FOOTPRINTS ON THE SANDS OF TIME

by Ken McNamara and Nigel Trewin

Slicing its way through hundreds of metres of deep red sandstone, the Murchison River has uncovered tantalising evidence of some of the earliest creatures ever to walk on Earth. The ancient fossilised remains found in the sun-baked rocks of Kalbarri National Park tell one of Western Australia's most fascinating stories.

The layers of sandstone exposed in the Murchison River gorge and in the coastal gorges south of Kalbarri townsite are known as the Tumblagooda Sandstone. They were deposited by a gigantic river system that drained Western Australia and discharged into a shallow sea about 420 million years ago. At that time the southern continents were nestled together as one vast super-continent called Gondwana. Southern Australia lay against Antarctica; moored off Western Australia's south-west coast was the fledgling India; while off the north-west of Australia, parts of present day south-east Asia, like Thailand, were just beginning to break from the clutches of Gondwana and begin their passage north.

Inland from Kalbarri 420 million years ago the Yilgarn Block, comprising the ancient Precambrian heartland of Western Australia that formed between two and three billion years ago, was a towering, naked mountain chain. At this stage in Earth's history plants were only just making their first, tentative attempts to establish on the land. With no plant cover there would have been nothing to temper the tremendous erosive forces of the wind and rain. Billions of tonnes of sand, eroded from the mountain ranges, was carried by periodic violent floods over sandy floodplains to the sea, through what is now Kalbarri National Park. During storms, sand and dust was swept across the bare sandy plains. Just imagine a badly over-grazed landscape today - massive erosion and choking dust storms. This was the everyday situation on Earth more than 400 million years ago. Rather surprisingly, it was in this hostile environment that animals first left their footprints on land.

SNAPSHOTS IN TIME

Fossilised remains in the Tumblagooda Sandstone almost invariably occur as enigmatic tracks and burrows known as 'trace fossils'. To a palaeontologist there can be little more fascinating than finding a slab of rock with delicate imprints of tiny feet made by an animal walking across a damp sand flat hundreds of millions of years ago. What we may be looking at here is a snapshot of the activity of a single animal, for perhaps just two minutes of its existence, a very long time ago.

Reverend William Buckland wrote about fossilised tracks in 1836:

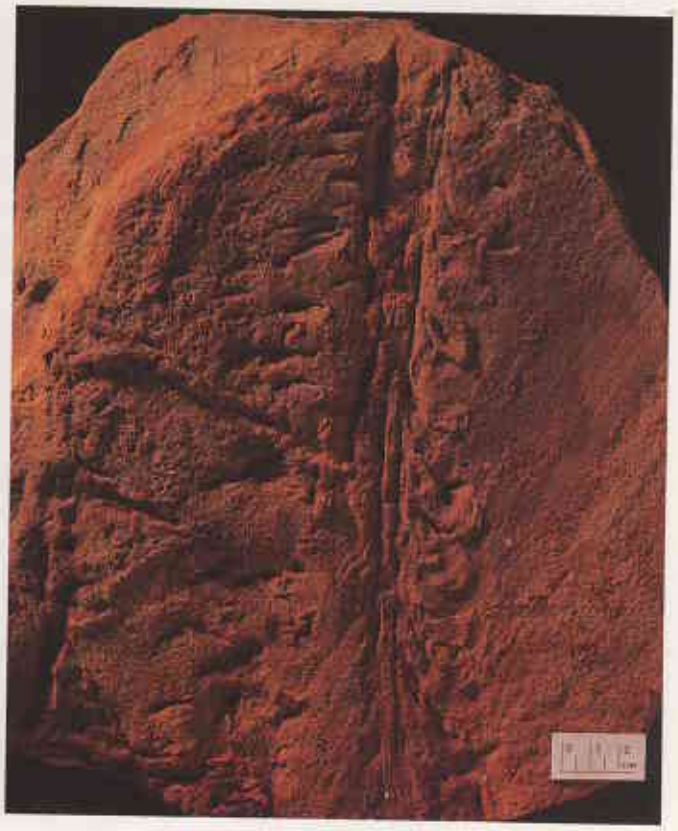
> "Yet we behold them, stamped upon the rock, distinct as the track of the passing animal upon the recent snow; as if to show that thousands of years are but as nothing amidst Eternity - and, as it were, in mockery of the fleeting perishable course of the mightiest potentates among mankind."

