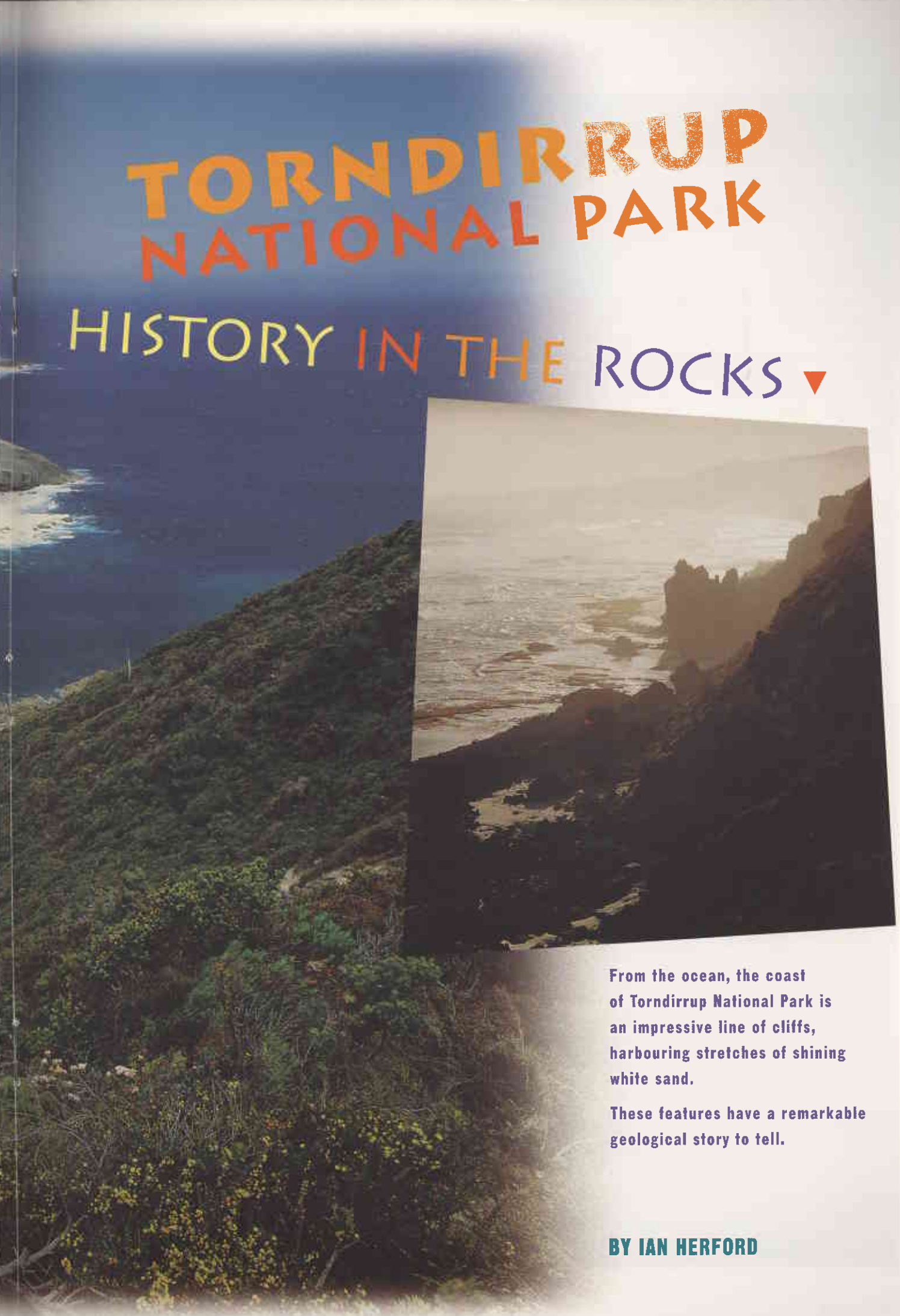
TORNDIRRUP NATIONAL PARK

HISTORY IN THE ROCKS



From the ocean, the coast of Torndirrup National Park is an impressive line of cliffs, harbouring stretches of shining white sand.

These features have a remarkable geological story to tell.

