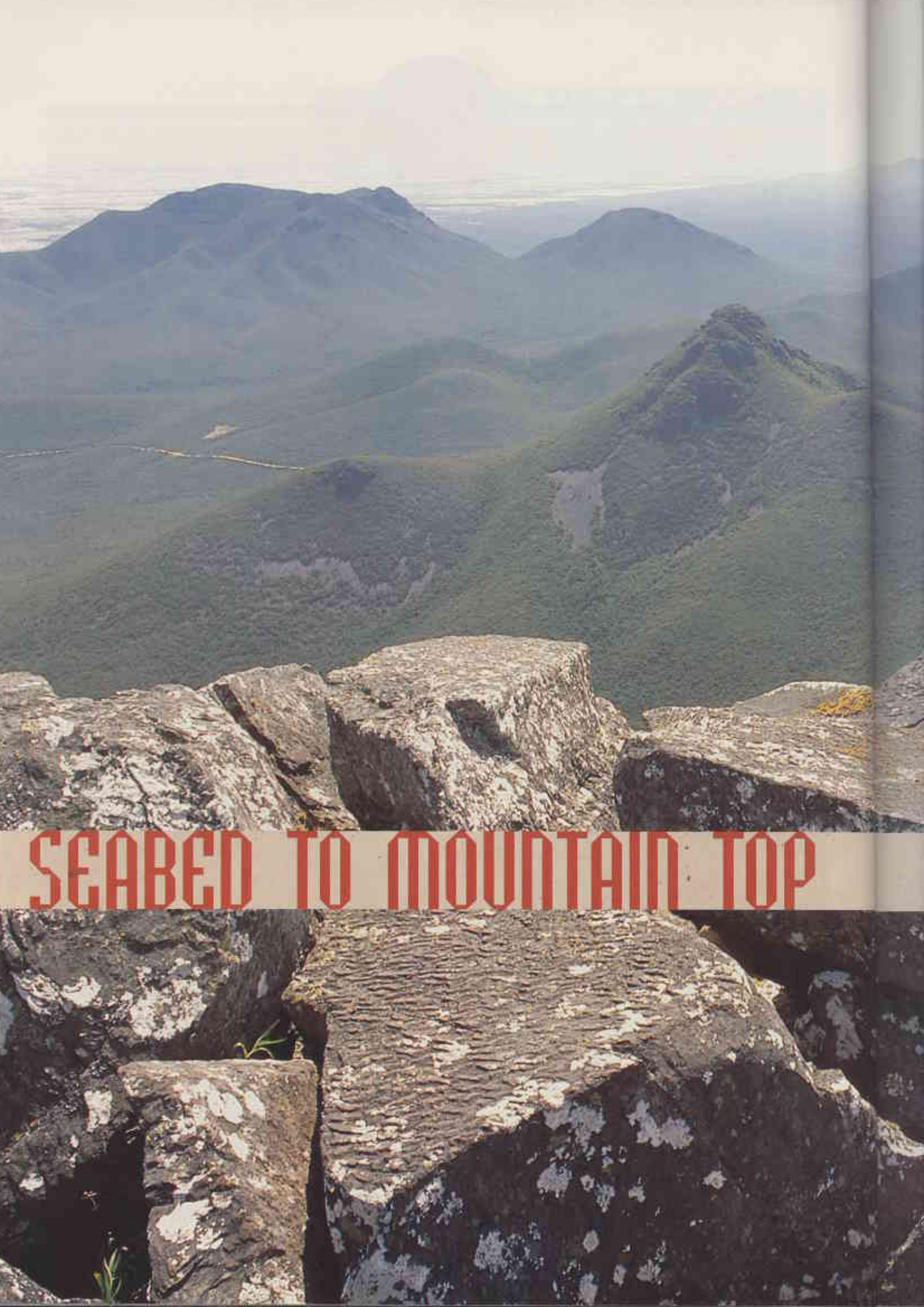
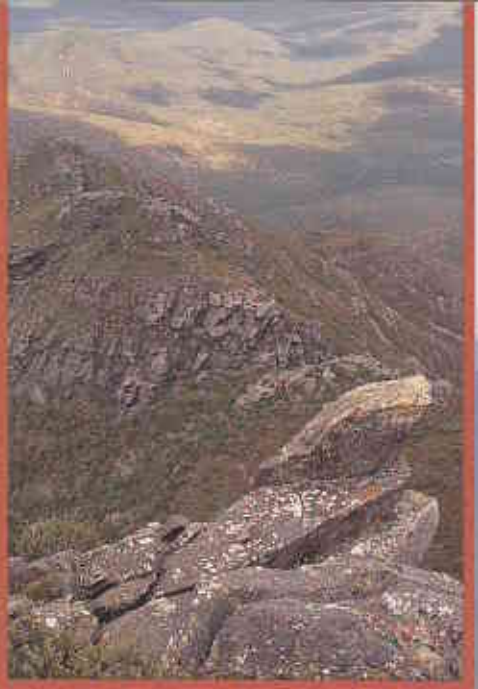