The trace fossils we have been searching for in the Murchison River gorge, over the last decade, come in a bewildering array of shapes and sizes. Some can easily be interpreted, as tracks or burrows, but others defy a simple explanation, perhaps demonstrating activities by types of animals that have long been extinct. The most easily recognised are tracks made by multi-legged arthropods (the group of segmented invertebrates that today

Facing page
Outside: Patterns in sandstone.
Photo - Bill Bachman
Middle: Murchison River Gorge, Kalbarri National Park.
Photo - Marie Lochman
Inset: Reconstruction of the eurypterid (*Mixopteris kiaeri*) on fossil tracks.
Photo - Douglas Elford/WA Museum

Below left: Fossil track of a eurypterid.
Photo - Douglas Elford/WA Museum

Below right: Fossil track of eurypterid that floundered through wet sand leaving impressions of its paddle.
Photo - Douglas Elford/WA Museum



includes animals such as insects, spiders and crabs). Some resemble tracks left by a motorbike driving across wet sand. Others, which are better preserved, consist of parallel rows of spaced pits. These pits may cluster together in groups of three, or six, or sometimes eleven, and much of the research in the last few years has focused on trying to identify the perpetrators of the footprints. The work of a palaeontologist is certainly very much like that of a detective - sifting for clues as to who (or what) committed the deed.

The most spectacular site at the base of the gorge consists of a flat, ripple-marked surface covering an area of about eight by five metres. Crossing this surface are at least six well-defined tracks up to 20 centimetres across, some extending for almost 10 metres in length. While the individual footprints are not well preserved, they do indicate that many large animals were walking across these wet sand flats. No other rocks of this age have yielded such spectacular fossil tracks.

This is the reason why it is imperative to protect this important natural heritage and, since the sites are within the Kalbarri National Park, the job of protection is carried out by the Department of Conservation and Land Management (CALM). The locations of the main sites within the Park are not marked so as to minimise disturbance as much as possible. But according to Roy Harris, CALM's ranger-in-charge at Kalbarri National Park, the public is not excluded from viewing these fascinating fossils. Locally organised tours that take in some of the fossil sites are available from the Kalbarri Tourist Bureau. Park Rangers and tour supervisors stress the importance of these sites and point out sensitive areas so as to help prevent inadvertent damage to the sites and to the fossil tracks themselves.

WA Museum scientists making a latex cast of fossil tracks in the gorge.
Photo - Ken McNamara/WA Museum

Latex drying prior to applying the first layer of cheesecloth, used to strengthen the final mould. The tracks here covered an area of approximately eight metres by five metres.
Photo - Ken McNamara/WA Museum

Fossil tracks showing where eurypterids emerged from a pool of water (coin marks edge of the pool).
Photo - Ken McNamara/WA Museum

FROM OUT OF THE SEA

To identify the animals that made these tracks we trekked across many square kilometres of rocks looking for more well defined footprints. The best were found just metres from the main Kalbarri road and close to one of the popular lookouts. This set of tracks revealed that the large animal had three pairs of walking legs and would have been about one metre long. The only animal that fits this description is the eurypterid, or 'sea scorpion', the dominant predator at the time. Within the group of arthropods known as chelicerates, the eurypterids form a separate family from the scorpions, even though, superficially, they resemble them quite closely. The major difference, apart from the number of legs, is the size - eurypterids grew up to two metres in length!

One of the more important discoveries to come out of our work was the realisation that these animals, thought to be exclusively aquatic, were in fact amphibious. As such, the Kalbarri tracks represent the earliest known direct evidence of animals walking out of water. To arrive at this conclusion we had to look not only at the tracks themselves, but also the nature of the sandstone in which they were fossilised.

The rocks at places such as the Z-Bend and The Loop, appear at first to be a monotonous sequence of layers of sandstone. But by standing at Nature's Window - a natural feature at The Loop - you not only glimpse through a window into the past, you also see that the layers

The recently described euthycarcinoid *Kalbarria brimmellae.*
Photo - Kris Brimmell/WA Museum

of sandstone in the cliff face opposite vary in form and structure. Some layers are thick and massive, and in these few, if any, trace fossils are found. These layers represent huge quantities of sand dumped by the fast flowing river. The thinner, often ripple marked, layers represent vast sand flats laid down as the flooding river subsided. Other sandstones, made of finer grains, are the remains of wind-blown sand. It is at the junction between these sand flats and wind blown sands that the trace fossils, particularly the tracks, are most often preserved.

PUTTING A NAME TO A TRACE

The footprints reveal that a range of animals - probably all arthropods, including the eurypterids - staggered from one pool to another, perhaps as the pools dried up in the harsh sun. Treading with their multi-legged feet over the wet sand, their imprints were preserved by sand storms that dropped fine sand onto the wet surface. The rock, which was eventually exposed by the modern Murchison River carving its way through the ancient layers of sandstone, preferentially split between the water-lain and wind-blown sands to reveal the fossil tracks.