BY IAN HERFORD

Local Aboriginal people lacked watercraft and so did not venture out into the Southern Ocean. The cliffs of Torndirrup National Park were probably not seen from the sea until the first European explorers arrived along Western Australia's southern coast. Dutchmen Pieter Nuyts and Frans Thyssen sailed past in the *Gulden Zeepaardt* in 1627. They did not get close enough to shore to see what is now called King George Sound at Albany, but must have seen the coastal cliffs. They would not have known that these rocky cliffs contain a geological record of some of the most significant events in the formation of our island continent.

ROCKY HISTORY

The Torndirrup peninsula, 10 kilometres south of Albany, is composed of three major rock types. The oldest of these, which took its current form amid high pressures and temperatures between 1,300 and 1,600 million years ago, pre-dates almost all life on Earth. Despite their staggering age, these gneisses (rhymes with 'ices'), were formed in the second half of our planet's geological history, which began 4,500 million years ago.

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Main: Jimmy Newells Harbour, Torndirrup National park.
Photo – Jiri Lochman
Inset: Torndirrup's rugged coastline has been millions of years in the making.
Photo – Michael Morcombe

One of the best places to see these rocks is at The Gap. Gneisses can be recognised by the 'stripey' pattern within them, caused by layers of different coloured minerals. In many cases, the stripes display bends or folds caused by pressures so high that the rocks behave like plasticine. Such high temperatures and pressures are found at great depths within the Earth's crust.

When the gneisses were formed, Australia was separated from Antarctica, as it is today. However, over many millions of years, the two continents moved together and began to collide, ending their collision around 1,160 million years ago. This process of continental drift is more correctly known as 'plate tectonics' and is still occurring today. Australia is currently moving north by as much as 10 centimetres every year.

At the time of the momentous collision, rocks at the base of the Earth's crust, between the two continents, began to melt and rise slowly. This material then cooled, forming a 'glue' between the continents. The glue can still be seen today—it is the granite of Torndirrup National Park. Stony Hill is a good place to see granite, which is easily recognised by its large crystals and by the characteristic rounded shape of the boulders, known as 'tors'. Granites can also be seen at the Gap, where they are mixed with the much older gneisses, in a complex association formed when the rising magma, which hardened into the

Below: Vancouver Peninsula, an isthmus of sand connecting the Torndirrup Peninsula to a granite island, forms Albany's Princess Royal Harbour (left).
Photo – Jiri Lochman

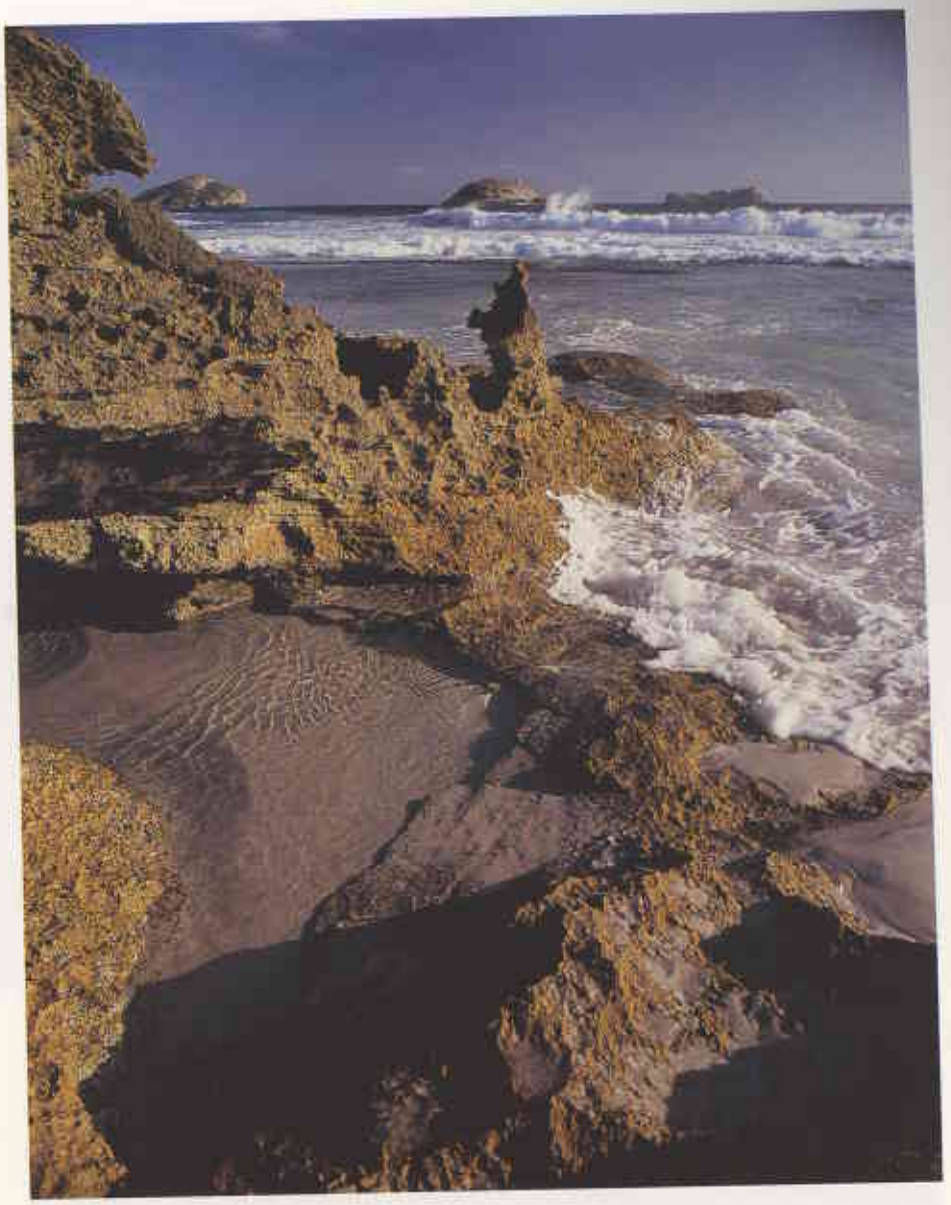
granite, squeezed into the older rock. This occurred at a depth of around 20 kilometres (a fact deduced from the particular minerals in the granite). The combined continents gradually rose, and the surface eroded until, finally, rocks that had been at a depth of 20 kilometres were exposed at the surface.

