpa porters," Greg says. "But we

did have Nepali friends come with us into Tibet and on to the climb."

One, Naryan Shrestha, died on a later Everest expedition, says Greg. The other, Tenzing Sherpa, now resides in Sydney and he and Greg are still in regular contact. "These guys are the glue that binds all expeditions," Greg says. And not just physically – they also "smiled, laughed and took care of our souls", Greg says.

As a way of saying thank you to the Sherpa people for their continued support and guidance, the AGS has redirected some funding towards the Sherpa Support Fund, run by the Australian Himalayan Foundation. This money will fund the education of Sherpa porters and their families.



## WILDLIFE RESEARCH

# Backyard bandits

Is this endangered mammal eking out a viable living from your pet food?



**T**HE FIRST European naturalists in Australia considered the southern brown bandicoot to be one of the continent's commonest mammals, says Sarah MacLagan, an ecologist at Deakin University. Today, they are listed nationally as endangered.

As urbanisation exacerbates habitat loss, Sarah is working on an AG Society-sponsored project that looks at survivalists she's dubbed "backyard bandicoots" – those who have managed to live with humans on urban fringes. Sarah's field research over the past three years has shown that bandicoots can live successfully within narrow linear strips of vegetation along roads, drains and railway lines. Moreover, she says, "at a number of sites, bandicoots appear to make use of artificial food sources provided indirectly by humans, such as pet and domestic animal food".



**Little larrikins.** Sarah MacLagan (above, at right) measures a bandicoot (top) with a volunteer.

The next step will be to look into the differences between urbanised and non-urbanised bandicoots. Sarah will compare the diets and health of both, and study how the city dwellers are coping with their modified lifestyle – and what can be done to help them adapt as cities spread. She'll even be examining levels of stress hormones in fur samples, to test the psychological impacts of city life.

## SOCIETY FUNDRAISER

## Bring back our bandicoots

Support the natives hiding in our backyards.



**P**OPOPULATIONS of the charming little southern brown bandicoot have been suffering from habitat fragmentation and loss, and predation by feral animals across the south-eastern states. Today, they are in a state of worrying decline. The good news is that they have a gestation period of less than 15 days and breed in litters of up to six. This quick reproductive turn-around means the chances of a bounce-back are, in theory, good.

One of the biggest causes of habitat loss is the spread of urbanisation. Our fundraiser will go towards Deakin University ecologist Sarah MacLagan's work (see left) looking into possible management practices for bandicoots carving out lives on the outer edges of our big cities.

**DONATE**

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▶ **OR VISIT** our website: [www.australiangeographic.com.au/society](http://www.australiangeographic.com.au/society), or send a cheque to: The Australian Geographic Society administrator, Level 9, 54–58 Park Street, Sydney NSW 2000.



# Member benefits

AUSTRALIAN GEOGRAPHIC subscribers are eligible for all manner of discounts. Here are some of the special offers available when you show your Society membership card or quote your membership number.



TOYOTA PRADO

**WHO:** Toyota **SAVE:** Be one of the first 50 to book a test drive and receive a free Australian Geographic book **BOOKINGS:** [toyota.com.au](http://toyota.com.au), then email [toytabenefits@bauer-media.com.au](mailto:toytabenefits@bauer-media.com.au)

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PAPUA NEW GUINEA CRUISE

**WHO:** Coral Princess Cruises **SAVE:** 25% off supplementary costs for solo travellers **BOOKINGS:** [coralprincess.com.au](http://coralprincess.com.au) or 1800 079 545

Mysterious Papua New Guinea is, in the truest sense, one of the last frontiers on Earth. This is the land of the unexpected, a place of stark contrasts where welcoming smiles await you, and villagers and their families become lifelong friends. The Rabaul to Alotau trip departs 20 November, 2014.



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# Upcoming expeditions

Head off with a group of like-minded travellers on one of these unforgettable experiences and you'll also be contributing vital funds to the AGS.



