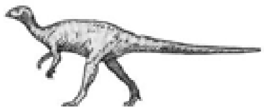
DINOSAUR DREAMING 2025 FIELD REPORT



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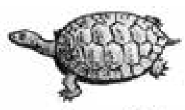

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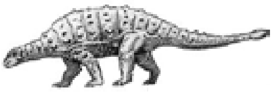

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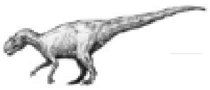

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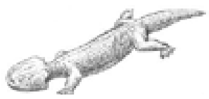

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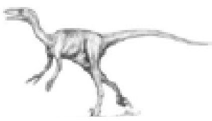

Dinosaur Dreaming acknowledges the Bunurong and Eastern Maar peoples, the Traditional Owners of our Victorian Cretaceous dig sites, and pays respect to their Elders past and present. We extend that respect to indigenous peoples throughout Australia.

FRONT COVER: Reconstruction of the Early Cretaceous Koonwarra ecosystem, honoring the long-term work by Tom Rich and Pat Vickers-Rich by MIchael Rothman (2025). See Ancient Life in the Koonwarra Fossil Beds (p 22). Copyright Swedish Museum of Natural History.
INSIDE FRONT COVER: Cretaceous animals by Peter Trusler.
BACK COVER: Cretaceous vegetation of the Bass Coast (top) and Otway Coast (bottom) by Bob Nicholls (2024). See Building a Picture of Ancient Plant Life (p 12).

Collection of Victorian Cretaceous material is completed under the National Parks Act 1975 Research Authorization Permit No 10009432 from the Department of Environment, Land, Water and Planning granted to Prof Patricia Vickers-Rich, Monash University, 9 Rainforest Walk, Clayton, Victoria, and associates under the direct supervision of the authorisation holder.
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The Dinosaur Dreaming 2025 Field Report was compiled and edited by Wendy White. It was printed by NewArtworx. Thanks to Mary Walters for proofreading.

Contents:

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www.dinosaurdreaming.net

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Image: L Nink

The House and the Wrapping Rock

By Wendy White

The 2025 Dinosaur Dreaming Twin Reefs fossil story was all about amazingly preserved fossil finds, turtles, ornithopods and pretty plants.

The 2025 Dinosaur Dreaming logistical story was full of triumphs and disappointments.

Week 1 - running to plan

On Friday January 31, a subset of the core crew arrived at the Dig House in Cape Paterson, and began the work of transforming a family-style home into an area suitable for feeding and in many cases housing a dig crew. Alan Evered took charge of cleaning the back yard and ridding it of jumping jacks (horrible bite-y ants). As usual, we hid most of the nice clean things that actually belonged in the house away in corners and cupboards, and removed as many trip hazards as we could. This year we decided to invite our neighbours around to see what we were doing, and to show off some fossil finds. Marion Anderson volunteered to walk around the neighbourhood depositing flyers in letter boxes to advertise this. As night fell, we ordered the usual fish and chips, as Cape Paterson is not renowned for its choice of cuisines.

The next day we sent a small crew to site in the morning, to stare at the future excavation hole and plan our attack. Those of us back at the house unpacked the tried and trusted house gear from Lesley's shed, and pretended we had sound logic for where we stored it. The rest of the first week crew arrived, including two rookies who shared a bus ride down but did not actually notice each other until they were standing at the Cape Paterson bus stop waiting for me to pick them up. We did the Rookie training and broke a little of the leftover rock collected in previous Field Seasons.

Sunday we all went down to the Twin Reefs site, where Marion Anderson did some mapping, and John Wilkins dug a drainage channel in the shore platform to send water around our dig site. John would spend time each day we went to site clearing that channel as the tide deposited stones, shells, seaweed and other debris in it. No bones were found in the channel rock. In the afternoon we erected a marquee over the backyard rock-breaking site to keep some of the rain away. The neighbours turned up to see what we were doing. We had our first dinner cooked by a Rookie - a nervous-looking Jack Biggs made their now-famous chicken pesto pasta.

Monday was our first real excavation day but when we arrived on site bright and early it was still under water. Alan Tait obligingly filled in the waiting time with an impromptu geology tour, whilst I, who once received an individual thermos as a present, sat on a rock and drank tea that I had prepared earlier. As the fossil wrapper, I often find the first half hour at site very quiet, and a sneaky cup of tea really hits the spot. After a wet Sunday, it was hot.

Tuesday we had a visit from Mackenzie Enchelmaier, Collection Manager at Australian Age of Dinosaurs Museum of Natural History (AAOD). Mackenzie was in Melbourne to scan some fossils through the synchrotron, and took the opportunity to check out our operations and share some insights from the work she is doing in central Queensland. We had traditionally associated AAOD with huge sauropod bones but they are collecting more and more small fossils, so it was interesting to compare notes. To make her feel welcome, the Bass Coast put on some hot weather.

Image: C Ennis

Alan Tait removes rock for the waiting crew


Image: A Pentland

The crew breaking rock at Twin Reefs

On Wednesday I managed to lock the key in the house when we went to site, instead of storing it in its little key safe. D'Oh! It turns out that with a ute to climb on and a rookie unafraid of heights, our house was pretty easy to break into. Corrie William's eggplant parmigiana for dinner cheered me up.

Jack Biggs, who loves plants, found a lovely fossil cone on Thursday. Even though it was an *Araucaria*, a genus that we had already recorded, it was such a pretty fossil that we all felt happy. Corrie Williams, Lesley Kool and Adam Hopkins spent the day at The Inverloch Community Hub hanging pictures for our month of community engagement (more on that later in the Field Report). We found a nice dinosaur skull element and our first turtle skull.

On Friday, we found 11 bones, including an ornithopod tooth. There was mist and drizzle, so a number of the crew took the opportunity to visit The Inverloch Community Hub. Nick van Klaveren did a lot of rocksawing at the house, making large fossil-bearing rocks into smaller more manageable fossil-bearing rocks. Mason Searle, the teenager behind Dinosaur Fossil Fashion, and his parents joined us for dinner, which meant extra sausage rolls and brownies.

Week 2 - definitely not running to plan

Saturday February 8, was a drizzly day, not enough to force us off the beach, just enough for us to wish the sky would make up its mind. Even Mason, super-keen on dinosaurs, headed back to warm dry lodgings after a shorter time visiting our beach than he had intended. Our new crew arrived, and, perhaps the result of a slight miscalculation, we squeezed five tents into our back yard. Adam Hopkins, who had taken my pleas to bring a small tent seriously, was at least 30 cm longer lying down than the tent that he brought. He made it work. We increased the number of rockbreaking stations in the back yard, and extended the tarp to cover more area. On site, Dean Wright, a surveyor, recorded the GPS of our marker points to better inform our maps. Our old crew left, including Jack Biggs whose phone remained behind undetected in Lesley's car.

On Sunday, Jack caught the bus all the way to Cape Paterson, retrieved their phone, visited for a few minutes, and then caught the bus all the way back to Melbourne. Some things are too important to trust to an overnight courier! We found lots and lots of fossils. They were everywhere. Many of the fossils were found by John Wilkins and ace fossil finder Mary Walters. After we climbed the steps from site, I discovered that my car keys, that I had leant to Adele Pentland so she could deposit rocks in my car, were in her pocket on the way back to the house and not with me and my car. I spent a lovely 20 minutes looking at the view from the top of the cliff. We retrieved a turtle shell fossil that was so big and beautiful and fragile that it was delivered from the hole to my wrapping station in five seedling trays. When presented with a normal fossil, the first thing I do is check that it is complete - that I have both halves with no gaps. If there is a chunk missing, this allows the finder to look at their rockbreaking surface and the top of their bucket of rubble to see it they can find it. Not so when I am presented with five trays, each with a few rocks in it, and I am informed that it is one fossil. The tide is usually encroaching, because it takes some time to extract five trays worth of material. I wrap the rocks on each tray, label them as associated and with a tray number, and hope for the best. I mutilate the lyrics from Rawhide...

Don't try to understand 'em,
Just smile an' wrap an' brand 'em.
Soon we'll be matching halves inside...


Image: W White

John Wilkins and Sachi Kerr clear the drainage channel.

Our fossils were beginning to take over all our available surfaces, so we bought an extra folding table, and filled it with more fossils. Lesley, who did not come to site, was kept very busy trying to catalogue and pack the fossils away in order to create more space.

Alan Evered, a digger with more than 90 years of life experience, found a lovely skully bit on Monday. We think its really great when our older diggers find really cool fossils. The low tide had moved to the afternoon, so in the morning we broke rock at the dig house, and I helped Lesley do a lot of cataloguing. In the afternoon, we found more turtle elements at site. So many turtles! And a weird thing that looked like a turtle shell but both halves looked like the counterpart with no actual bone on them. It might be a pseudofossil. It might be weird preservation. Adam Dellal found a nice mystery bone and John Wilkins found an even nicer skully bit. It was so refreshing to have no rain and dry newspaper. A solid week of ripping wrapping tape with my teeth finally wore off enough layers of skin on my bottom lip for me to flinch a little at the relatively mild chilli in the fajitas (catch phrase: they're Mexcellent!) that Alyssa Fjeld made for dinner.

Tuesday February 11 was International Day of Women and Girls in Science. The tides would have meant a late afternoon site visit, so we forewent that in order to listen to our panel discussion, although a few crew members went prospecting without success. It does not mean that it was a wasted day. We broke rock at the house. John Wilkins accidentally sawed a turtle skull in half in a way that looked very beautiful. Corrie Williams installed some shelves in Lesley's shed so that we could fit more stuff in it.

On Wednesday, since the tides were wrong for us to be on site, we decided to break up some Koonwarra rock at Mike Cleeland's house on Phillip Island. We found a few nice plants, but no animals — no insects and no feathers. Some of the crew took advantage of Mike's life-sized ornithopod dinosaur to reenact scenes from the movie Jurassic Park (the original of course). Pip Cleeland made us chocolate-covered frozen bananas which went down very well on the hot day. Adele Pentland and Zev Landes brainstormed some ideas for a project in outback Queensland that they were working on. Adele broke her rock-breaking surface neatly in half. For dinner, Corrie made her famous crowd-pleasing potatoes for dinner, and afterwards Ruairidh Duncan explained to anyone still at the dig house why Celebrations are objectively the best chocolate available in Australia, whilst we happily scoffed down Cadbury Favourites.


Image: W White

Jack Biggs and Sachi Kerr model our new vests

Thursday was another house day, with lots of cataloguing achieved. Adele found an ornithopod tooth just after her chisel did, but overall it was not a very find-y day. Jake Kotevski and Sally Hurst spoke to children from Inverloch Primary School at the Inverloch Community Hub. Ruairidh made his spicy chicken wings which cheered us up a bit.

On Friday morning, we confidently headed down to site but the tide was still too far in to let us dig. We all looked sad, especially our embedded artist Zev Landes who had come to site to sketch us doing what we do. We headed back to the house. Former Dreamer Ben Franceschelli, who now thinks mostly about younger fossils from the Bayside area, and geologist Mike Hall came to visit.

Week 3 - back on track

Saturday February 15 started with some early morning rain. Doris Seegets-Villiers and Alan Tait reconnoitred our site and reported back that it would be under water all day. So we settled in to another rock-breaking day at the house and for crew change-over. We had a fossil table and a display of rock-breaking at the Inverloch Community Hub. Lesley spent most of the day putting fossils on her new shed shelves. We covered the fossils on the outdoor tables with tarps, but miscalculated the heights so that one fossil got destroyed by runoff water. The rock breakers reported no significant finds. Not the best day, but a bad day on a dinosaur dig is still pretty good! It kept raining, and most of our tenters decided to bunk inside.