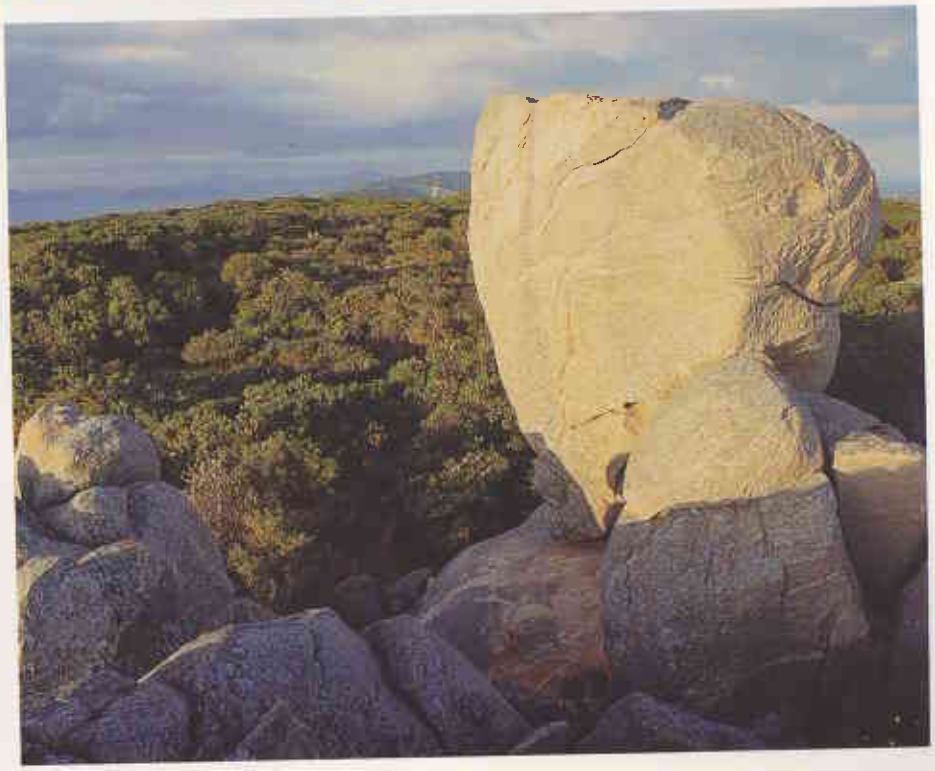
FAMILY TIES

The 'marriage' between Australia and Antarctica lasted more than 1,000 million years. Evidence of the connection can be found in both the rocks and the flora and fauna. Patterns of deformation in rocks of Australia's southern coast have been matched to identical rocks found on the northern coast of Antarctica. The area around Bremer Bay, for example, used to be joined to the Antarctic coast near the Australian Base at Casey, now more than 2,000 kilometres away.