**DATE:**  
September  
2015

## NOMADS OF WESTERN MONGOLIA WITH TIM COPE

**WHO:** World Expeditions

**COST:** price on application

**BOOKINGS:** 1300 720 000 or [www.worldexpeditions.com](http://www.worldexpeditions.com)

Discover the ancient nomadic cultures of western Mongolia on this unique journey with Tim Cope (see page 100). The tour will take you from remote desert landscapes to glacier-capped peaks and the bustle of Olgii, one of the most isolated, yet vibrant, towns in Central Asia. Highlights of the journey include a three-day trek accompanied by nomads, and attendance at the annual eagle festival – the largest gathering of its kind.



**DATE:**  
April  
2015

## DINOSAURS OF THE GOBI

**WHO:** Odyssey Travel

**COST:** from \$9450pp

**BOOKINGS:** 1300 888 225 or [www.odysseytraveller.com](http://www.odysseytraveller.com)

Hosted by editor of AUSTRALIAN GEOGRAPHIC and dinosaur enthusiast John Pickrell, this trip takes you on a journey to discover the dinosaur wonders of Mongolia. Participants will explore the capital Ulaanbaatar and travel to historically significant sites; they will spend eight days camping in the Nemegt Basin, prospecting for and excavating fossils under guidance of a Mongolian Academy of Sciences expert.



**DATES:**  
Oct 2014  
April 2015

## CHINA DINOSAUR ODYSSEY

**WHO:** Odyssey Travel

**COST:** from \$7930pp ex Sydney

**BOOKINGS:** 1300 888 225 or

[www.odysseytraveller.com](http://www.odysseytraveller.com)

During this 13-day trip you will visit many of China's cultural highlights and its best dinosaur sites including the Beijing Museum of Natural History, Liaoning Museum of Palaeontology, Zigong Dinosaur Museum in Sichuan and the World Dinosaur Valley in Yunnan. Along the way, experts will talk about finds, such as the remains of China's famed, feathered dinosaurs.



**DATES:**  
Jan 2015  
Feb 2015

## GALAPAGOS – THE WEST AND CENTRAL ISLANDS

**WHO:** G Adventures

**COST:** from \$5499pp

**BOOKINGS:** 1300 853 325 or

[www.gadventures.com.au](http://www.gadventures.com.au)

Join G Adventures aboard the *Evolution* and set sail for a 10-day adventure on the high seas. Check out Fernandina Island's massive marine iguana colonies, meet giant tortoises and get a deeper understanding of ecology at the Charles Darwin Foundation. Best of all, you'll have a pair of Level III naturalist guides at your disposal to explain the biodiverse riches of this unique island chain.



**DATE:**  
18 April  
2015

## GALLIPOLI 2015 EPIC CRUISE

**WHO:** Fairy Chimneys Travel

**COST:** from \$6990pp ex Athens

**BOOKINGS:** 1300 766 595 or

[www.gallipoli-2015.com.au](http://www.gallipoli-2015.com.au)

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# YOUR AG

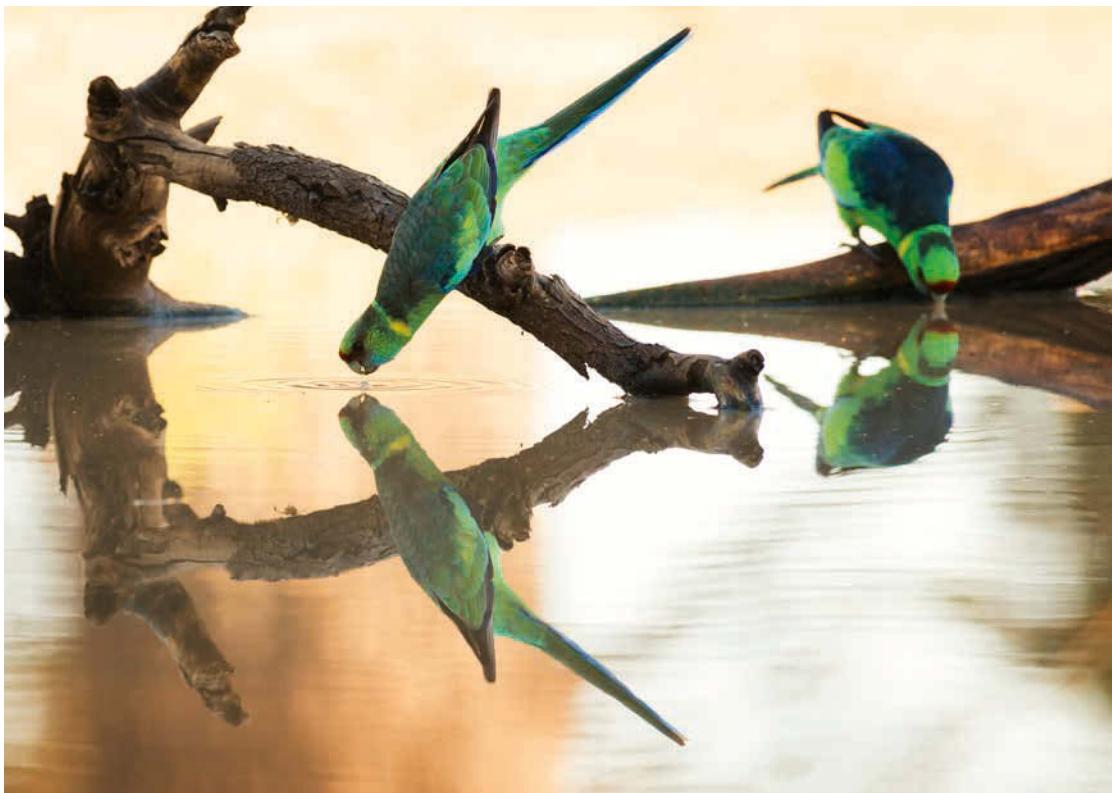
FEEDBACK, READER PHOTOS, BOOK REVIEWS & ASK AN EXPERT