SEABED TO MOUNTAIN TOP



The view from the summit of Toolbrunup Peak in Stirling Range National Park is truly breathtaking. The range stretches east and west, forming a jagged series of mountain peaks.

Stirling Range National Park

Near the summit, which is more than 800 metres above the surrounding plain, some flat slabs of rock bear the unmistakable patterns of ripples on their surfaces. These ripple marks were imprinted on the sediments from which the rocks formed when they were covered by shallow water hundreds of millions of years ago. They are an important clue to the geological history of the Stirling Range.

By Ian Herford

The rocks of the Stirling Range were once sands and silts deposited in the delta of a river flowing into a shallow sea. Geologists have been able to determine this from features in the rocks which are visible in the sediments of today. Structures such as ripple marks, bedding planes (formed by the addition of successive layers of sediment) and mud cracks (like those which form at the bottom of dried-up dams) abound within the rocks of the Stirling Range, just as they do in the sediments of modern deltas.

Previous page
Main: The Stirling Range contains the highest peaks in southern WA, including Bluff Knoll with a height of 1075 metres.
Photo – Jiri Lochman

Inset (top): The Stirling Range's rocks were once sands and silts deposited in the delta of a river flowing into a shallow sea.
Photo – Marie Lochman

Inset (below): These ripple marks were formed when shallow water covered sediments hundreds of millions of years ago.
Photo – Lyal Harris

Deposited over many millions of years, these layers of sediment became so thick and heavy that, in combination with unimaginable forces stretching the Earth's crust in the area, they caused the crust to sink. As the surface subsided, still more sediment was deposited in the depression which was left. The final thickness of sediment is believed to be over 1.6 kilometres! As the sediment built up, so did the pressure on the layers below. The water was forced out of these layers, which solidified to become rocks known as sandstones and shales.

A QUESTION OF TIME

A question of great interest to geologist is "when was the sediment deposited?" Only by answering this question can the true relationships between the rocks of different areas be determined. Initially, geological ages were determined by the types of fossils found in sedimentary rocks. Geologists could estimate the age of sedimentary rocks from a knowledge of the ages of many extinct life forms. However, fossils proved elusive in the Stirling Range. In 1920, geologist W Woolnough wrote that "no trace of fossils have been detected in spite of repeated and assiduous search". This suggested that the sediments were laid down before life became abundant on Earth.

Confirmation of this view was sought using a dating technique called the Rubidium-Strontium method. This method relies on the fact that the element rubidium, found in minute traces in some minerals, transforms at a constant rate by a process of radioactive decay into the element strontium. It takes about 50 000 million years for half the rubidium in a rock to transform to strontium! This constant change acts like a clock—as the percentage of rubidium drops, the percentage of strontium rises over time, enabling scientists to determine the age of the rock containing them. When this test was performed on five pieces of slate from the eastern slopes

The bedding planes clearly visible in many of the rocks were formed by the deposition of successive layers of sediments in a shallow delta.
Photo – Bill Belson/Lochman Transparencies

Above: This fossil imprint is believed to be of a plant-like organism which was attached to the sea floor by a stalk, visible as the raised innermost circle. Geological material is protected in national parks and any such finds should be left untouched and reported to the ranger.
Photo – Lyal Harris

Above right: The Stirling Range exists today as an island of bush in a sea of cleared agricultural land.
Photo – Bill Belson/Lochman Transparencies

Right: The walk up Bluff Knoll, the highest point in the Stirling Range, is popular with park visitors.
Photo – Marie Lochman

of Mount Toolbrunup in the 1960s, an age of 1 340 million years was obtained for the sediments. This accorded well with the absence of fossils in the rocks, as only the simplest single-celled organisms are believed to have existed at that time.