Before the break-up and dispersal of its component parts, the supercontinent of Gondwana was made up of what is now called Australia, Antarctica, New Zealand, New Guinea, South America, Africa, India and other parts of south-east Asia. During its 1,000-million-year existence as a single landmass, plants and animals were able to diversify and disperse across its length and breadth, without the barrier provided by today's oceans. As a result, many closely related groups are today found in continents now separated by thousands of kilometres.

Growing in the sandy soils of Torndirrup National Park are plants which, though only ten centimetres high, look like miniature pine trees. These plants (*Loxocarya fasciculata*), which belong to the family Restionaceae, are often found growing in clumps, as they sprout from a single root. Without the knowledge we have of the Gondwanan supercontinent, it would be difficult to make sense of the global distribution of this family. There are 150 species throughout Australia, 300 in southern Africa, one in South America and three in New Zealand.





Above right: Coastal limestone weathers to form jagged surfaces.
Photo – Michael Morcombe

Right: Characteristic rounded 'tors' of granite at Stony Hill.
Photo – Alex Bond

The family clearly evolved before the separation of the Gondwanan supercontinent. Similar stories abound in the animal world. For example marsupials, the mammal 'monarchs' of Australia, had their origins in Gondwanan times. This explains their current distribution through Australia, New Guinea and South America.

SPLITTING UP

Around 60 million years ago, a developing rift began to move Australia and Antarctica apart once more. By the time of this split, the face of the Earth had been changed forever. When the two continents joined, life existed as rudimentary single-celled organisms. At the time these two landmasses broke apart, the seas were teeming with fish and marine plants, and the land had been colonised by both animals and plants. Around five million years before the split, the dinosaurs became extinct, possibly due to the impact of a comet or asteroid crashing to Earth. The impact itself would not have been sufficient to cause such a catastrophe, but the huge amounts of dust blown into the atmosphere would have blocked out the sun, killing much plant and animal life. If this scenario is true, and there is a great deal of evidence to support it, these deaths would have set off a chain reaction of extinctions in other plants and animals.

Among the survivors of this mass extinction was a small group of warm-blooded animals, which had coexisted with dinosaurs for 100 million years. These animals—the mammals—were able to exploit the absence of the dinosaurs and diversify to fill ecological niches all over the planet. These ancestors gave rise to marsupials, such as the western grey kangaroo, quenda (southern brown bandicoot), ringtail possum, honey possum, mardo (yellow-footed antechinus) and dibbler, which inhabit Torndirrup today.

Above left: The spectacular coastal scenery of Torndirrup National park is renowned throughout Australia.
Photos – Michael Morcombe