## YOUR PHOTOS

**Mirror image**  
by Peter Taylor

As the sun rises, a pair of Australian ringneck parrots heads to a local dam for a morning drink at Bowra Station, an Australian Wildlife Conservancy property west of Cunnamulla, QLD.

Submit your photographs for possible publication:  
[www.australiangeographic.com.au/yourpics](http://www.australiangeographic.com.au/yourpics)



### DOWN SOUTH

Reading *History brought to life* (AG 119) took me back to the Ross Sea region of Antarctica, which I sailed to in January this year with Heritage Expeditions. As a teacher, I have often taught classes about Antarctica, even building a replica Mawson's Hut from paddle-pop sticks and matchsticks.

Despite that, I hadn't realised the

true extent of the historic huts, particularly those in the Ross Sea region. I was able to visit Shackleton's Nimrod hut (Cape Royds) and Scott's Terra Nova hut (Cape Evans), which have both been conserved by the New Zealand Antarctic Heritage Trust.

I also visited Scott's Discovery Hut (Hut Point), which was still under conservation. We saw Borchgrevink's Cape Adare huts from the ship but couldn't visit due to the ice. The huts' contents are amazing and so well preserved for future generations to learn from. It was a privilege to be able to visit the huts in a part of Antarctica only visited by 350-odd tourists each year.

KAREN LONG, MILES, QLD

## HAVE YOUR SAY

Use the free *viewa* app and scan this page to tell us your thoughts about this issue, upload your reader photos and enter our competitions!



You can also email us at [editorial@ausgeo.com.au](mailto:editorial@ausgeo.com.au) or send mail to Australian Geographic, GPO Box 4088, Sydney, NSW 2001. Letters will be edited for length and clarity.

### A NEW STATE

I am convinced that Australia will never develop to its true potential until there are a few more states. None of the existing states will fully develop the regions far away from their capital cities, which is where the majority of their populations are found.

A Pilbara city by the sea will only develop when the Pilbara region becomes a state. A standard gauge railway could be built from here to Rockhampton-Gladstone by way of Alice Springs and Longreach. When that happens, two steel mill cities will develop at both ends of the railway, and Australia can become an exporter of steel.

HARRISON H. DUNCAN, CARDWELL, QLD

# LET'S GO CAMPING

*Pitch a tent and roll out the sleeping bags.  
Camping is fun for everyone and offers an  
ideal chance to get back to nature.*

Berri Riverside Caravan Park, SA

Camping is not just unique, it represents fantastic value and a perfect opportunity to escape the hustle and bustle of everyday life. Kids love the adventure and the whole family cherishes lifelong memories that camping provides. Better still, camping equipment has never been so affordable and easy to use.