FOSSIL FIND

As if to prove that nothing is ever certain in geology, a discovery made in the Stirling Range in the early 1990s is causing a major re-analysis of the age of the sediments. In the rocks of three peaks in the range, what appear to be the imprints of fossils were discovered. These fossils are not of plants or fish, but two primitive creatures which lived in the shallow seas long ago.

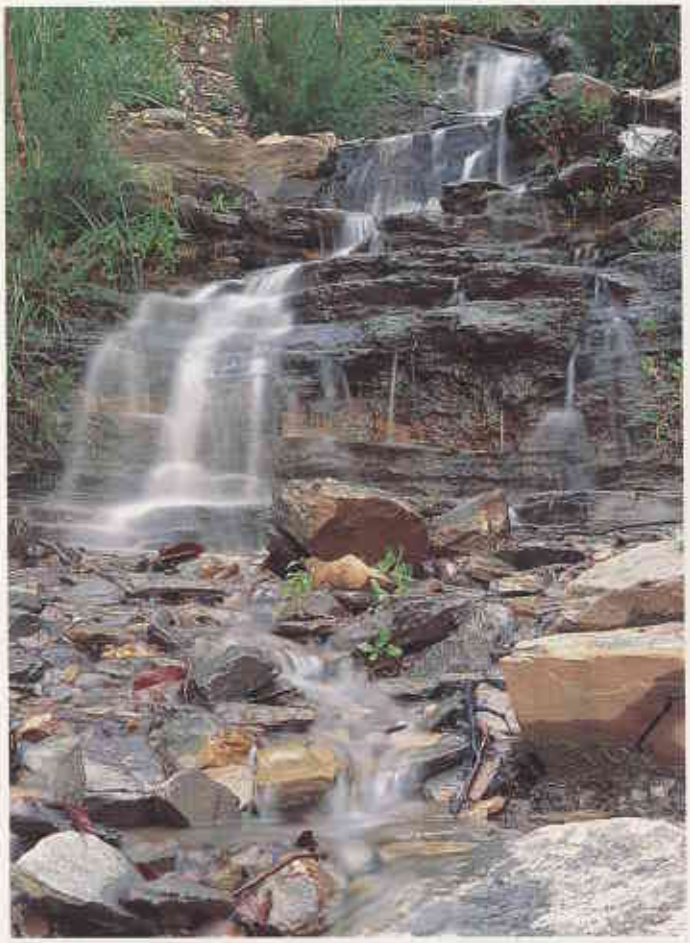
The first is believed to be the fossil imprint of a plant-like organism which was attached to the sea floor by a stalk. The imprint appears as a series of concentric circles, 30 millimetres in total diameter, with the innermost circle (the imprint of the stalk) slightly raised. The second, consisting of a set of raised disks around five millimetres in diameter, each with a depression in the centre, has been interpreted as imprints of the fossil remains of numerous minute jellyfish.

Similar fossils have been found in several locations around the world and have been dated at between 590 and 540 million years old. This is at least 700 million years more recent than the previously calculated age for the deposition of the rocks of the Stirling Range! The discovery has sparked a re-examination of the entire geological history of the area around the Stirling Range.

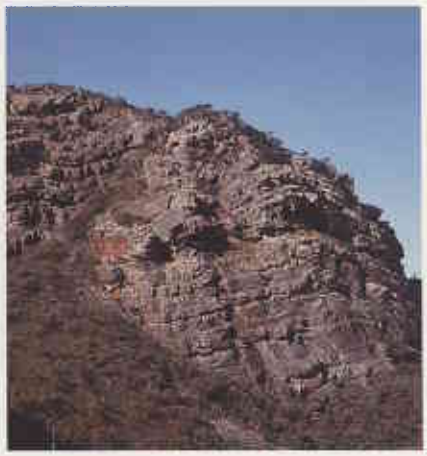
SEABED TO MOUNTAIN TOP

There are also questions about the events which transformed a sequence of horizontal marine sediments into a mountain range. Obviously, the forces required for such an event are stupendous. For many years, it has been considered that the Stirling Range was uplifted around 1 150 million years ago. The 'new' age of the rocks (590 to 540 million years) is completely inconsistent with this date for the uplift.