On Sunday we were still not able to dig at site, and were feeling more frustrated. Three of our four Rookies found ornithopod teeth breaking rock at the house. John Wilkins found a mammal jaw in some old rock, equalling Mary's record. We processed a lot of our rock backlog, and printed a lot of T-shirts.

Finally, on Monday we got to dig at the site. Yay! We found lots of scrappy turtle bits. Melissa Lowery and Doris Seegets-Villiers measured some footprints not too far from our dig site. The small Phillip Island Village School all came to visit. The fossil wrapping got a bit busy towards the end of our time on site, and my feet got a bit wet. Socks dry. Corrie found fossils that on site we thought might be some associated ornithopod foot-bones. John found a beautiful curly-edged bone. We printed more vests.

By Tuesday it started to rain just as we left the beach, so we started feeling lucky again. We had hit our groove, and had a steady flow of fossils for me to wrap. In order not to keep track of the changing roster of hole assistants, I started calling the hole Rookie "Sponge Bob". No-one complained, but then again, working on the hole, even as the fetcher-carrier-sponger is a pretty coveted position. Amber Craig was on rocksaw. There was no big fossil rush at the end which makes me calmer. Back at the house, not much was found. The crew started showing me the plant fossils that they uncovered. That only happens when it is slow.

By morning tea time on Wednesday, our official count on site was one fossil and one heavy shower. Not a good ratio. Melissa and Doris measured more footprints. Artist Sharyn Madder, taking a year off digging, came to visit.

Thursday was a textbook day at site, and we happily extracted fossils.

Friday was our last day at site, and it was clear and blue and beautiful, as if reminding us how much we would miss it. We found a fossil I called an imploded fish - a large number of small fish scales clumped together but not arranged in any fish-like shape.

Saturday we packed up the house, said our goodbyes for another year, and headed home.

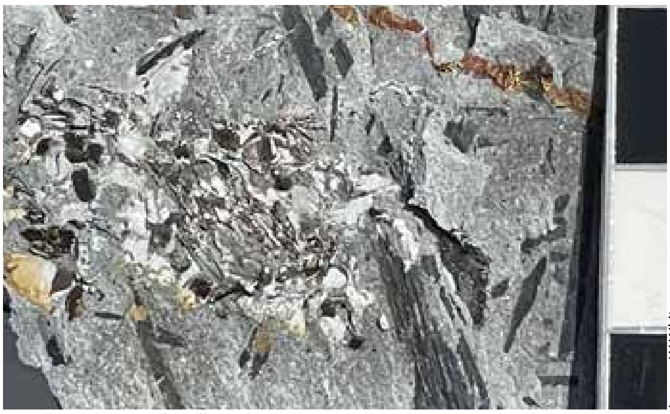

Image: W White

An "imploded fish". Scale in cm.

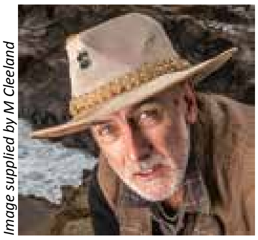

Image supplied by M Cleeland

Victorian Cretaceous Quiz

By Mike Cleeland

1. What is the type locality of *Atlascopcosaurus*?
2. Who discovered the GOK?
3. What is a *Tarwinia*?
4. Who is *Wadeichthes* named after?
5. Which two Palaeobotanists described the fossil flower from Koonwarra?
6. Is the Punchbowl at San Remo...
   a. A meteorite crater
   b. A collapsed sea cave
   c. A volcanic crater
7. W. H. Ferguson found the first dinosaur bone in Victoria. Who found the second?
8. Which bone is the type specimen of *Serendipaceratops*?
9. Where is Lesley's Lair?
10. What process causes the formation of an injectite?

Answers

1 Point Lewis
2 Tim Flannery
3 Fossil Flea from Koonwarra
4 Mary Wade
5 Leo Hickey and David Winship Taylor
6 Sea cave
7 John Long
8 Ulna
9 West of Eagles Nest
10 Earthquake

Image: A Pentland

Breaking Koonwarra rock in Mike's garage

Fossil Bonanza


Image: W White

By Lesley Kool

The 2025 field trip to the Twin Reefs site continued from where it left off in 2024 and once again the dominating fauna were the ornithopod dinosaurs, closely followed by well-preserved turtle fossils. Unlike other fossil localities like Flat Rocks, the bones tended to show little evidence of extended fluvial transport and were, for the majority, fairly complete. This is reflected in many fewer discarded fragmented specimens than occurred at the Flat Rocks site.

Meticulous mapping and isolation of individual blocks in numbered buckets resulted in us being able to track concentrations of bones. For example, bucket 4-16 (indicating that it was the 16th bucket to be filled on February 4th) contained more than 25 bones. Using the data collected and collated by Marion Anderson and Astrid O'Connor, we were able to pinpoint where this bucket of bones came from in the fossil layer.

On February 7th the excavation team pulled out a large block with 11 bones exposed on one surface, including an ornithopod dentary (Fig.1). The counterpart block was also collected and after the dig ended I began to carefully prepare the exposed bones. Naively, I planned to remove the partial bones from the counterpart block and place them, with their partners on the original block. I struck a snag when removing one bone only to find more bones below it. Eventually, the original 11 bones became 28 bones, most of which probably belong to ornithopod dinosaurs. At this time I am unsure if we are seeing the bones of an individual dinosaur or several.


Image: L Kool

Fig. 1. Partial Dentary


Image: L Kool

Fig. 2. Predentary.

Apart from the number of associated bones there were some interesting bones that were rare in other Victorian Early Cretaceous fossil localities. In the 30+ years that we excavated at the Flat Rocks site, we only found one ornithopod basicranium (base of the skull). This field season at Twin Reefs, two basicrania were found, both by ace fossil hunter Mary Walters. Their preservation is amazing. There is no sign of crushing and even the delicate parts of the basicranium are present and undistorted, perhaps suggesting that they have not travelled very far before being buried.

Another rare element in the collection is the predentary, a small triangular bone that adjoins the two dentaries in the lower jaw of an ornithopod (Fig.2). Very few have been found over the years, but during the 2025 field season two predentaries were found. Similarly, two ornithopod quadrates, bones at the back of the skull that articulate with the lower jaw, were also recovered (Fig.3). These bones are extremely fragile and tend to break up when transported, but the two found at Twin Reefs were complete and undistorted. The number of isolated ornithopod skull elements that were recovered during the 2025 field season is encouraging and augers well for something more complete to be found during the up-coming 2026 field season.

Apart from the well-preserved ornithopod bones, numerous turtle shell fragments were recovered as well as six turtle skulls (Fig. 4). In all the years we excavated at the Flat Rocks site we only discovered two turtle

Image: L Kool

Fig. 3. Quadrate. Scale in cm

Image: L Kool

Fig. 4. Partial turtle skull with scapula coracoid. Scale in cm

skulls, one of which is the holotype of a new genus and species. Of the six turtles skulls from Twin Reefs, only two of them are complete enough to compare with the holotype and they appear to be very similar, if not the same genus and species. The remaining four skulls are partially preserved and more preparation is necessary to determine if they are also the same as the Flat Rocks turtle.

The domination of ornithopod dinosaurs to the exclusion of other dinosaur species, is perplexing, but evidence of a possible theropod bone, a partial theropod frontal bone, has given researcher Jake Kotevski hope that his favourite dinosaur group will make more of an appearance next field season.

Most interesting are the bones that, at this early stage of investigation, we are unable to identify. Two of the mystery bones appear to be skull elements, but we are unsure as to which taxon they belong. More research is necessary to discover their identity.

During the second week of the dig when we were unable to access the Twin Reefs site because of unfavourable tides, we supplied the rock breakers with some left-over rock collected from previous Flat Rocks field trips. It was in one of these rocks that John Wilkins found his 4th mammal jaw. Although we have found no evidence of these tiny mammals at Twin Reefs yet, more than 60 mammals jaws have been recovered from the Flat Rocks site over the years, and John added another one to the list. Our resident mammalogist, Tom Rich has tentatively identified the jaw as a Bishops whitmorei .

We eagerly await the discoveries to be made during the 2026 field season and with the data we collected this year we hope to be able to hone in on some of the hot spots.

Stay tuned.

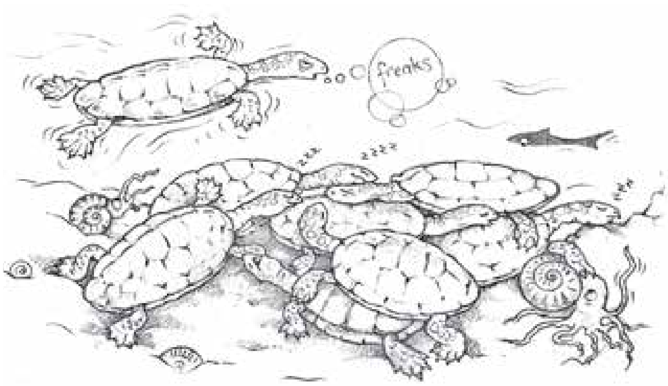

Image: S Madder

Sharyn Madder speculates about why so many turtle skulls were found close together

Image: J Biggs

Detail of the turtle in Jack Bigg's Victorian Early Cretaceous reconstruction

Image: W White

Weekend Warriors Report

By Adam Dellal

On the 5th and 6th of April this year, a small group of Dinosaur Dreaming's weekend warriors braved the windy weather to further explore bone concentrations found by Melissa Lowery at Noddyland, not far from Flat Rocks. As we eagerly walked out to the rocks at Noddyland, we immediately got to work despite the harsh winds attempting to blow off our hats. Melissa's keen eye pointed us to small fossil fragments that protruded from the rock surface, and we began to remove the sand brought in by the tide, in typical Dinosaur Dreaming fashion, with buckets of water and intense sweeping with brooms.

Once the rock was cleared, we began to excavate. Unfortunately, Noddyland did not have as comfortable seating as some of the alternative locations, such as Twin Reefs or Flat Rocks, though we were all able to make do. Corrie Williams, John Wilkins, and I got to work with a chisel and hammer and extracted large slabs of rock. As a side note, this was one of my first experiences where I was constantly working in the 'hole' actually hitting the rock as it lay in the shore platform. This was a task that I enjoyed thoroughly, and it was great to learn the techniques from Corrie and John, always trying to follow the grain of the rock.

In some ways, this technique is not dissimilar to what we use in archaeology, following the sedimentary patterns when excavating. The only difference is we do not need a chisel and hammer to get through our sediments when digging. As we kept digging, John and I got a bit too carried away and seemingly bit off more than we could chew by continuously extracting larger and larger slabs of rock. To our disappointment, little conglomerate could be seen in the rock, though this does not always mean the rock is lacking fossil, so we took a break and helped the others begin to chisel down the larger slabs into smaller rocks.

We soon discovered that bone was within some of the rock. However, it was a fish frenzy, with most being various fish fossils, the most impressive being a large fish jaw found by Corrie. I also managed to get in on the action, finding my very own fish palate. Along with the fish, a piece of turtle was found by John, as well as a potential skull fragment by Corrie.

As the tide came in, we moved closer to shore to continue breaking rock, and at the end of the day, assessed that the area we excavated was not worth continuing. We instead decided to work on other areas that may have greater potential. As a new day dawned, we headed back out to the site and began clearing rock from sand the same way we always do. On this day, we sampled more areas than we did the day prior. Most testing locations were on the rocks located closer to the shore at Noddyland, in three different spots where Melissa had spotted bone.