Top Tourist Parks are a fantastic place to set up camp. Providing more than 200 parks nationwide, there are plenty of Top Tourist Parks to choose from, including some in tourist hotspots including the Sunshine Coast, Margaret River, the York Peninsula, as well as in major capital cities.

Torquay Holiday Park, Vic



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**NOT YOUR AVERAGE AUSSIES**  
In *Hey, true blue* (AG 121), we asked you to tell us about your heritage. We received many fascinating stories and here we publish a small selection.

My family and I are foundation members, having been subscribers since AG's first edition in 1986. A passion for Australia was passed on from my parents to me, and now from my wife and me to my children. I believe Australia's cultural diversity is one of our greatest strengths. I am a 46-year-old white male who was born in Victoria. My father is Australian, my mother Danish. Japanese was my first language because we lived in Japan during my early childhood, Danish was my second and English my third.

I have lived in Europe, North America, Asia and the Middle East, and speak passable Danish, Spanish, Arabic and German. My wife is from the Philippines and our children are US citizens. Throughout I have remained proudly Australian while appreciating the global and cultural influences on my life. Twenty years ago this story would have been highly irregular; today it's increasingly representative of the new fair-dinkum Aussie. Keep up the good work.

IAN DAVIES, BRISBANE, QLD

Don't know or care where anyone comes from or how long they've been here. If you love this beautiful country and contribute to it in some way, you're an Aussie to me.

BARBARA O'KEEFE,  
VIA FACEBOOK

Continued page 122 ▶



# Discoveries

WITH DR KARL KRUSZELNICKI

## STOMACH ULCERS

**W**HEN I WENT through medical school in the 1980s, I was wrongly, though inadvertently, taught that stomach ulcers were caused by excess acid production – from 'hurry, curry and worry'. But then two Australian doctors came up with the correct finding, which is that most stomach ulcers are caused by a bacterium. This won them the 2005 Nobel Prize in Physiology or Medicine.

An ulcer is simply a break in the lining of a surface. The acids in the stomach can dissolve anything from meat to iron nails, but your stomach doesn't dissolve itself because a protective layer of mucus covers its inner surface, preventing the acid from touching the naked meaty substance of the stomach.

Professors Barry Marshall and Robin Warren discovered that the vast majority of stomach ulcers are caused by a bacterium called *Helicobacter pylori*. It seems to be the only bacterium that can survive in the acid of the stomach. Squirming through the layer of mucus on the inside of the stomach, it then sticks to the epithelium, the stomach lining. It manufactures an enzyme (urease), which creates a tiny local alkaline environment around each individual bacterium. This alkali effectively neutralises the acid so the *Helicobacter* can live in comfort.

This is such a clever trick that, even up to the 1970s, scientists couldn't believe that bacteria would survive in the incredibly acid stomach. Unfortunately, *Helicobacter* is an ungrateful guest. It damages the epithelial cells lining



**Ghastly guests.** Illustration of *Helicobacter pylori* bacteria (upper left) in the lining of a human stomach.

your stomach (and duodenum) by several mechanisms. It produces various chemicals, which can split the junctions between these epithelial cells, trigger 'cell suicide' and set off inflammation. The inflammatory response, in turn, disturbs local hormone production, which can cause further damage in the stomach and the duodenum. Even worse, some of these chemicals are potential carcinogens. If you carry *Helicobacter pylori* you have a 10–20 per cent lifetime risk of developing stomach ulcers and a 1–2 per cent chance of stomach cancer.

DR KARL is a prolific broadcaster, author and University of Sydney physicist. His 34th book, *Game of Knowns*, is published by Pan Macmillan. Follow him on Twitter at: [twitter.com/DoctorKarl](http://twitter.com/DoctorKarl)



## ▲ YOUR PHOTOS

### **Fishy foliage**

by Tony Brown

Leafy sea dragons are named for the leaf-like growth on their bodies, which helps to camouflage them in Rapid Bay, SA, where I took this image.

I have a blend of ancestors from all over the world, including some with indigenous origins. We should embrace multiculturalism, whether we were born here or migrated here, because it is the new face of Australia. Australian attitudes and values are the bonding ingredient that typifies Australia today.