Whatever the exact date, however, some time after the sediments had lithified (turned to rock), movements in the Earth's crust compressed the rocks deep beneath the surface and caused them to change. Evidence of these titanic forces is clearly written in the record of the rocks. The original sandstones and shales, which formed from the sediments, have been transformed (or 'metamorphosed') by heat and pressure into quartzite, slate



Above left: The bedded rocks of the Stirling Range enable the development of 'steps' in watercourses cascading down the mountain sides.
Photo – Bill Belson/Lochman Transparencies



Above: Spongelite (seen here at an old quarry in Fitzgerald River National Park) is formed from fragments of ancient marine organisms such as sponges. It was deposited in a shallow sea, which lapped at the foothills of the Stirling Ranges about 55 million years ago.
Photo – Dennis Sarson/Lochman

The mountains of the Stirling Range were not 'uplifted' as many people believe, but were left behind as surrounding rocks were eroded away.
Photo – Marie Lochman

Once horizontal layers deposited in a shallow delta, the beds in this rock face have been folded by enormous pressures when the rocks were buried deep beneath the Earth's surface.
Photo – Lyal Harris

and phyllite. These rocks form through changes in the minerals of the original sediments, caused by a process similar to pressure cooking. In addition, whereas sediments are laid down in approximately horizontal layers, the layers of rock in the Stirling Range have a pronounced slope to the south (called a 'dip' by geologists). The southern slopes of Bluff Knoll, for example, follow this dip, which can also be seen clearly in the slopes of Mount Success.

The rocks in the range reveal some even more interesting structures. From the point on the Bluff Knoll walk where the path swings east along the ridge, visitors look across the saddle to a sheer face of rock. A closer look at this face will reveal that the rock is made of layers (or 'beds') which are severely contorted and wrap around through almost 180 degrees. Although solid, the rocks gradually yield to enormous pressures, and bend to form 'folds'. Similar folds are commonly seen in glaciers which also 'flow' without breaking. Where the rocks break instead of bending, a fault is formed. A fault can be easily identified as a line in a rock face which disrupts and displaces the beds so that they no longer match up on either side.

Buried deep in the Earth's crust, the rocks which form today's Stirling Range were gradually exposed over millions of years as the surrounding rocks were worn away by the forces of weathering

(chemical breakdown) and erosion (physical removal of material by water, wind and gravity). It was during this process that the current form of the range was sculpted.