Left: Honey-possum with babies feeding on a Banksia.
Photo – Jiri Lochman

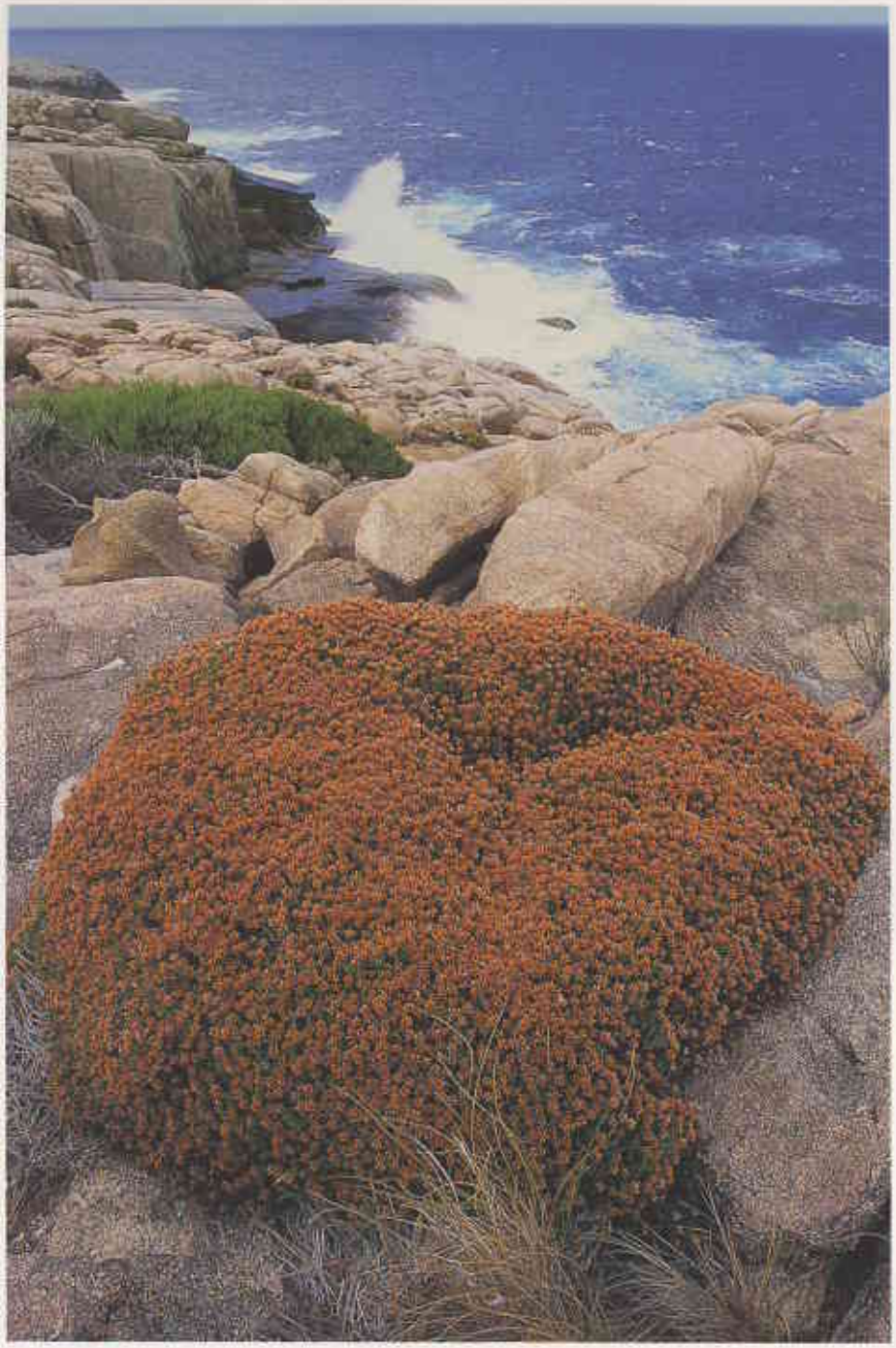
As the Antarctic and Australian continents parted, the sea once again entered the rift between them and began to shape the coast that can now be seen at Torndirrup National Park. The rocks continued to rise and erode, causing cracking and, where joints were more frequent, enabling the ocean to selectively remove those blocks that were less well attached to the coast. It was this process that led to the formation of features such as The Gap, The Natural Bridge and Jimmy Newells Harbour, for which Torndirrup is renowned. Perhaps the gneisses at The Gap may have originally been part of the Antarctic continent, left behind when the continents parted!

RISE AND FALL

While these events were occurring, the sea level was by no means static. During a series of ice ages, for example, huge quantities of the Earth's water were locked up as ice at the poles and in glaciers, causing the sea level to drop. One of those ice ages, around 120,000 years ago, left an extensive flat plain on the southern edge of the Australian continent. Driving winds blew shell fragments and sand into enormous dunes along the coast. These were cemented into a rock called limestone, by a process similar to that which causes stalagmites and stalactites in caves. Water trickling through the shell fragments partially dissolved them. The

Above: Jointed blocks of ancient rocks removed by the ocean led to the formation of The Gap.
Photo – John Kleczkowski/Lochman Transparencies

Right: Jointing in the Natural Bridge will eventually cause it to collapse.
Photo – Rob Olver



Left: The relentless attack of the Southern Ocean will continue to change the shape of the South Coast. Photo – Alex Bond

dissolved material, when redeposited deeper down, acted as a cement. This process formed the limestone cliffs of Torndirrup.

Limestone can be seen along the coast, from Bald Head to Sharp Point, and can be recognised by its pale colour. Its surface is jagged as a result of weathering. In many places, you can see the limestone resting on the granites and gneisses, onto which the original dunes were piled. Fossil shells can be found in the limestone at some sites, a reminder of its origin.