The essence of these values is of rights and freedoms and good deeds to others, and caring and solidarity, even in the face of diversity, and this bonds our way of life. Focus on the values of Australians to understand who and what constitutes truly being Australian.

**TONI ARFANIS, VIA FACEBOOK**

My wife Nancy and I were both born in South Africa, of British and

European extraction. As a young man, I was conscripted into the South African army, and served in 1969–70. During that time, I came to the conclusion that the philosophy of the army conflicted with my own.

I had passed the primary medical examination for a qualification in anaesthesia in 1971 and heard the Australian qualification was well regarded, so I applied to the Royal Australian College of Surgeons. By this time Nan and I had two small children: George and Lisl. We packed up the house, and boarded SS *Canberra* in Cape Town in January 1972. The *Canberra* arrived in what was then known as Port Phillip Bay on 1 February, the Tuesday after Bloody Sunday in northern Ireland.

The tugboat crews, being of Irish origin, refused to help the *Canberra*, a British ship, through the channel and the ship was too big to manoeuvre on her own. So, when we came on deck, it was to see the lifeboats launched. Finally, late in the afternoon, we landed at an old wooden jetty. I retrieved as many bags as I could and

we headed to the airport to sort out what we could do about our missed flight to Adelaide. We were booked with Ansett and when we arrived, somewhat flustered, they said they knew all about us and had put us on a later flight. Gratitude swept over us. We awoke the next morning to the hotel phone ringing.

A voice said, "Good morning, this is Maurice Sando, welcome to Australia. We are very short staffed, when can you start?" Fantastic – I had a job. When our first two-year visa was nearing its end, we asked the immigration department if we could become citizens, and their reply was, "When would you like the ceremony?" It has been an honour to have spent the greater part of our lives here. We hope we have contributed!

**DAVE FENWICK, ALDGATE, SA**

I have seven great-grandchildren, who claim a total of 10 ancestral origins. My wife and I arrived here in 1958. I was born of Irish, Ukrainian, English and Romanian grandparents, while my wife's origins are Polish and French.

Our children married spouses of Welsh, German and Lebanese origin, and their children in turn married spouses of Welsh, Irish and Pakistani origin. They may be a mixed breed, but they're all the better for it!

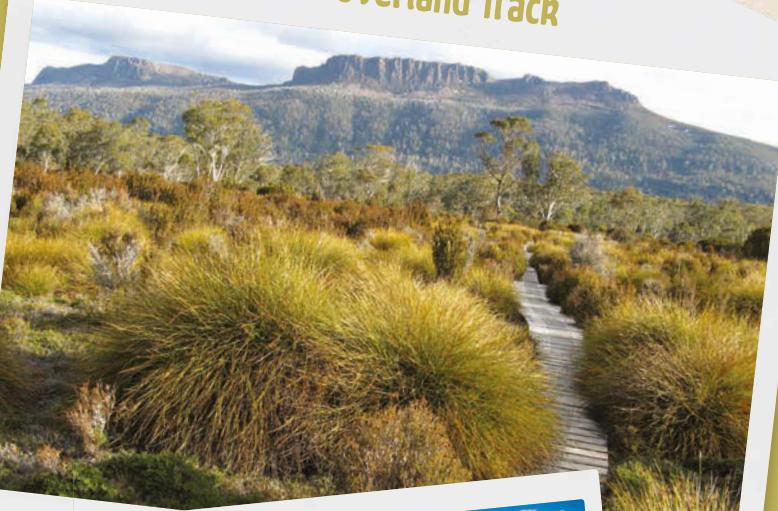
**JACK KANE, VIA FACEBOOK**

## POSTSCRIPT

In *Haven in the hills* (AG 121), we said the "Sturtian glaciation kicked off about 30 million years ago". The glaciation actually began about 730 million years ago.

In *Hey, true blue* (AG 121) we incorrectly described Bundanoon as a south coast village. Bundanoon is actually a town in the southern highlands of NSW.