At about midday, Corrie, John and I decided to sample another area closer to RACV Point and the Mary Anning locations, where mammal bones had been found previously. However, other than some scraps of undiagnostic fossils, there was not much else embedded in the rocks, and we returned to the Noddyland site.

Despite finding three fossils that we decided to keep, including a fish fossil extracted from the hole, a fish jaw found by Marion Anderson, and an unidentified small shaft by Melissa, the site did not yield as much as we had hoped. As a result, Noddyland may not be a top-priority site to return to in the near future. Needless to say, these Weekend Warrior digs are important for us to test for the next major dig location. Who knows, we may be one rock break away from something big!

Image: W White

Weekend Warriors Saturday dig crew

Image: W White

Cleaning the rock at Noddyland

Image: W White

Termites at Flat Rocks: Builders of the Polar Forests

By Jon Edwards

We are all familiar with the incredible vertebrates that roamed and swam along the Victorian Cretaceous coastline, such as *Koolasuchus*, *Galleonosaurus*, and the theropods which are only now being revealed after decades of scarcity. These animals fuel our imagination, but don't tell the full story of our ancient polar forests.

These forests, unlike anything on Earth today, faced challenges that tested their survival. How did they endure three months of winter darkness? How did they cope with three months of summer light without a night to rest? And most importantly, how were nutrients recycled when the decay of wood by fungi slowed to a crawl in the cold? Without recycling, a forest cannot thrive. A log spotted by Melissa Lowery (who else?) about five years ago offered an amazing clue.

Less than 100 meters from the Flat Rocks Dig Site, Melissa noticed the 80 cm piece of fossilised wood riddled with channels, each packed with minuscule pellets. Cut out of the ground by Mike Cleeland, the log was transported to Monash University, and over the next few years, we worked to uncover its story.

The breakthrough came when we looked at the pellets under a microscope: they were hexagonal! This immediately identified the pellet creators as termites, whose poop takes on that shape after being squeezed by three bands of muscle to conserve water. The log, in turn, was a nest for a polar colony of termites — the first evidence that they reached extreme southern latitudes during the time of dinosaurs.

This discovery shows that termites were already globally widespread by the Early Cretaceous, and their role in Victoria's forests would have been crucial. In the long, cold winters, when fungi were slowed, termites could keep breaking down fallen wood and recycling nutrients back into the ecosystem. Crucially, modern termites cannot survive prolonged freezing. If these polar forests had been locked in ice, there would have been no colonies at all. Their presence instead shows that winters were relatively mild, probably averaging around six degrees — cold and dark, but not frozen wastelands.

The story doesn't end there. The tunnels also hold tiny coprolites from wood-eating mites, which likely moved in after the termites were gone. Together, they show how even small invertebrates shaped the health of ancient polar forests — and perhaps deserve a place in our dreams alongside the dinosaurs.

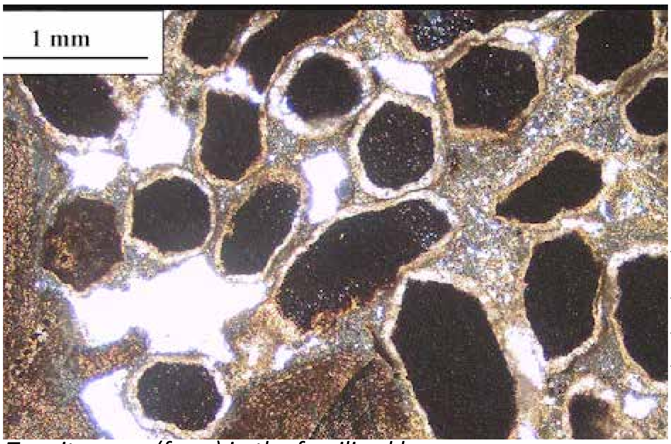

Image: J Edwards and W Parker

Termite poop (frass) in the fossilised log

Image: E Herbert

When termites clock off, the mites clock in! by Emil Herbert.

Image supplied by V Korasidis

Building a Picture of Ancient Plant Life

By Vera Korasidis and Barbara Wagstaff

Image supplied by B Wagstaff

A paper that was published in Alcheringa (Korasidis and Wagstaff 2025) this year has been 42 years in the making. Little did one of the authors of the paper (Barbara Wagstaff) realise, when the journey started as an honours project on an Early Cretaceous cliff at Kilcunda in 1983, that the data collected then, would still be useful. Over the 42 years there have been various sources of funding for the research, several students palynological projects supervised, a terrific team of field helpers involved in sample collection, and lots of new palynological data collected on the vertebrate fossil coastal localities. So why was this work undertaken? Well primarily to establish the age of the vertebrate fossils from the sites in the Otway and Gippsland basins. To date them the palaeontologists needed the expertise of us palynologists — palaeontologists who study microscopic fossil spores and pollen produced by plants. We identified key species that were dissolved out of small samples of the rocks to provide the age. The publication of a paper in 2020 (Wagstaff et al. 2020) where palynology provided the age control of the vertebrate fossil sites and deduced the dinosaur bones ranged in age from about 126 to 100 million years old, was supposed to be the end of the whole long process, but we palynologists had another trick up our sleeves.

Unbeknownst to the vertebrate palaeontologists, we did not just look for age indicators in our slides, we looked for all the microscopic spores and pollen species that were present and we counted the number of each to get a proportion of them in the vegetation. Thus, we had a picture of the plants that were present and how abundant they were at any moment in time and at any site that was associated with the polar dinosaurs. What we also had was a record of the change in the vegetation through the Early Cretaceous period in Victoria as the climate warmed. We then provided the artist Bob Nicholls in the UK with a detailed list of species and pictorial examples of their fossil and living relatives. We also provided him with an idea of the overall environments the plants would have been growing in. Bit by bit over more than a year, and with a lot of zoom catchups, Bob finally produced images that represent two snapshots of Early Cretaceous Victoria. One for Gippsland at about 120My and one for the Otway at about 100My. We must admit we were thrilled with the results.

What did Victoria look like 120 million years ago?

Though inside the polar circle, Victoria had lush temperate forests instead of ice. The forest canopy (mainly comprised of podocarp conifers) was open, with a seed fern and conifer subcanopy, a fern understory and a lycophyte, liverwort, hornwort, sphagnum moss and fern ground cover (see back cover).

The flowering plant explosion Victoria 100My ago

Our new research suggests that warmer conditions at the younger Early Cretaceous sites in the Otway's helped flowering plants colonise understorey habitats shortly after migrating to the poles. Their appearance in the landscape resulted in the extinction of numerous understorey plants (particularly ferns) that had had a long fossil record. As a result, by 100 million years ago, the forests of Victoria included an open conifer-dominated (araucarian and podocarp) forest canopy, a seed fern and fern subcanopy, with diverse flowering plants and ferns in the understory, alongside liverworts, hornworts, lycophytes and Sphagnum-like mosses (see back cover).

Acknowledgements

We would like to thank Geoscience Australia and Museums Victoria for the loan of select slides. We would also like to thank Global Geolab Limited for altering their standard processing techniques. Robert Hills collected pollen samples

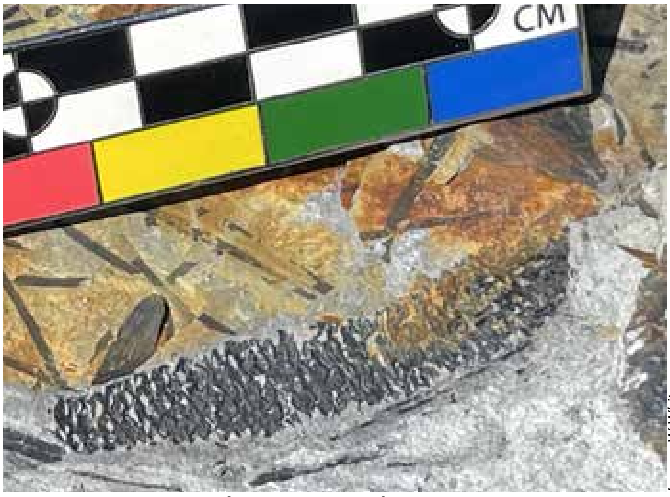

Image: W White

An Araucarian cone from Twin Reefs

from Devils Kitchen, Arnold Dix some samples from Eagles Nest, Mark Nan Tie and Andrew Constantine collected some samples from the Gippsland Basin sites, Ross Brown collected and examined some samples from Dinosaur Cove, Katherine Charlton collected and examined samples from Black Head and Doris Seegets-Villiers collected and examined a large sample set from the Caves/Dinosaur Dreaming Fossil Site/Flat Rocks area. Some early microscope work (pre-1992) was also undertaken by Jennifer McEwen Mason. We would particularly like to thank Mike Cleeland and Tom Rich for their major contributions to the fieldwork. David Cantrill, Pip Cleeland, Andrew Constantine, Stephen Gallagher, Gil Hollins, Jane Lindsay, Jennifer McEwen Mason, Martin Norvick, Alan Tait and Anne-Marie Tosolini also assisted with some of the fieldwork. We thank Parks Victoria and the local Rangers for several permits and access to these field areas.

Funding
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Image: W White

An Isoetalean from Twin Reefs. Scale in cm

Image: L Nink

New Dreamer

By Wendy White

Dinosaur Dreaming is pleased to welcome Owen Stratos Corcoran born Friday 1st August 2025. He might have cornered the market of dinosaur-themed presents for very small people — he has quite a collection already.

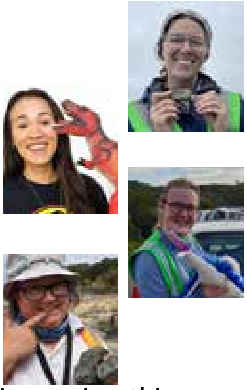
I guess Owen explains why Fotini Karakitsos has missed her first dig in years!

Monash University rules prohibit us actually putting Owen to work until he turns 18, so we have pencilled him in as a rookie on the 2044 dig.

Image supplied by F Korakitsos

Community Engagement

By Sally Hurst, Adele Pentland, Astrid O'Connor and Wendy White



In addition to many exciting fossil discoveries, this year's dig was rich in outreach, with a strong emphasis on sharing the science and stories of Victoria's Cretaceous past with the local community. From school visits to panel discussions (and the countless conversations with curious passersby), the dig team went above and beyond to engage members of the public.

Neighbours Day

On our first Sunday afternoon, we invited our neighbours round for a cuppa. The main objectives were to ensure that our neighbours felt special about having us there instead of just inconvenienced, and for us to feel more part of the Cape Paterson community. Marion Anderson did a letter box drop around Cape Paterson on the Friday before the dig started. Given the short notice, we were delighted to get 15 interested visitors. Lesley Kool set up a fossil table that was very popular. Most of the real fossils were turtles, but we had plenty of casts of dinosaur bones. Many visitors stayed for close to an hour. It was hot, so Alan Evered ran a refreshments table under a backyard tree, although many of the neighbours had brought a drink from their homes. Doreen, our landlord's mother, climbed over the back fence after delivering a chocolate strawberry cake (yum!).