SECOND ENCOUNTER WITH THE SEA

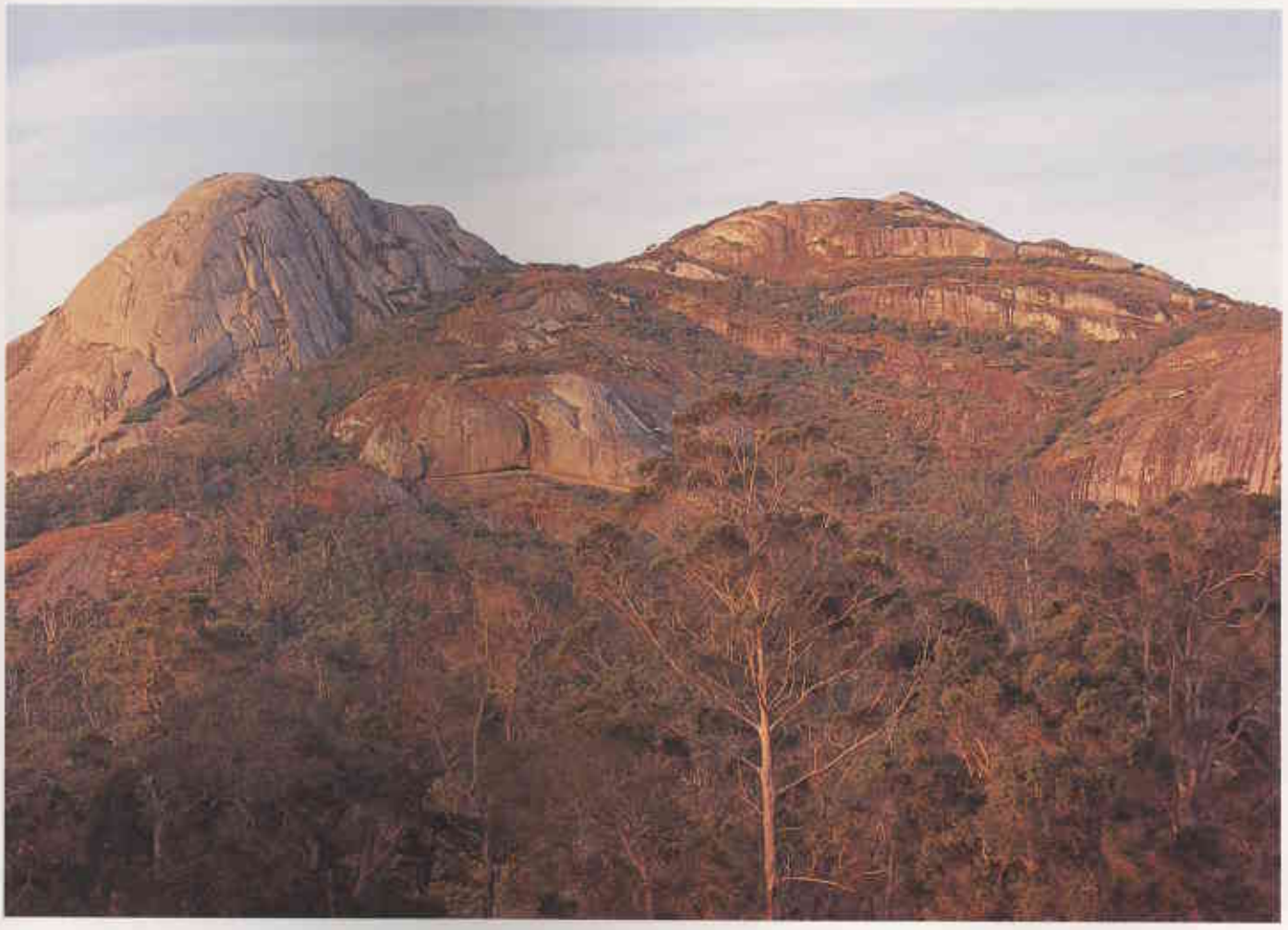
Having left their marine origins far behind, the sediments which formed the Stirling Range were to have another encounter with the sea. Around 55 million years ago, some five million years after Australia's break with Antarctica, the sea level rose to more than 130 metres above its present level. The Porongurup Range, to the south of the Stirling Range, became a true island and the coast moved inland to the southern foothills of the Stirling Range. Just as the rocks of the range had originally been deposited, more sediment settled on the new seabed.

These sediments formed a blanket over the country south of the Stirling Range and are now known as the Plantagenet Beds. One of the major rock types deposited at this time was formed from fragments of ancient marine organisms such as sponges. Called spongelite, it is known locally as Mount Barker stone, and has been valued as a building material since pioneering days.

Once the sea retreated, the Stirling Range was left landlocked once more. The forces of erosion and weathering are gradually wearing down the spectacular crags and cliffs for which the range is renowned. This process, if left to occur over eons, may eventually reduce the entire range to the level of the surrounding plain, unless some new twist in the roamings of the Australian continent subjects these ancient sediments to more of the tremendous forces which created the range millions of years ago.

Ian Herford has been Regional Planning Officer for CALM's South Coast Region since 1989. His initial degree was in earth science and he maintains a keen interest in the geology of WA's south-west. Ian is currently on secondment in Perth, as Policy Advisor to the Director of Nature Conservation. He can be contacted on (08) 9442 0312 or by email at ianh@calm.wa.gov.au.
Ian wishes to thank David Lynch, Val Milne, Bill Moir and Lyal Harris for their valuable comments on this article.

The rounded hills of the Porongurup Range are composed of granites, and contrast markedly with the jagged peaks of the Stirling Range, which are composed of altered sedimentary rocks.
Photo – Jiri Lochman



The threat from below . . . How can we defeat our greatest environmental enemy? Read about salinity and what we can do about it on p. 10.

One of the best aids to plant conservation is completely invisible. See our plant DNA story on p. 18.

LANDSCOPE

VOLUME THIRTEEN NUMBER 1, SPRING 1997

Dryandra, one of the last refuges of the native wildlife. Now you can experience this woodland wonderland for yourself. Find out how on p. 36.

Europeans brought alien plants and animals to WA's rangelands, which have since become degraded. What can be done? See p. 42.

How old is the Stirling Range? Read about this stunning area in our story on p. 48.

FEATURES

REGULARS

COVER

The Fitzgerald River National Park boasts a startling array of habitats, mammals, birds and other species. Its wildflowers in spring are often spectacular. Our story on p. 28 is a fascinating tale of variety, beauty, and threat in this aged land.

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