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# LORD HOWE ISLAND



**BIRD WEEKS:** 1 - 8 November 2014, 14 - 21 March & 14 - 21 November 2015

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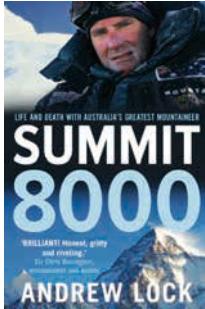


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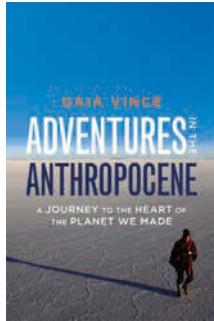
## AG'S BOOKSHELF



### Summit 8000: Life And Death With Australia's Greatest Mountaineer

ANDREW LOCK,  
MELBOURNE UNIVERSITY  
PRESS, \$29.99

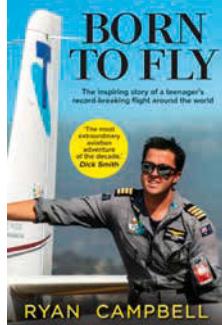
Andrew Lock, the only Australian to have reached the summit of all 14 of the world's 8000m-plus peaks, has a few tales to tell. Andrew, who was the AG Adventurer of the Year in 2009, talks frankly about his passion for climbing in small teams, or solo, without help or even supplemented oxygen. His candid first-person prose culminates in his trip to Everest in April 2014, where he witnessed the deadliest avalanche in the peak's history and its effects across the community.



### Adventures In The Anthropocene: A Journey To The Heart Of The Planet We Made

GAIA VINCE, RANDOM  
HOUSE, \$37.99

The scale of our impact on Earth has become so far-reaching that its effects are now felt in even the planet's remotest corners. Journalist Gaia Vince set out across the world to document the ingenuity of indigenous peoples on the front line of climate change – those who are coming up with novel solutions to adapt to the rapidly changing environment. This AG Society-sponsored journey (AG 103) reveals the lives of people making do in a changing world.



### Born To Fly: The Inspiring Story Of An Australian Teenager's Record-Breaking Flight Around The World

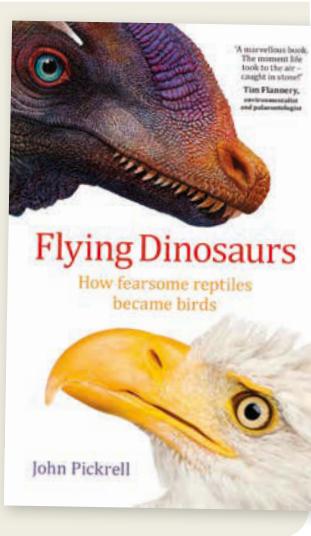
RYAN CAMPBELL,  
HARLEQUIN, \$29.99

Twenty-year-old Aussie Ryan Campbell is no stranger to firsts, having been, at 15, the youngest Australian to earn a pilot's licence. He tells of his quest to become the youngest person to fly solo around the world with confidence as his diary-style narrative describes both his 31-stop flight, and the lead-up to it. This is a classic coming-of-age adventure tale from Australian Geographic's 2013 Young Adventurer of the Year.

## Competition

We have five signed copies of *Flying Dinosaurs: How Fearsome Reptiles Became Birds* to give away.

Written by AUSTRALIAN GEOGRAPHIC editor John Pickrell, it reveals how dinosaurs developed flight and became the birds in our backyards. John delves into the latest discoveries and goes beyond the science to uncover a black market in fossils, infighting between dinosaur hunters, and the controversial plan to use a chicken to bring dinosaurs back from the dead. You can enter by downloading the free **viewa** app and using your smartphone to scan this page, or by visiting: [www.australiageographic.com.au/issue122](http://www.australiageographic.com.au/issue122)



## WHAT'S ON

### NATIONWIDE

#### AUSSIE BACKYARD BIRD COUNT

Head outdoors to record the birds you see and upload the info to the Aussie Bird Count app or website. This is a chance to get to know the birds that live near you and contribute to the nationwide research program.



**When and where:** 20–26 October

**More information:** [www.aussiebirdcount.org.au](http://www.aussiebirdcount.org.au)

### COONABARABRAN

#### STARFEST

The Siding Spring Observatory is celebrating 50 years with a blockbuster weekend of events, including the annual Bok Lecture, open days and the opening of the nearby Milroy Observatory.