Evidence that the animals were moving from pool to pool can be seen in a number of places where gentle depressions in the rock surface represent shallow pools. Footprints only occur **between** these depressions, where the sand was exposed and wet. At one spectacular site in the gorge, located by Mr Roger Hocking of the Geological Survey of Western Australia, a steep slope from a sand flat into what was once a pool of water has been preserved. Here, tracks wind their way along the sand flat to the slope. They are then replaced by a pair of deep grooves made by the animal, probably a eurypterid, as it slid down the bank into the pool, crocodile fashion.

Until a couple of years ago we thought we were dealing only with eurypterid tracks, but the discovery of a single body fossil opened a whole new world of strange, extinct arthropods. On one of our field trips in 1990, Kris Brimmell, Technical Officer from the Western Australian Museum, made one of the most important Western Australian palaeontological discoveries.

Walking along a goat track late one afternoon, her eyes were attracted to a peculiar looking fossil. Highlighted by the low angled, raking sunlight, the fossil looked, for all the world, like a trilobite - an extinct group of marine arthropods that lived in the sea between 200 and 540 million years ago. However, closer examination revealed that this was not the case. Looking rather like an enormous cockroach with 11 rather than three pairs of legs, we had no idea what it was. For many years we had hoped to find remains of the eurypterids that we believed had made many of the tracks, but this creature had far too many legs for a eurypterid.

A SHIFT IN TIME

After weeks of pouring over literature, we excluded all animal groups that were known to have lived 420 million years ago. We then began looking at extinct animals that had lived at other times. Eventually we realised that the only group that the fossil could be placed in was an obscure group of arthropods known as euthycarcinoids, but the oldest examples of euthycarcinoid - found in rocks in France and the United States - were dated at a mere 300 million years old! But the Murchison Gorge rocks where our specimen had been found were 420 million years old.

After showing photographs of the specimen to other palaeontologists around the world who had worked on euthycarcinoids, it was confirmed that we had unearthed the oldest euthycarcinoid by far. We had extended the known range of this subphylum by a staggering 120 million years.

In the early 1980's two palaeontologists had raised the possibility that euthycarcinoids could be the

ancestors of the insects. However, the suggestion gained little acceptance because the oldest fossilised remains of an insect pre-dated the earliest euthycarcinoid known at that time. But with this new evidence that euthycarcinoids did live before the insects, the case is greatly strengthened.

NEVER ENDING STORY

We returned to Kalbarri in early 1991 in the hope of finding some more specimens. Although we were unsuccessful, what we did find was almost as exciting.

Walking along the edge of the gorge early one morning, the low-angled sun highlighted a slab of sandstone covered by delicate tracks. From the way the animal must have been 'crabbing' along, perhaps being blown sideways by the wind, the repeated pattern of about 11 sets of footprints could be discerned, indicating that a euthycarcinoid made the tracks.

Nearby we found horseshoe-shaped excavations that may have been the feeding burrows of these creatures. The tiny U-shaped burrows, also present in these rocks, even gives an indication of what the euthycarcinoid might have been feeding on.

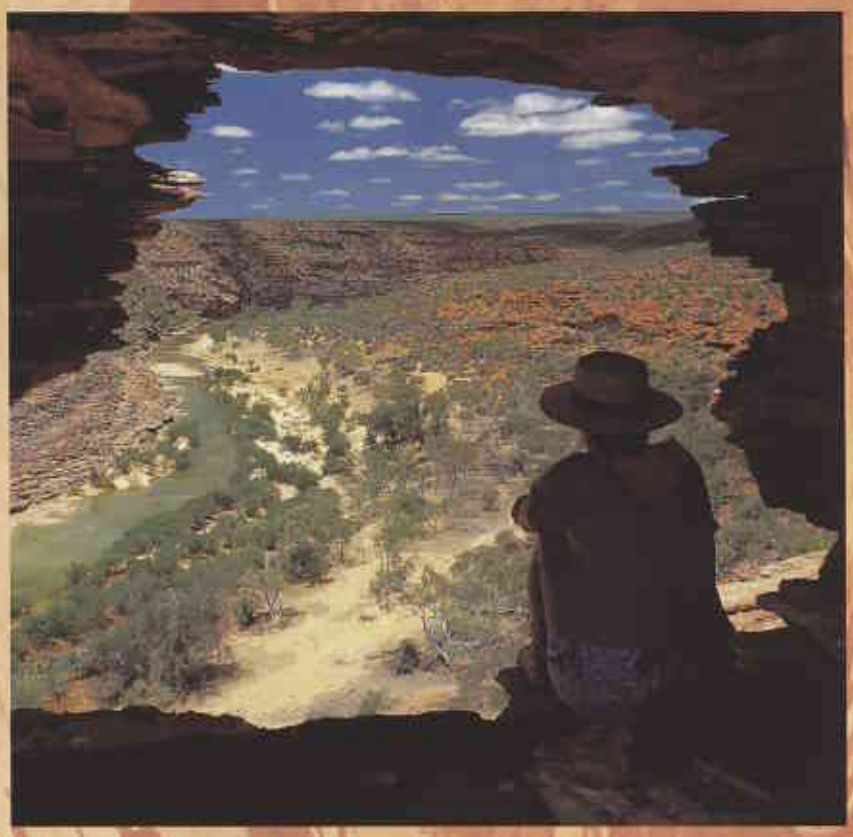
In his 'Psalm of Life' Longfellow reminded us that :