In some places, where the limestone has eroded, it leaves behind a 'forest' of small cylinders protruding from the sand. These structures puzzled early naturalists, who interpreted them as corals or petrified trees. One contributor to this debate was none other than Charles Darwin, who visited King George Sound (Albany) in March 1836 on his celebrated round-the-world voyage on the Beagle. Darwin visited Bald Head with Robert Fitzroy, the Captain of the *Beagle*, to view these structures. Darwin's journal records his observations:

> "According to our view, the beds have been formed by the wind having heaped up fine sand, composed of minute rounded particles of shells and corals, during which process branches and roots of trees, together with many land-shells became enclosed. The whole then became consolidated by the percolation of calcareous matter; and the cylindrical cavities left by the decaying of the wood were thus also filled up with a hard pseudo-stalactitical stone. The weather is now wearing away the softer parts, and in consequence the hard casts of the roots and branches of the trees project above the surface, and, in a singularly deceptive manner, resemble the stumps of a dead thicket."

This explanation is remarkably similar to that of today. These structures are now believed to form when plant roots die and rot away, leaving a hollow, which fills with calcareous cement like that in limestone.

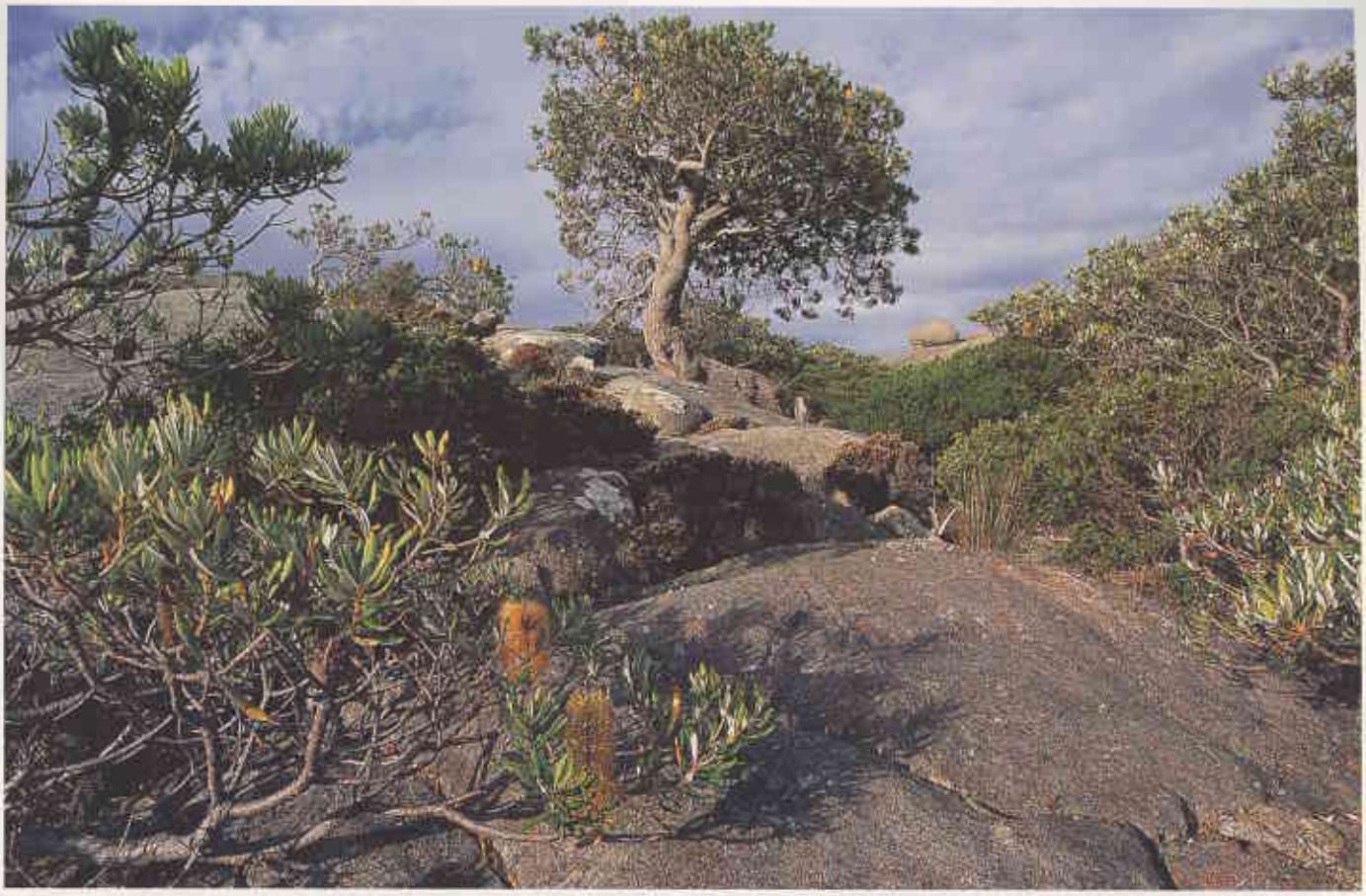
Darwin spent eight days at King George Sound, near the end of the *Beagle's* five-year voyage. He witnessed a corroboree danced by local Aboriginal people and the visiting White Cockatoo Tribe. Overall, however, he was quite unimpressed by Albany. His journal records one of his journeys into the hinterland:

> "In the open parts there were many grass-trees—a plant which, in appearance, has some affinity with the palm; but, instead of being surmounted by a crown of noble fronds, it can boast merely a tuft of very coarse, grass-like leaves. The general bright green colour of the brushwood and other plants, viewed from a distance, seemed to promise fertility. A single walk, however, was enough to dispel such an illusion; and he who thinks with me will never wish to walk again in so uninviting a country."

Although, in Darwin's day, the sea level was the same as it is today, it had only risen to its current level 6,000 to 7,000 years ago. In the process, it flooded river valleys, which became Albany's harbours, and created the coastline we see today. Aboriginal people were present throughout this rise in the sea level.

BETWEEN SEAT AND FEET

At the Blowholes, visitors can see all the major rock types in close proximity. Here, people often sit on a shelf of light-



coloured rock to observe the spray that shoots from cracks reaching down to the surface of the sea. This 'seat' is composed of limestone, formed from sand dunes 120,000 years ago. While sitting on the limestone, visitors dangle their feet onto the darker rocks below. These are the granites, almost 1,200 million years old, that once glued Antarctica to Australia. The site is a good place to reflect on the ancient origins of this coastline as, for a visitor seated here, there is more than one billion years 'between seat and feet'. Embedded in the granites are rounded darker patches of rock. These are the gneisses, which formed part of the Australian and Antarctic continents prior to Gondwana and extend the story back between 1,300 and 1,600 million years.

Today, geological processes are still at work in Torndirrup National Park. Gradually, over aeons, the sea will change the shape of the coast. The Gap will widen, and then disappear, and the Natural Bridge will finally collapse. The ocean will continue to push the coast further inland until perhaps halted by another titanic movement in the Earth's crust. But, for now, visitors can marvel at the spectacular coastline, which has literally been millions of years in the making.

Above: The global distribution of some plant families in the Park betrays their Gondwanan origins.
Photo – Alex Bond

Left: Ancient granites and gneisses (foreground) were overlaid by huge sand dunes 120,000 years ago forming the limestone (background) today. Land slips (centre right) are common.
Photo – Marie Lochman

Ian Herford is CALM's Regional Planning Officer for the South Coast Region. He holds a geology degree and has a strong interest in the geology of the South Coast. He can be contacted on 9842 4517.

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LANDSCOPE

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Western Everlasting, see page 22, follows the same successful approach to protecting threatened plants as Western Shield did for mammals.

Beneath its black and burnt exterior, the common balga is giving up its secrets. See 'Believing the Balga' on page 10.

For 25 years, CALM's Wildlife Research Centre in Woodvale has been 'A Centre of Diversity'. See page 36.

The spectacular coastline of Torndirrup National Park has been years in the making. See page 28.

Read how locals, CALM and other agencies are working together to save the Lake Muir-Unicup wetlands. See page 49.

FEATURES

REGULARS

COVER

'Moving Mala' (page 17) tells the story of the translocation of these endangered mammals from Australia's Central Desert Region to a small island off WA's north coast.

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Design and production: Tiffany Aberin, Maria Duthie, Sue Marais
Illustration: Gooitzen van der Meer, Ian Dickinson
Marketing: Estelle de San Miguel ☎ (08) 9334 0296 Fax: (08) 9334 0498
Subscription enquiries: ☎ (08) 9334 0481 or (08) 9334 0437
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