**When and where:** 3–5 October, Siding Spring Observatory, Coonabarabran, NSW.

**More info:** [www.starfest.org.au](http://www.starfest.org.au)

### BRISBANE

#### DEEP OCEANS

Journey below the surface at this exhibition and see strange real life creatures. Also discover the myths and legends surrounding the incredible monsters of the deep.

**When and where:** 28 March–6 October, Queensland Museum, Brisbane.

**More info:** [www.qm.qld.gov.au](http://www.qm.qld.gov.au)

### CANBERRA

#### FLORIADE

This is the largest floral festival in the Southern Hemisphere and the city's biggest annual tourist event. Celebrate the arrival of spring with events for all.

**When and where:** 13 September–12 October, Commonwealth Park, Canberra.

**More info:** [www.visitcanberra.com.au/event/floriade](http://www.visitcanberra.com.au/event/floriade)

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## ASK AN EXPERT

GOT A  
QUESTION FOR  
AN EXPERT?

Email it to  
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**Q** How did the mistletoe plant evolve – was it first a tree in its own right or was it always a parasite?

**BOB CURRIE, BRISBANE, QLD**

**A DAVID M. WATSON,**

ASSOCIATE PROFESSOR IN ECOLOGY, CHARLES STURT UNIVERSITY, SAYS:

Mistletoes are stem-parasitic plants from five different families, but all evolved from root-parasitic ancestors in the sandalwood group of flowering plants. We can infer that the first root parasites in this group (related to olive trees) acquired the ability to take nutrients and water from the roots of other plants, possibly evolving in low-productivity soils where access to nutrients is limited. At a later date – and occurring independently in all five families of mistletoe – these plants shifted from parasitising roots below ground to parasitising stems above ground. And it's clearly a winning strategy: at more than 1500 species, mistletoes are one of the most successful groups of parasitic plants worldwide.

**Q** Why does our metabolism slow down as we age?

**PATRICK HORNSEY, CHESTER HILL, NSW**

**A TIM CROWE,**

ASSOCIATE PROFESSOR IN EXERCISE AND NUTRITION SCIENCES,

DEAKIN UNIVERSITY, SAYS:

Beginning about age 25, the body starts to slowly lose muscle. The more muscle a person has, the more energy (kilojoules) they will burn 24 hours a day, even without exercise. That's because muscle is a high-maintenance tissue and requires more kilojoules than fat to sustain itself. Less muscle means a lower metabolic rate. Some of our organs also decrease in size with age, such as the brain, kidneys, liver and spleen, and this means they use less energy to function.

## Talkb@ck

## TWITCHING AND TWEETING

We asked you for your favourite birdwatching sites in Australia and here's what you had to say on our website, Facebook and Twitter.

**The Arnhemland Barramundi Nature Lodge, NT: more than 200 species within a 50km radius of the lodge; Gouldian finches in flocks, northern rosellas and hooded parrots, chestnut rail and more.**

**RICHARD EUSSEN**

Putta Bucca Wetlands in Mudgee, NSW, is a fabulous place, especially considering it's within easy walking distance of town. Also Rylstone Dam near, of course, Rylstone, which as well as being a fabulous birding spot, is an excellent chance to maybe see a platypus in the wild.

**STEVE MENCINSKY**

**My front verandah: have layered plantings of eucalypts, callistemon, hakea and correa. The Tassie blue gum acts as drop-in centre for all the locals and travelling birdies.**

**SUZANNE DWYER**

Glen Davis in the Capertee Valley, NSW: free camping (including hot showers, power, and playground and BBQ area) in the community park, where you're surrounded by Wollemi National Park and more than 235 bird species. Oh my, what an orchestra to wake up to in the morning!

**KERI HENNESSY**

**Edwards Point Wildlife Reserve near St Leonards in Victoria.**

**HELEN WRIGHT**



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## Croc capers

WILD CROCODILE RIVER

80

DESPITE WEARING a slightly different hue of khaki, AG's editor-in-chief Chrissie Goldrick (above, eighth from left) became a guest member of the Australia Zoo crocodile team for a day when she joined the Irwin family at the Steve Irwin Wildlife Reserve in Cape York. "From the moment the steel trap opened, to the point this huge crocodile slipped back into the water, everything went like clockwork. I wasn't allowed to be in the jump crew but they did let me join them immediately afterwards," Chrissie says. "I was holding the crocodile down and could examine him at very close quarters. His colours and markings were beautiful. I wasn't nervous because the handlers were so confident and skilled, and you could tell that they had done this hundreds of times before." A couple of days after Chrissie left, the team trapped a new 3.2m croc they christened Aus-Geo. He was the 105th crocodile captured there since 2007. He has been fitted with a tag and we'll be following his progress from now on.