> "We can make our lives sublime, And, departing, leave behind us Footprints on the sands of time;-"

So too the Murchison River gorge footprints which, having had the good fortune to have been made in wet sand, were not blown away into eternity, but were blessed with an almost immortal existence. The result has been that these ancient footprints, some 420 million years since they were made, are providing us with new insights into the behaviour and early evolution of the land's first inhabitants.

Box: Nature's window, above the Murchison River Gorge in Kalbarri National Park.
Photo - Bill Bachman

THE CARE AND CONSERVATION OF FOSSILS



All fossils and rocks in Western Australia's national parks are protected by law. As such, they must not be removed, broken or otherwise damaged. The benefit is that an important part of our national heritage is protected and many people can see and appreciate the fossils and rocks in their natural state. While the plants and animals of the State are fully protected, fossils, which are a finite resource, are only protected if they occur within a national park or reserve.

Once a fossil has been collected it is effectively lost to the community, unless it is housed in the WA Museum. Many of the fossils in the Kalbarri National Park are of immense scientific importance. Their conservation within the Park, therefore, goes a long way towards protecting an important part of the nation's cultural heritage.

In addition to being the repository for the State's fossil collection, the Western Australian Museum also serves an important function in disseminating information about Earth sciences to the general public. The professional staff in the Department of Earth and Planetary Sciences at the Museum assist the Department of Conservation and Land Management (CALM) by providing information on geological features within national parks, such as the Pinnacles at the Nambung National Park, and for displays at the Milyering Visitor Centre in the Cape Range National Park and at Wolfe Creek Crater. CALM staff actively assist the geological research at the Museum and this has been particularly so with the research at Kalbarri, where Park Rangers have provided invaluable help over the years.

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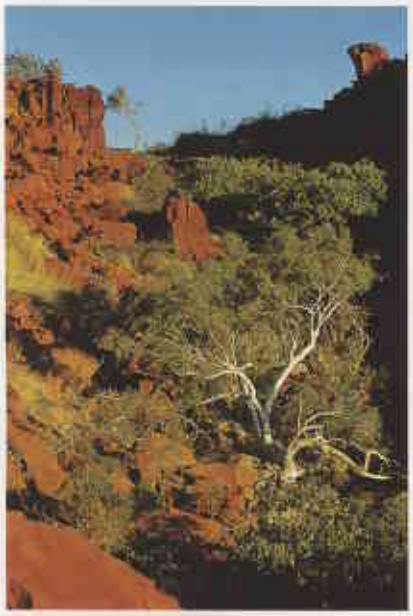

Nature-based tourism is a rapidly-growing industry and WA is poised to take a slice of that growth. See 'Our Natural Advantage' on page 10.

'Seagrass, Surf and Sea Lions' (page 21) are just some of the features of a string of islands that dot the WA coastline north of Lancelin.

Forrestdale Lake is an 'Outer City Sanctuary' for thousands of visiting and resident waterbirds. See page 35.

Frogs can be an interesting addition to any suburban native garden. Grant Wardell-Johnson describes how to attract them to your garden on page 16.

When is a flower not a flower? Neville Marchant, from CALM's WA Herbarium unravels the intricacies of the State's many 'False Flowers' on page 39.

FEATURES

REGULARS

COVER

*The bull frog (*Litoria moorei*) is very large and has a voracious appetite. It is a frequent visitor to gardens and may be found particularly in greenhouses, ferneries and wet areas such as streams and ponds.*

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