Image supplied by S Hurst

Women in Palaeontology Panel

Women in Palaeontology Panel

To celebrate International Day of Women and Girls in STEM, we organised a powerhouse panel of international palaeontologists including Pat Vickers-Rich, Adele Pentland, Doris Seegets-Villiers, Alyssa Fjeld, and myself (Sally Hurst) as host. The event was held at the Inverloch Visitor Information Centre and live-streamed across social media, connecting to both local audiences, and to people across the globe! It was a fantastic discussion of pathways into palaeontology careers, our favourite fossils and places to dig, and advice for others looking to enter the field.
This event represented an opportunity to raise the visibility of women in Australian palaeontology – especially important for the Dinosaur Dreaming Crew since it has long been organised and led by a majority of incredible women over many decades. For many of us on the panel, we grew into our careers with a lack of female role models in science, and so it was an honour to be that role model for other young girls who may be looking at a career in palaeontology in the future. Scan the QR code for a link to the recording.

Image: A O'Connor

Image: J Kotevski

Image: A O'Connor

L-R: The Flyer for our Neighbours Day; Sally Hurst with Inverloch Primary School students; Astrid O'Connor at the Library

Inverloch Primary School

A highlight of the dig week for myself (Sally Hurst) and Jake Kotevski was being able to run fossil workshops for Year 3 and 4 students from Inverloch Primary School. Presenting to over 150 students over three sessions on one of the hottest days was no small feat, especially when it was Jake's very first time presenting this particular program, and speaking to this many kids! Focused around Fossil Features, the kids explored what features modern animals have to help them survive, and then applied this knowledge to the fossils — getting to handle museum replicas and real fossils from all over the world to talk about what features they had. From the flat teeth of a *Diprotodon*, or the coiled shell of an ammonite, to the ripping claws of a megaraptorid (Jake's favourite), the kids had a wonderful time, and we had excellent feedback from the accompanying teachers, with hopes to run similar workshops for next year's dig. At the end of the sessions, each student was able to take home a fossil fragment from past Dinosaur Dreaming digs – becoming the next [very excited] custodian of Victoria's fossil heritage.

Inverloch Community Hub

The dig also wrapped up its residency at the Inverloch Community Hub with an immersive outreach session. Surrounded by Zev Landes's life-size cut-outs of cartoon reconstructions of Victorian Cretaceous animals in their ancient environments, Doris and Mary led a rock-breaking demonstration, while John Edwards, Lisa Wilkins, Adam Dellal and Adele Pentland ran a show-and-tell session. Curious locals had the opportunity to get up close to replica fossils and hear about what makes the Bass Coast fossils important—not just for Victoria, but for Australia.

It was tough having to tell enthusiastic kids that they're still too young to join our digs, but I'm confident it won't be long before some of them are out there with us, hauling rocks up the cliff and making discoveries of their own.

Image: W White

Adam Dellal and Adele Pentland at the Inverloch Community Hub with a ceratopsian by Zev Landes

Image: W White

Doris Seegets-Villiers and Mary Walters on show at the Inverloch Community Hub

Inverloch Library

On the 19th of February, Astrid was delighted to give a short talk on the Dinosaur Dreaming team progress and the process of reconstructing extinct animals to a small audience at the Inverloch Library. Custom plush toy Polycotylid 'Penny' was very well received — as were the fossil specimens and the interactive animations of *Leaellynasaura* and the *Koolasuchus*-adjacent *Siderops*. The participants showed great excitement and interest but the relative lack of marketing for the event meant that very few people knew it was happening. Something to improve on for next year!

Phillip Island Village School

During the third week of the dig, we were visited onsite by the Phillip Island Village School as in, the entire school! Adele Pentland and Astrid O'Connor spoke to around 35 students from Prep to Grade 6 about what Victoria was like roughly 120 million years ago when dinosaurs roamed the ancient landscape. With help from "Penny the Polycotylid," a handmade plushie, the pair introduced students to deep time, dinosaurs and climate change, as well as the unique fossils uncovered at Twin Reefs.

Image: W White

Adele Pentland talks to the Phillip Island Village School

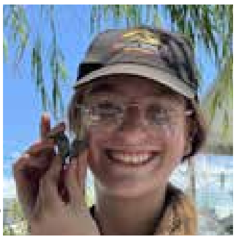


Image: W White

Backyard Fossil Hunting

By Marlonique Wolmarans

Is there something missing?

Image: Museums Victoria

By Tom Rich

If it can be said that there is an art to palaeontology, it is the intuitive grasp of the incompleteness of the fossil record. A collection of fossils is derived from a once existing community or possibly a remarkable diversity of communities of formerly living organisms. In order to attempt to reconstruct and interpret those assemblages realistically, the palaeontologist must always keep in mind what is not there.

Ornithopods are by far the most abundant elements of the dinosaur bones and teeth from the Victorian Early Cretaceous. Fossils of theropods, while present, are much less common. In stark contrast, the picture of presumably the same community or communities that emerges based on study of foot prints or ichnites, is the complete reverse. Anthony Martin suggested that, where the foot prints are so abundant, they occur in sediments laid down in overbank deposits formed when a stream or river floods, carrying clay and sand into the area adjacent to the main channel. This would have been an open area providing little protection from predation for the herbivorous ornithopods, a matter of less concern to the theropods. By contrast, the bones and teeth found in the palaeochannels where they accumulated as the flowing water picked them up in one place and carried them along to where they finally came to rest, favoured the presumably more numerous ornithopod bones and teeth in the source area. Recognising the difference in the way these two records came to be, which one, if either, more accurately reflects the living community or communities from which they were drawn?

Certainly, fossil foot prints cannot have been moved. While it is known for certain that a dinosaur stood at the very spot all those million years ago where a footprint occurs, one still does not know the structure of the entire community of which that dinosaur was a part, for the community may well have occurred in additional places besides a flood plain.

The majority of Victorian Early Cretaceous dinosaurs can be regarded as small and at most intermediate in size. This includes all the ornithopods, ankylosaurs, and the one ceratopsian. With one exception, this generalisation is true of the Victorian theropods, too. Both ichnites and a few isolated bones document the presence of either *Australovenator*, a theropod known from Queensland on the basis of much of the skeleton that was 5 to 6 metres in length with a hip height of about 1.9 metres, or a closely related form.

What seems to be missing in the Victorian dinosaur assemblage is the herbivorous prey taxa for a theropod of this size.

In all other extensive dinosaur assemblages, there are herbivores larger than the largest predators that could have preyed upon them. But in Victoria, the largest theropod was about ten times as massive as the largest ornithopod and equally larger than the ceratopsian. The size of the Victorian ankylosaur is not known.

The explanation for this is not the high palaeolatitude of Victoria in the Early Cretaceous. The Prince Creek Late Cretaceous dinosaur assemblage of northern Alaska not only has a pygmy tyrannosauroid as it large theropod, but in addition much even larger duck-billed dinosaurs (hadrosaurs) as well as a horned ceratopsian (the group to which *Triceratops* belongs). Located now in northern Alaska, during the Late Cretaceous, the Prince Creek Formation was even further north than it is today, then about 82^{o} North which meant it was about 10^{o} closer to the North Pole than Victoria was to the South Pole in the Early Cretaceous.

So if not high palaeolatitude accounting for what is missing, what was the limiting factor on the size of the potential items for the largest Victorian theropod to prey upon? Elsewhere, large herbivorous dinosaurs do occur before and during the Early Cretaceous. If the largest Victorian theropod evolved elsewhere in a "balanced" community with even larger herbivorous prey but only the large theropod was then able to reach Victoria because some obstacle acted as a filter preventing some members of that community from dispersing to Victoria, what was the filter owing to?

A plausible candidate region to fill these criteria is southwestern Queensland. There occurs not only *Australovenator* but also a number of large herbivores, four sauropods and *Muttaburrasaurus*, a large ornithopod. The filter that prevented the large herbivores from reaching Victoria could have been the widespread Eromanga Sea that occupied much of Queensland in the Early Cretaceous. There simply is no record of Queensland dinosaurs penecontemporaneous with the 10 million year older Victorian ones. But during that earlier time, Queensland may well have had a dinosaur community quite similar to the one that is known subsequently. Although limited in this way, this somewhat younger occurrence is the most plausible evidence available as an answer to "Is there something missing?"

Image: W White

Twin Reefs Dig Site: A Possible Crevasse Splay

By Alan Tait

In the 2024 field report, I mentioned that the Twin Reefs dig site was located on the inner margins of a large-scale fluvial pointbar or on the adjacent floodplain. It is extremely difficult to pick boundaries in such settings but, after the 2025 dig, I now think the dig site is in the basal part of a crevasse splay as discussed below.

The Lower Cretaceous sediments that we prospect and excavate in were deposited in a large-scale meandering river system. The meandering channel sandbody exposed at Twin Reefs has a basal sandy layer overlain by silty muds deposited in the channel during a partial abandonment (Fig. 1). Sand deposition then resumed in the channel as shown in the cliffs to the west of Twin Reefs. The mudstones were more easily eroded and thus form a rock platform while the sandstones resisted erosion and form the cliffs to the west. Various pointbar surfaces can be recognised in the abandonment mudstones indicating lateral accretion of the river channel towards the northwest (Fig. 1). The pointbar surfaces appear steeper than they actually are because the structural dip of the bedding results in a four times vertical exaggeration of sedimentary structures compared with true stratigraphic thickness. Overlying the pointbar surfaces are levee and overbank sediments with vague horizontal bedding made up from thin flood increments disturbed by bioturbation by plants and animals. However, within this interval, a zone of relatively well-bedded sediment stands out. Our dig site is in the base of the zone which appears to have been deposited as a crevasse splay (Fig. 1).

Image: A Tait

Figure 1. Aerial view of Twin Reefs meandering channel sandbody with location of dig site.

But what is a crevasse splay? In a fluvial environment, a crevasse is a break in a levee, and a levee is the raised ground either side of a meandering river where sediment first falls out of suspension during an overbank flood (Crevasse and levee are both French terms coming from the lower Mississippi river area where the French were early settlers.). Since the first sediment to fall out of suspension during an overbank flood is also the coarsest (usually fine

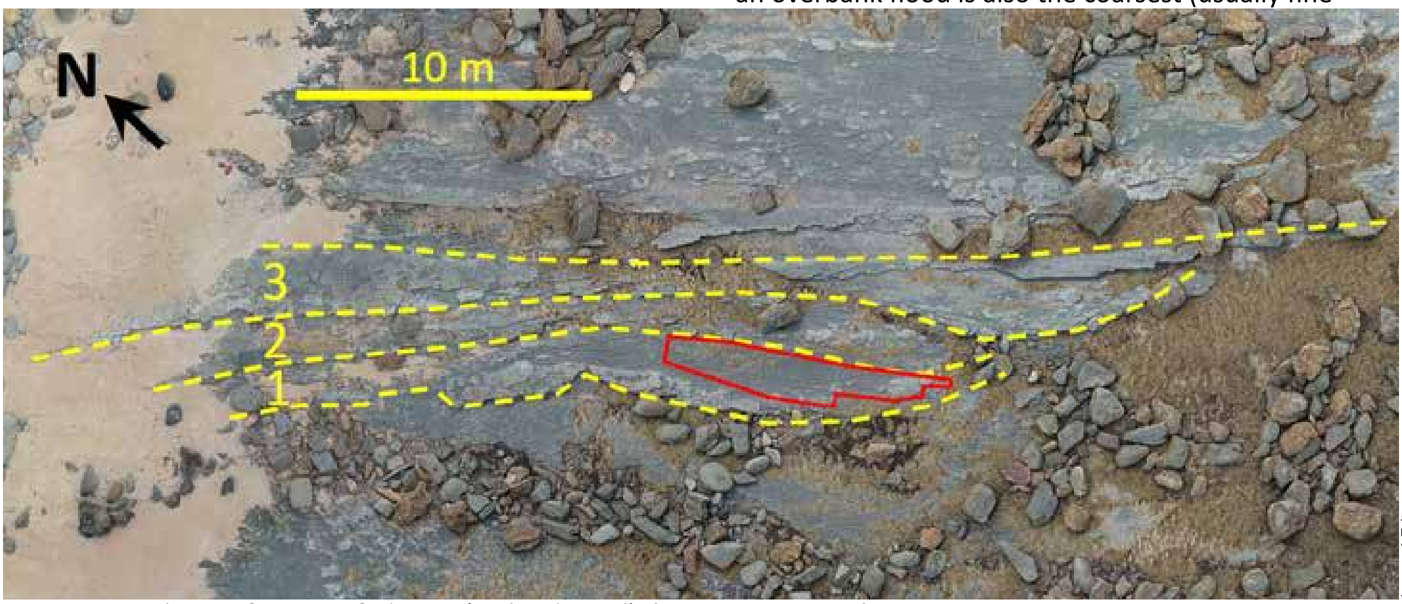


Image: A Tait

Figure 2. Aerial view of Twin Reefs dig site (outlined in red) showing crevasse splay units.