RUSSELL SHAKESPEAR E; NATSUMI PENBERTHY

## Judgement day

BOLD, BRIGHT AND BEAUTIFUL

42

IN MARCH, Australian Geographic art director, Mike Elliott (right), joined seasoned photographers Esther Beaton and Nick Rains to judge the Australian Geographic ANZANG Nature Photographer of the Year competition at the South Australian Museum in Adelaide. For two days they pored over hundreds of images to select winners and runners-up across categories, the winner of the best portfolio prize, and the overall winner. Mike says that while Esther and Nick considered things more in terms of technical achievement, he saw his role as judging each image purely on its visual merit and impact. "One of the most interesting things about the process," says Mike, "is that from the judges' perspective, all the entrants are anonymous." This means that great images from photographers with little experience and who have not entered before have just as much chance at winning as those from old hands.





## Line in the sand

PHOTOGRAPH BY JAMES McCORMACK AG 96, OCT–DEC 2009, OUT TAKE

PICTURED HERE IN 2009, Sarah Sard, a new resident of Booleroo, South Australia, shows friends the dress she wore to a wedding the previous weekend. Booleroo sits on Goyder's Line – an imaginary mark that snakes its way across the state from Ceduna in the west, to south of Blanchetown on the Murray River in the east. The nation's drought of 1864–65 resulted in one of the least recognised land-management accomplishments of early Australia. For nearly two years farmers had struggled: livestock perished, crops failed, vegetation dwindled and topsoil billowed away. George Goyder, the state's surveyor-general, was sent north to discover the extent of the drought, and his resultant boundary was believed to indicate the edge of land suitable for cultivation. North of the line rain is not consistent, and the land is better suited to pasture – but south of it, the land receives an average of at least 250mm rainfall annually, which is enough to sustain crops. Although rainfall varies, the boundary holds true today – 150 years later – and the residents of Booleroo, and other towns along Goyder's line, put livestock to graze to the north and harvest crops to the south.

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## Deep River Shiraz Cabernet 2013, McLaren Vale, SA

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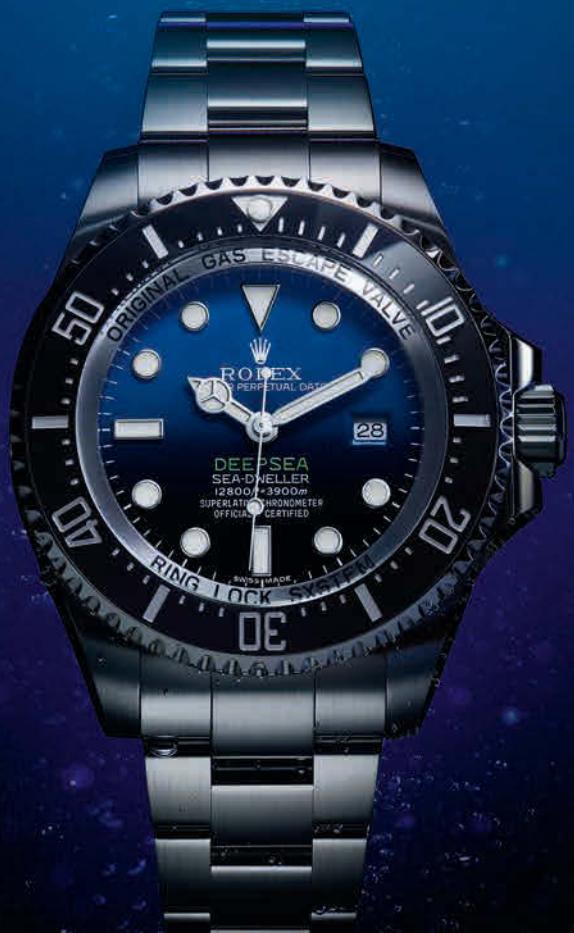
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