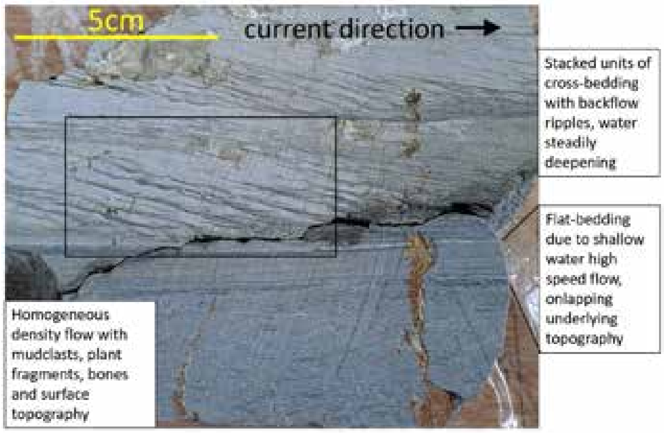


Figure 3. Sawcut section through part of dig site sediment. Inset is basis for figure 5.

sand), after repeated floods the levee becomes higher than the distal parts of the floodplain which receive only silt and clay. If, however, an overbank flood cuts a narrow channel (crevasse) through the levee, it may deposit a fan of sediment (crevasse splay) on the floodplain beyond the levee. A crevasse splay is thus a topographic feature which makes it difficult to recognise in cross-section as at Twin Reefs.

Back in the zone of relatively well-bedded sediment where our dig site is (Fig. 2), three spoon-shaped units can be outlined, overlapping towards the southeast, together recording the lateral migration and aggradation of a shallow channel within a sheetflood or on a crevasse splay. The stacking of the units suggests rapid deposition as the muddy water from the fast-flowing flooding river cut a crevasse channel through the levee and spread out on the floodplain, thereby losing competence and hence rapidly depositing sediment. As we excavate the units, we may be able to determine if the three are the product of one river flood or three separate floods. The units as shown on figure 2 appear thicker because of the exaggeration caused by the dip of the bedding but are each mostly less than 0.5 m in stratigraphic thickness.

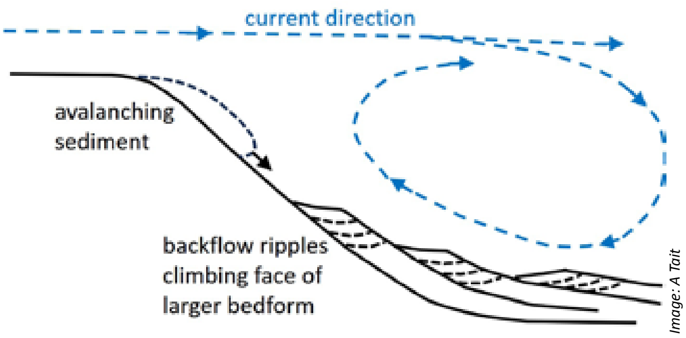


Figure 4. Diagrammatic explanation of formation of backflow cross-bedding.

Each of the units has a basal layer of cross-bedded sandstone but the overlying sediments include homogeneous density flows with mudclasts, flat-bedded layers and cross-bedded layers displaying backflow ripples (Fig. 3). Backflow ripples develop when a roll current forms in front of a migrating bedform (Fig. 4). The coarsest sediment (fine sand) avalanches down the face of the bedform but finer sediment is swept back up the face of the bedform to make backflow cross-bedding (Figs 4 and 5), the two effects alternating with the normal pulsing speed of the current. In figure 5, each avalanche of sediment seems to truncate a layer of backflow ripples, and there are intervals of contorted bedding caused by water escape from the rapidly deposited sediment. Some of the sedimentary structures may relate to changes in water depth over the bedforms as the overbank flood waxes and wanes but all seem to be related to rapid deposition of sediment.

Many of the larger plant fragments encountered during excavation were orientated between east-west and southeast-northwest, and ripples in the sandstone at the base of the dig appear to be climbing towards between west and northwest, so it seems that the currents depositing the dig sediments were flowing obliquely out of the excavation approximately towards the westnorthwest. Our intended excavation in 2026 will thus lead us obliquely upcurrent in this possible crevasse splay and hopefully extend the zones of high fossil bone concentration which we encountered in 2025.

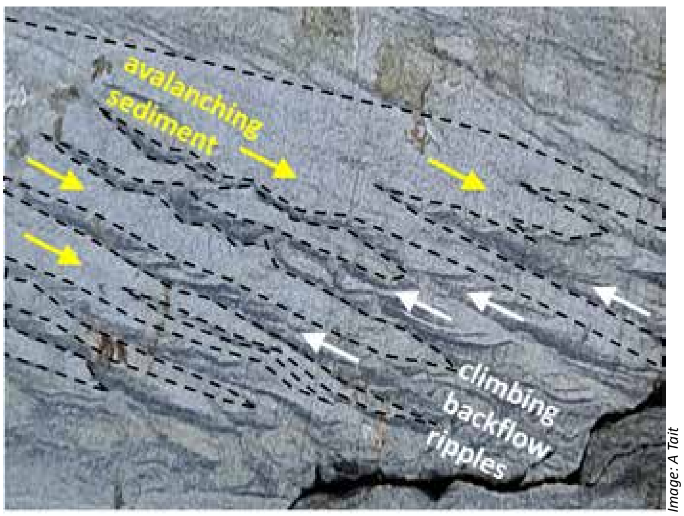


Figure 5. Inset from figure 3 decompacted (stretched to original thickness) to show avalanche and backflow bedding.


Image: L Nink

I Found a Fossil!

By Wendy White


Image: W White

Tom Lawler and Mary Walters


Image: W White

Adele Pentland


Image: W White

Annie Chisholm


Image: W White

Marlonique Wolmarans


Image: W White

Amber Craig


Image: W White

Mary Walters


Image: W White

Jack Biggs


Image: W White

Melissa Lowery


Image: W White

Caroline Ennis


Image: W White

Prahaladh Reddy


Image: W White

Corrie Williams


Image: W White

Peter Swinkels


Image: W White

Astrid O'Connor


Image: W White

Adam Dellal


Image: W White

Alan Evered


Image: W White
Doris Seegets-Villiers and Adam Hopkins


Image: W White
Adam Dellal


Image: W White
Sachi Kerr


Image: W White
Adam Hopkins


Image: W White
Alan Tait


Image: W White
Corrie Williams


Image: W White
Doris Seegets-Villiers


Image: W White
Sally Hurst


Image: W White
Geordie Ball


Image: W White
Alyssa Fjeld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Jörg Kluth


Image: W White
Prahaladh Reddy


Image: C Williams
Wendy White


Image: W White
Tom Lawler


Image: W White
Astrid Werner


Image: W White
Astrid O'Connor and Amber Craig


Image supplied by V Vajda

Ancient Life in the Koonwarra Fossil Beds

By Vivi Vajda

In our recent work, published in the journal Review of Palaeobotany and Palynology (Vajda et al. 2025) we have been exploring one of the most extraordinary fossil sites in Australia, the Koonwarra Fossil Bed in Victoria. This site has long fascinated scientists because it captures, in remarkable detail, the life that thrived in a polar ecosystem during the Early Cretaceous. Thanks to the long-term research efforts of the scientists Tom Rich and Patricia Vickers-Rich and other colleagues including John Talent, Mary Dettmann, Peter Jell, Andrew Drinnan, amongst others, the astonishing diversity of life represented in the fossil assemblages have been revealed. The successions hide shoals of small fish, beetles and dragonflies, ginkgo forests, delicate early flowers (angiosperms). Feathers, preserved with microscopic details of their structure, remain among the most thrilling clues of ancient bird and dinosaur life in the Southern Hemisphere.

Until recently, however, two crucial questions remained unresolved: exactly how old are these deposits, and what was the composition of the vegetation that surrounded this ancient lake? To answer this, we combined two powerful tools: zircon dating, which gives us precise ages from tiny crystals in volcanic ash layers, and palynology (the study of fossil pollen and spores). Together, these approaches have given us a new timeline and a much clearer picture of the ecosystems that supported life in this polar landscape.


Image: M Rothman with scientific guidance by S McLoughlin and V Vajda

Photograph of fossil angiosperm from the Koonwarra locality (left) accompanied by an illustrated reconstruction depicting its probable appearance (right). The plant was possibly similar to, and related to extant Chloranthaceae. *Scale bar 1 cm.*

Dating an Ancient Lake

To pin down the age of the Koonwarra Fossil Bed, we turned to uranium-lead dating with help from Dr. Ian Duddy. From a drill core that cut directly through the fossil-bearing layers, we recovered zircons. These tiny crystals form during volcanic eruptions and act like natural clocks, recording radioactive decay where uranium isotopes turn into stable lead isotopes. The ratio between these isotopes can be measured with great precision. The results showed a maximum age of around 114 million years, with some younger grains dating to about 110 million years, revealing that the Koonwarra Fossil Bed belongs to the early Albian stage of the Early Cretaceous. This age is slightly younger than previously assumed but accords well with the new pollen and spore assemblages that we recovered from the drill core.

Reading the Ancient Pollen Rain

While zircons gave us the age, fossil pollen and spores revealed the composition of the vegetation — that is, the types of plants that surrounded the ancient lake and in which portions the different plant groups occurred. In total, we identified more than 33,000 individual pollen grains and spores from the drill core, representing 138 different species. Based on the thorough palynological analysis, we can say that the vegetation was dominated by gymnosperms, cone-bearing plants, such as relatives of today's Araucaria (Norfolk pines), podocarps, and ginkgos. These formed tall canopies and mid-level trees. Beneath them grew bushy seed-ferns and bennettitales, along with carpets of ferns, lycophytes, and numerous mosses. Interestingly, lycophytes, relatives of modern club mosses, were especially diverse and abundant, making up as much as 17% of the assemblage.

Flowering plants, or angiosperms, were only just beginning to establish themselves. Their pollen makes up less than 1% in the lower parts of the core, but toward the upper levels we saw a gradual increase to about

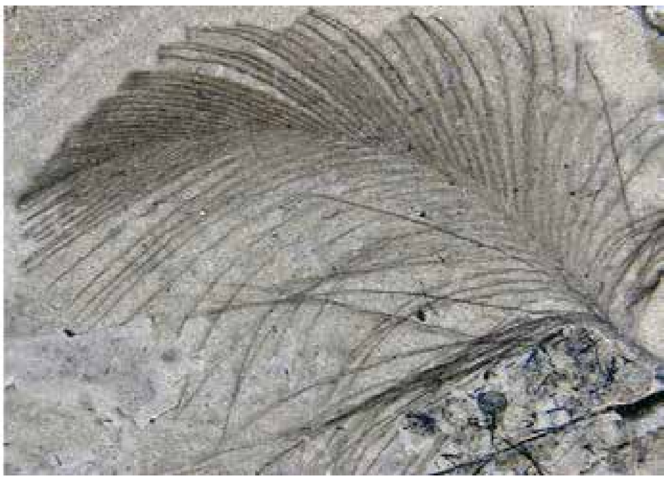
Image: Kundrát et al, doi: 10.1016/j.gr.2019.10.004.

Koonwarra Feather

Image: S Poropat

Koonwarra Fish

6%. This pattern suggests that early flowering plants were starting to expand their foothold in polar regions, possibly including aquatic species that grew in or near the lake.

Life in and around a Polar Lake

What kind of environment do these plants reflect? The palynology suggests a stable and diverse forest ecosystem, thriving in a cool, humid climate with pronounced seasons. Some early interpretations proposed that the lake froze over in winter, suffocating fish and invertebrates during so-called "winterkills". Others argued for a rain-fed, swampy system. Our findings point to a lake that was periodically low in oxygen, helping explain the exceptional fossil preservation: with little decay and no burrowing organisms disturbing the sediments, delicate structures, such as feathers and insect wings could survive for millions of years.

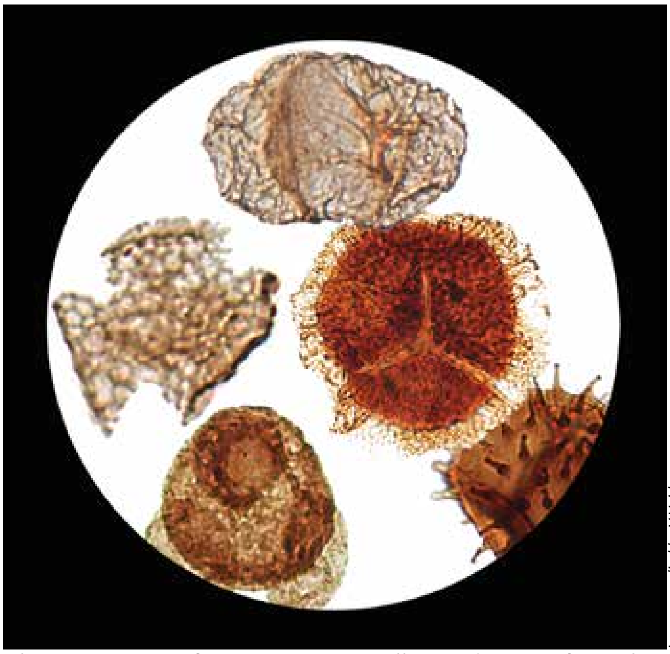

Image supplied by V Vajda

Photo montage of representative pollen and spores from the Koonwarra beds

Chemical evidence also supports this view, showing signs of anoxic conditions and the absence of carbonate shells, which would normally form in more oxygen-rich water. Yet, despite these challenging conditions, the ecosystem remained healthy, with no signs of algal blooms or ecosystem collapse.

A Window into Early Polar Life

By combining precise zircon dating with detailed pollen analysis, we can now say with confidence that the Koonwarra Fossil Bed dates to the early Albian, about 110 million years ago. This places it alongside other world-famous Early Cretaceous Lagerstätten and allows us to compare its fossils within a global framework.

Equally important, the pollen record paints a vivid picture of a polar forest dominated by conifers, ferns, and seed-ferns, but beginning to feel the expansion of flowering plants. These findings remind us that evolutionary revolutions, like the rise of angiosperms, did not happen overnight but unfolded gradually, even at the Earth's cold southern fringes.

Koonwarra continues to astonish us. Its fossils tell stories of dinosaurs and birds that left their feathers in the mud, of early flowering plants tentatively pushing into new environments, and of a lake that became a natural time capsule. As we refine its age and unravel its ecosystems, we gain not only a clearer view of life in ancient Gondwana but also a deeper appreciation of how global change has shaped the history of life on Earth.

Image: M Rothman

Legend for front cover Koonwarra Paleohabitat:
1. Leaellynasaura amicagraphica*; 2.* Araucaria *sp;*
3. Wollemia*-like conifer;*
3A. Wollemia*-like conifer (male cone);*
4. Koonwarra angiosperm (in damp soil);
5. Cladophlebis *sp; 6.* Taeniopteris *sp;*
7. Muttaburrasaurus*; 8.* Teinolophos trusleri
9. Remnant snow on higher elevation
10. Edge of stream (small waterfall)

Image supplied by A Romilio

First Tracks, Second Chances

By Anthony Romilio

In 1989, Helmut Tracksdorf discovered a set of intriguing dinosaur footprints on a rocky shoreline near Skenes Creek. Two of these tracks were later cut out and sent to Museums Victoria, while the others—along with their original positions—faded into mystery. Fast forward more than three decades, and our team, with Helmut as a coauthor, has finally pieced the puzzle together. It turns out, those prints were part of a trackway—Victoria's first dinosaur trackway identified by Western scientists.

Using digital reconstruction techniques and old photos taken at the time of discovery, we were able to return the removed footprints to their original positions in the rock. This let us analyse the trackway properly for the first time. What we found was a small ornithopod dinosaur, running westward across a river-influenced floodplain about 110 million years ago. While the prints had been attributed to "Skenes Creek," our work shows they're actually from Browns Creek, about 2 km east—and that's a significant distinction. It also means this was Victoria's first scientifically recognised dinosaur trackway, predating others by more than 30 years.

But the story doesn't stop there. About 220 metres from the original site, we uncovered a completely new surface bearing 13 additional dinosaur tracks, spread across three groups. These included both small and

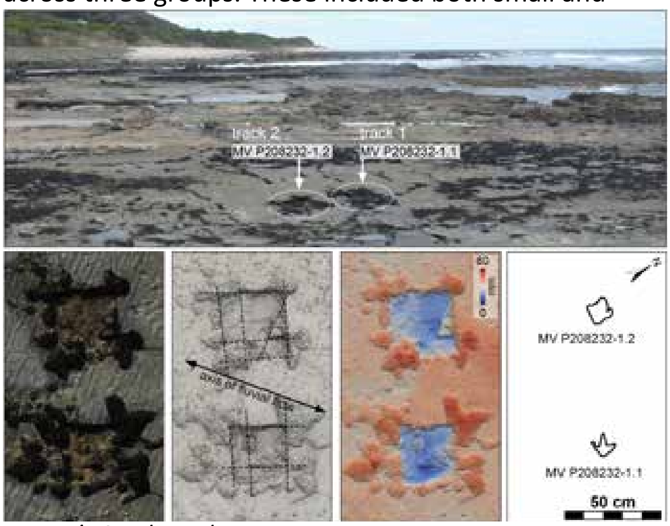

Image supplied by A Romilio

Brown's Creek trackway

Image supplied by A Romiio

Brown's Creek track and theropod trackmakers

large tridactyl (three-toed) impressions, likely made by different dinosaurs—some ornithopods, and others possibly theropods. Though weathered by waves and time, these footprints still tell us something remarkable: multiple dinosaurs were moving across this same ancient surface.

Both discoveries come from the Eumeralla Formation, a geological treasure trove along the Otway Coast that's been revealing glimpses of Australia's polar dinosaur life for decades. With erosion slowly unveiling more of the shore platform, there may be even more hidden footprints waiting to be found.

What began with Helmut's careful discovery and the removal of two promising footprints in 1989 has, decades later, become a story of rediscovery—and new discovery. Our re-evaluation at Browns Creek doesn't just correct the scientific record; it highlights how patience, technology, and a good dose of curiosity can breathe new life into old finds.

Image supplied by A Romilio

Ornithopod trackmaker.

Image supplied by M Cleeland

Prospecting Report

By Mike Cleeland

The last year has resulted in numerous discoveries, perhaps the highlight which has been Tim Wagstaff passing the mark of 4,000 footprints along the Otway coastline. Most of these have been in the areas of Brown's Creek and Milanesia Beach but Tim seems to find footprints pretty much wherever he looks, including over 30 at Dinosaur Cove.

Meanwhile on the Bass Coast, Melissa Lowery has again been active, finding numerous bones mostly in the Inverloch area but also Cape Paterson and other locations. Highlights include an ornithopod mandible exposed in oblique section at Ankylosaur Point and a tiny footprint only 15 mm long, the smallest ichnite she has ever found.

Further west, Inverloch resident Lauren Kelly found an interesting looking chevron at Andrew's Beach east of The Punchbowl, which is yet to be collected at the time of writing.

Andrew Ruffin continues to be active around the San Remo area and found a small number of bones there including two well exposed centra.

Earlier this year I took up a position as a voluntary tour guide at the State Coal Mine in Wonthaggi, and am hopeful that the first vertebrate fossils will eventually be identified in the several exposed conglomerate layers underground.

There has been something of a winter hiatus but we look forward to an active summer season of discovery as erosion continues to expose new bones at the surface.

Image: Z Landes

Image supplied by J Kotevski

Victorian Megaraptors

By Jake Kotevski

Whether 2025 was your first — or merely your latest — dig with Dinosaur Dreaming, I'm certain you've heard a few names of Mesozoic groups. Perhaps an ornithopod, our abundant bipedal herbivores; maybe temnospondyl, the group to which our state fossil emblem *Koolasuchus* belongs. But if you're anything like me there is one that stands out. A name heard all along eastern Australia. The name of our ancient apex predators – *Megaraptor*.

Throughout my life, I've been fascinated with non-avian Theropoda, the group that includes all strictly carnivorous dinosaurs. For most of that time I'd been captivated by the giants: animals like *Tyrannosaurus rex*, *Giganotosaurus carolinii* and *Spinosaurus aegyptiacus*, the largest terrestrial predators ever known. Animals exceeding 12 metres in length, and multi-ton in weight; something that is apparently absent from the Australian Cretaceous.

What I never thought would pique my interest is the intermediate predators. Those of a lighter build, with weapons on their limbs rather than big teeth. But through fortune and chance, these are apparently the apex predators of Cretaceous Australia, and the group that has become the core focus of my research; the Megaraptoridae.

The story of megaraptorids is relatively young in the span of dinosaur palaeontology: the eponymous *Megaraptor namunhuaiquii* was only discovered just before the turn of the century (Novas, 1998); recognition of a distinct lineage of theropods termed Megaraptora was only fifteen years ago (Benson et al., 2010); and the recognition a lineage therein unique to the Southern Hemisphere — our Megaraptoridae — only shortly after that (Novas et al., 2013). In the Southern Hemisphere, they are presently only known from two continents: South America (where they grew to large size during the Late Cretaceous), and our very own Land Down Under.

There are six Cretaceous-aged deposits where non-avian theropods are found in Australia, and four of them (probably five) yield megaraptorids geologically older than their South American cousins. Australia's most complete and best understood theropod — *Australovenator wintonensis*, from the Winton Formation of Queensland — is an undoubted megaraptorid, and demonstrates some of the key features of the group: proportionally small teeth, enlarged forelimbs, and wicked sickle-like claws (Hocknull et al., 2009). Indeed, megaraptorids are so far the only theropod body fossils found in the Winton Formation (White et al., 2020). The next best is the informally named 'Lightning Claw' from the Griman Creek Formation of New South Wales (Bell et al., 2016), often in contention as one of Australia's largest known theropods. Lightning Claw is joined by *Rapator ornitholestoides*, one of the first theropods named from Australia, and also recently recognised as a megaraptorid (White et al., 2013); as well as other isolated remains.

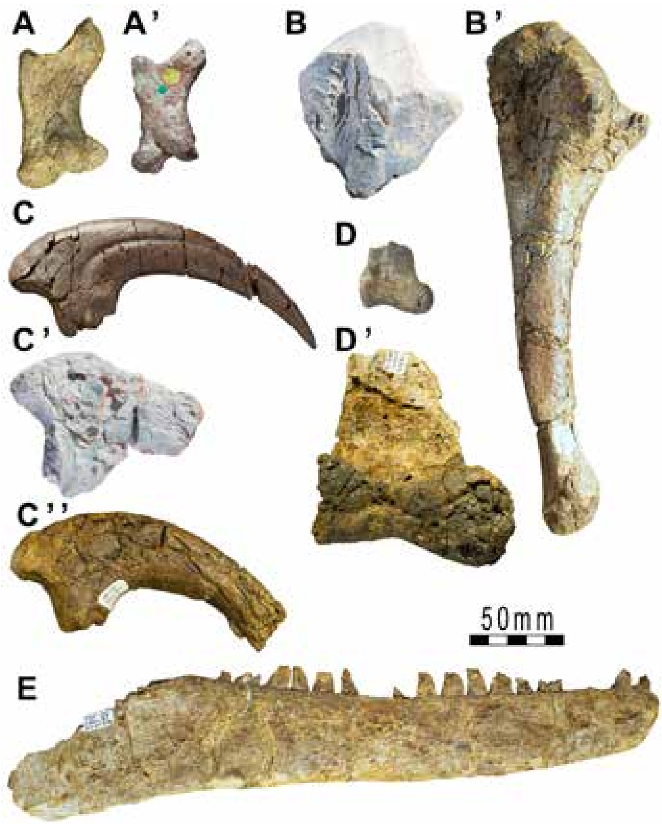

Image: J Kotevski (A, B', C', C'', D' & E) and S Poropat (A', C & D)

Figure 1: Select body fossils of Megaraptoridae from the Cretaceous of Australia. Metacarpal I in dorsal view of A, Australovenator wintonensis *(AODF 604) [right] and A',* Rapator ornitholestoides *(NHMUK R3718) [left, mirrored]; ulnae in lateral view of B, LRF 100-106 [right] and B',* Australovenator wintonensis *[right]; manual ungual I-2 in lateral view of C, NMV P239464 [right], C, LRF 100-106 [left, mirrored] and C'',* Australovenator wintonensis *[right]; astragali in anterior view of D, NMV P253701 [right] and D',* Australovenator wintonensis *[right]; and E, right dentary of* Australovenator wintonensis *in lateral view.*

I hold the last two nearest to my heart for several reasons: they're in our own backyard, down here in Victoria; most of the team reading this have at least visited or dug in one or both deposits; and, they are home to the first geological appearance of the Megaraptoridae in the history of life (Poropat et al., 2019, Kotevski et al., 2024). Megaraptorids on the Otway coast — that is, the Eumeralla Formation — were first hinted at by Smith et al. (2008), who favourably compared an ulna (forearm bone) to that of *Megaraptor*. But the real kicker graces the cover of both the 2014 and 2016 Field Report: John Wilkin's Otway Claw (Poropat et al., 2019), described and referred to Megaraptoridae by my PhD supervisor, friend and mentor, Steve Poropat. Also included in that work were isolated teeth, a smaller claw (from the third digit of the hand) and an astragalus (ankle bone) — all of which compared favourably with *Australovenator*. As Steve so eloquently put it to me the other night: "You could throw a blanket over *Australovenator* and the Otway megaraptorids, they're very similar."

The Otway coast is our younger deposit, of around 113–108 million years of age (Wagstaff et al., 2020). The older deposit is where we currently dig: the upper Strzelecki Group of the Bass Coast, around 121.4–118 million years age (Wagstaff et al., 2020). We've now found megaraptorids from four localities: The Punchbowl, where the bottom half of a large claw was found; Flat Rocks, where just about every theropod tooth is a megaraptorid; Shack Bay, where in 2007 Mike Cleeland found what was to be the first described upper skull bone of an Australian theropod; and most recently, our current site of Twin Reefs, where Melissa Lowery found the bottom of a tibia (leg bone) and two tail vertebrae with chevrons of one of Australia's largest known theropods, which we described this year (Kotevski et al., 2025). Importantly, these bones weren't found in the shore platform; rather, they came out of boulders at the base of the cliff. I wouldn't be surprised if we keep finding more megaraptorids on either coast.

Let's zoom back out and look at the bigger picture, and why I've given you all this information. Something quite interesting about our megaraptorids is that they're all very similar: small, partially serrated teeth are known from all four Australian deposits they show up in; that distinctive forearm claw with asymmetric vascular grooves have been seen in the Otways, the Griman Creek, and Winton. The Bass coast tibia is a slightly thicker version of that of *Australovenator*, but almost a mirror image; the Cape Paterson claw, too, is very similar (albeit much bigger than) the claw of *Australovenator*'s second finger. Whatever megaraptorids were doing in Australia, they were doing it well — so well in fact, that their skeletal morphology seems to be very conservative throughout the 30-million-year window we can glimpse. The same can be said in South America, where they retain most features but enhance a few; in particular, that killer claw becomes so much larger.

The story of megaraptorids improves every day — we're still unsure what a complete megaraptorid looks like! But exploration of their first geologic appearance down here in Victoria will undoubtedly yield important results, with the right patience and care. It's a privilege to work on the frontier of a relatively unknown group of dinosaurs, and I am confident that Cretaceous Victoria will unlock more secrets of the early evolution of this group. Back in 2022, I loathed the fact that almost all we found were megaraptorids. Today, I can't get enough, and I am champing at the bit for a chance to find more. I've got a gut feeling that the Twin Reefs cliff face holds more secrets yet…

Image: S Hurst

Figure 2: Jake Kotevski prospecting the boulders at Twin Reefs during the 2025 field season.

Prospecting as observed by Zev Landes

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Theropods at Twin Reefs imagined by Zev Landes

Image: W White

Rookie Persepective

By Jack Biggs

A week on site with Dinosaur Dreaming is a bit like being struck by lightning.

A rookie's lot is to come with no idea of where you fit amongst this distinguished crowd, then to puzzle it out with your fellow first-timers — sometimes quite literally. Inevitably, we will have forgotten enough cold weather gear (it's summer), accidentally brought a picnic blanket instead of a sleeping bag, and still somehow overpacked (or was that just me?).

Just as in the shoreline we've come to delve into, everywhere in the dig house you'll find an interesting story. It's relentlessly friendly here; full of the down-to-earth, the bone-a-fide, and the sedimental. It's Wendy the Wise presiding over the shore with buckets, pens, and film canisters waiting for the incredibly delicate and delicately incredible. It's Lesley at her microscope with turtle tails and dino tales. It's Corrie, queen of the verts; and world-renowned fashionista Mary. It's Nick with the rock-saw and John W's magnificent drainage canals. It's Marion's marvellous photogrammetry and it's Doris documenting animal, vegetable, mineral. It's John S, storyteller and safari guide. It's Alan T incandescent with sedimentary glee, and Alan E the master of tiny teeth.

Jack's picture of the Victorian Cretaceous (spot the Koolasuchus*!)*

As the sun goes down, it's Pat and Tom Rich holding court on this polar landscape, and Mike advising me about the toes of *Koolasuchus cleelandi*.

It's Gerry Kool, a load-bearing pillar of this tidal community.

It's my fellow rookies, each a world of curiosity in an electrified shell. And of course it's Mullet and Mags, our breakfast-lunch-and-dinner guests, strutting their stuff as dinosaurs of today.

Together, we split rocks, duties, and bread. Through layers of plants, stone, teeth and bone, we travelled back. We were new arrivals to this planet — spongebobs and searchers. As time wore on, we learned to go with the flow of electricity through this river of stone. The lightning, no longer singeing but now singing in our bones, scorched right through to our boots.

I think I'll be chasing these sparks forever.

Cretaceous Vertebrate Localities in Gippsland

By Lesley Kool and Melissa Lowery

Key:

■ *fossil from locality identified;*

□ *fossil from locality tentatively identified*

TAXA	San Remo Back Beach	Potters Hill	Rowell's Beach	Skull Cove	Punch Bowl	The Haybaler	Andrew's Beach	Orbital site	Tree Trunk Point	The Arch	Black Head	Kilcunda	Powlett River	Harmer's Haven	Wreck Beach	F Break	Cape Paterson	The Oaks	Twin Reefs	Shack Bay	Lesley's Lair	Tom's Layer	Ferguson's Layer	Eagles Nest	Halfway Headland	The Honey Locality	The Caves	Flat Rocks	Swim O'Clock Rock	Ankylosaur Point	Noddyland	RACV Point	Mary Anning	Kirrak	Melissa's Mine	Bena	Koonwarra
Mammalia:																																					
Australosphenidae (Unidentified)																												■					■				
Ausktribosphenos nyktos																												■									
Ausktribosphenos sp.																										■		■									
Bishops whitmorei																												■									
Kryoparvus gerritti																												■									
Monotremata (Unidentified)																												■									
Teinolophos trusleri																												■									
Multituberculata (Unidentified)																																					
Corriebaatar marywaltersae																												■									
Dinosauria:																																					
Dinosauria (Unidentified)	■	■	■		■			■	■	■	■	■	■	■	■	■		■		■	■	■	■	■	■	■	■	■	■	■	■		■		■	■	
Ornithopoda (Unidentified)	■	■			■					■	■	■	■	■	■			■	■	■		■	■	■		■	■	■	■	■	■	■	■				
Fulgurotherium cf.										■														■													
Galleonosaurus dorisae																						□					■	■		■							
Qantassaurus intrepidus																												■									
Ankylosauria										■				■														■		■			■				
Neoceratopsidae (Unidentified)																																					
Serendipaceratops arthurcclarkei										■																											
Theropoda (Unidentified)	■				■					■	■	■	■						■	■	□			■	■			■									■
Noasauridae	■																																				
Carcharodontosauria																								■													
Tyrannosauroidea												■												■													
Megaraptora										■													■	■				■									
Megaraptoridae					■														■	■								■									
Unenlagiinae																					■																
Aves (birds+B28:AF39)																												■									■
Other Vertebrates:																																					
Plesiosauria (aquatic reptiles)	■		■										■										□	■				■					■				
Pterosauria (flying reptiles)																						□		■	□			■			■						
Testudines (turtles)											■		■				■		■		■	■		■	■	■	■	■	■		■	■	■		■	■	
Temnospondyli (amphibians)	■	■	■	■	■	■	■	■	■							■	■																				
Koolasuchus cleelandi	■	■	■		■																																
Dipnoi (lungfish)	■				■							■	■							■			■	■	■			■		■	■			■			■
Neoceratodus nargun					■																			■				■									
Archaeoceratodus avus																								■													
Actinopterygii (ray finned fish)										■	■		■									■	■	■	■		■	■	■	■	■		■	■		■	■
Coccolepis' woodwardi																																					■
Koonwarria manifrons																																					■
Psilichthys sp.																																					■
Wadeichthys oxyops																																					■
Waldmanichthys koonwarri																																					■
Trace Fossils:																																					
Dinosaur footprints																			■					■		■		■	■			■					

Maps: Google Earth
Data: SIO, NOAA, US Navy, NGA, GEBCO, Landsat / Copernicus, CNES / Airbus, Terrametrics

Image supplied by A Pentland

Seeing Through Stone

By Adele Pentland

It sounds like something straight out of a science fiction movie: a donut-shaped building that accelerates particles at high speeds to generate powerful x-rays capable of seeing through solid stone. Alongside its interstate cousin — a 20-megawatt, multi-purpose nuclear reactor, which just so happens to be Australia's only nuclear facility. However, these high-tech facilities operated by ANSTO (the Australian Nuclear Science and Technology Organisation) are very real, and revolutionising palaeontological research (with nary a radioactive spider in sight!).

The "donut" in question — the Australian Synchrotron — is just across the road from Monash University in Clayton, while its nuclear counterpart, the OPAL reactor, is situated in Sydney's south. Sadly, and perhaps unsurprisingly, these enormous scanners aren't portable and can't be used to scope out the potential of new fossil dig sites. Thankfully, Dinosaur Dreaming has no shortage of sites, thanks to the hawk-eyed Melissa Lowery who can spot fossils in the blink of an eye.

While ground-penetrating radar can't detect the subtle variations in density between fossilised bone and the surrounding rock in the field, those differences become crystal clear at the Synchrotron. It's especially useful when working with small delicate bones, or fossils still partially embedded in rock.

Only a handful of synchrotrons operate around the world. They run 24/7, with expert technicians on site and working remotely to help scientists with every

Image: Poropat et al. 2020 Figs. 2 and 3

NMV P252004 Ventral surface after digital removal of matrix

single experiment. Technically, "beamtime" is free to successful applicants, but using these facilities and round the clock access to highly-trained experts is an expensive operation. In reality, in-kind grant are worth tens of thousands of dollars, depending on the amount of time allocated for each experiment.

Fossils are sent from all corners of the globe, travelling through post, or carried in hand luggage chaperoned by researchers from various disciplines. As you can imagine, airport security is a little curious when a partial dinosaur skull passes through the scanner. But, speaking from personal experience, they've always been quite lovely and understanding about the whole thing. Although, some are rather reluctant to move on to the next passenger, because they're so interested and have so many burning questions!

Different beamlines serve different purposes, but in palaeontology, the Imaging and Medical Beamline (IMBL) or micro-CT scanners are most commonly used. Whichever beamline you use, if you're scanning fossils, you're almost guaranteed to bump into instrument scientist Dr Joseph Bevitt. Joseph first started scanning fossils after a chance meeting with Ben Galea, a bright-eyed and intelligent lad at a youth leadership summit, who also happened to be working as a tour guide at the Australian Age of Dinosaurs Museum of Natural History.

Image: A Pentland

Dr Andrew Stevenson (Lead Scientist for the Micro-Computed Tomography (MCT) beamline) with Natasha Sciortino (University of Sydney) at the Australian Synchrotron

This led Joseph to connect with David Elliott, the co-founder of the museum... and the rest, as they say, is history.

Several scientifically significant Dinosaur Dreaming fossils have been scanned at the Synchrotron, including several tiny jaws of Cretaceous mammals. These high-resolution scans capture the intricate 3D morphology of tiny teeth with micron-level precision. These scans can then be blown up, 3D printed and digitally sent to colleagues across the world, fast-tracking international collaborations.

These scans can also be used to digitally prepare bones from the rock, as was the case for the elaphrosaurine vertebra discovered by Jessica Parker at Eric the Red West in 2015, later described by Poropat et al. (2020). This allowed the team to see the underside (or ventral surface) of the vertebra, and a characteristic "keel", one of its diagnostic features. This also allowed us to see the 'pneumaticity' or air sacs inside the bone. Thanks to modern imaging techniques, it's not necessary to physically cut through specimens to see these structures — a far cry from the methods used in the early days of palaeontology!

In special cases — like Noddy, the beautifully articulated ornithopod specimen — synchrotron scans can help guide the process of physical preparation.

Scanning fossils is no small feat. Every second counts, so we try to cram in as many fossils as humanly possible into a single session. It's a team effort: students and researchers fuelled by coffee and curiosity, racing against the clock to set up samples, and collect as much data as possible. There aren't many things I'd get up at 4 am for — but helping uncover Australia's prehistoric past? Always worth it.

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Image: W White

Local Rookie Perspective

By Annie Chisholm

Dinosaur Dreaming was something I'd heard about in the early '90's. I went on a field trip and was gobsmacked to see someone (probably Mike Cleeland!) wielding a massive saw chopping up rocks. Volunteers from all over the world were busily bucketing sand and water out of pools. It was all very exciting.

I took my Year 9 science classes from Wonthaggi Secondary College along and was careful to **not** build their hopes up too high. A couple of students found bone, so all was well.

I went to the Russian dino exhibition in Melbourne, which was amazing.

And then, at choir, Mike invited me to come along with him and Melissa to dig out bone and round off holes. I was hooked! Lesley allowed me to play with some of her prep tools. Further hooked. Then the chance to do a week of DD — I was caught hook line and sinker!!

The atmosphere at the Dig house reminded me of uni field trips back in the day. People were friendly, fun and cooperative. When the tide was high, we chipped away at rocks in the backyard. When the tide was low, we were down at Twin Reefs like a well-oiled assembly line. People were excavating the hole into labelled buckets and others were going through the rock systematically, looking for fossils. Bones and turtle carapace were found and everyone was thrilled.

Feeding time at the Dig House was fun, and my hubby was welcomed. Important people like Pat and Tom Rich and Lesley and Gerry Kool mingled with everyone else. Nobody went hungry!! Individual food preferences were cheerfully catered for, and everyone enjoyed the meals.

I've got to say a huge thank you to the organisers. I'm already looking forward to the next DD season!

Image: W White

Crew working at Twin Reefs

Image: W White

Recipe for Dinosaur Themed Clothing

By Corrie Williams

Serving: 1. Prep time: 10 mins. Cooking time: 2-10 mins

Ingredients

1. Roll of printed decals
2. Items of clothing to receive the decal, cotton preferred
3. Scissors
4. Table and extension cord
5. Vevor Heat Press (borrowed from Zev Landes)
6. Baking paper

Method

1. On a clean surface, cut out decals from the roll. Ensure that the decals are cut out with at least a 5 mm margin around the image. This will allow easier peeling of the backing once the image is baked into place,

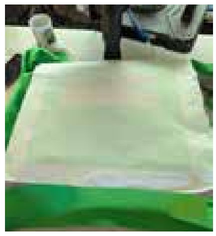
2. Set up a table on a stable area outside with good 1 m perimeter to ensure that hot decal setting machine does not burn bystanders. This will likely mean the use of an extension cord.

3. Place decal setting machine onto the table. Cut two pieces of baking paper slightly larger than the heat pads in the machine.

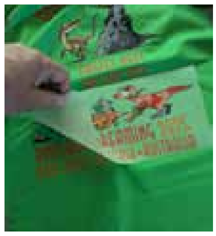
4. Turn on the machine and preheat it to 170, with a time of 20 seconds for synthetics and 30 seconds for cotton. The time will change depending on the type of material in the garment.

5. Lift the press lever handle, rotate the top heating plate assembly to one side. Place baking paper on base of heating pad, then place the clothing with the area the decal is to occupy in the middle of the plate. Add the decal image correct side up. Add the second piece of baking paper on top of the clothing and decal.

6. Carefully rotate the top assembly back around in line with the bottom plate and close the lever handle, making sure that the clothing/decal/ baking paper layers do not move. Press the red go button, preset to required time. Stand around and chat while the decal cooks.



7. Once the timer has counted down and it beeps, lift the lever, swing the top assembly to one side and remove the clothing. Allow clothing (with attached decal) to cool.



8. Once cool, carefully remove the clear backing film from the decal. If the backing film does not come off then “cook” the garment again and allow to cool again before removing the backing film.

9. Once the backing film is successfully removed, then put the clothing back into the press between the baking sheets and repeat the heating process.

10. Remove from the press and allow to cool. Your clothing is now ready to enjoy.

Image: W White

Seven Maids with Seven Mops

By Sharyn Madder

Image supplied by M Cleeland

The Very Model of a Modern Palaeontologist

By Mike Cleeland

... with apologies to WS Gilbert and Arthur Sullivan

I am the very model of a Modern Palaeontologist
I'm equal parts anatomist and fluvial petrologist
I know the fossil record and I quote successive stages
Such as Miocene and Pliocene and Pleistocene ice ages

I'm very well acquainted too with theropods and sauropods
I understand cladistics of Australian ornithopods
About our evolution I am teeming with a lot of news
About the many animals that went aboard the Ark in twos

I've found microinvertebrates in sediments quite talculous
I know the scientific names of fossils animalculous
In short as an invertebrate or vertebrate Phylogenist
I am the very model of the Modern Palaeontologist

I know our fossil history from Cambrian to Holocene
I've been on digs in Inverloch, Montana and the Evergreen
I quote, following Linnaeus, our own *Serendipaceratops*
And iron faced amphibians from Queensland such as *Siderops*

I can tell undoubted trilobites from graptolites or ammonites
I also can distinguish between stalactites and stalagmites
Then I can sing that song about the elements Tom Lehrer wrote
And rattle off all 92 that I have taught myself by rote

Then I can write a thesis about Palaeoecology
And tell you every detail of amphibian ichnology
In short as an invertebrate or vertebrate Phylogenist
I am the very model of a Modern Palaeontologist

In fact, when I know what is meant by contact metamorphism
When I can tell at sight a zeolite with pseudomorphism
When such affairs as igneous intrusions I'm more wary at
And when with preparation I've become much more prepary at

When I have learned what progress has been made in osteology
When I know fossil pollen like a Prof in Palynology
In short, though some geologists may be inclined to mock and laugh
You'll say no better Palaeo has ever split a rock in half!

For my scientific knowledge, though I'm plucky and adventurous
Has only been brought down from the Triassic/Carboniferous
In short as an invertebrate or vertebrate Phylogenist
I am the very model of a Modern Palaeontologist.

Astrid O'Connor

Jake Kotevski

Lisa Nink, Ruairidh Duncan

Adele Pentland

Ruairidh Duncan, Adele Pentland

Adele Pentland

Alyssa Fjeld, Ruairidh Duncan

Celebrating Modern Palaeontologists — Dinosaur Dreaming 2025 Palaeontology PhD Students

The Mammals of Victoria's Cretaceous

NMV Reg #	Taxonomy	Finder	Location / Field Catalog #	Date Found	Preparator	Notes
P208090	*Ausktribosphenos nyktos*	N. Barton	Flat Rocks #1111	1997	L. Kool	HOLOTYPE. Right. P6, M1-3
P208094	*Kryoryctes cadburyi*		Dinosaur Cove	1993	L. Kool	HOLOTYPE. Right humerus. Slippery Rock Pillar
P208228	*Bishops* sp.		Flat Rocks #329	1995	L. Kool	600my Exhibition display. Right. P4-M2
P208230	*Ausktribosphenos* ?		Flat Rocks	1995	L. Kool	Edentulous jaw fragment
P208231	*Teinolophos trusleri*		Flat Rocks	Nov. 1993	L. Kool	HOLOTYPE. M3 or M4. Mentor's trip
P208383	Monotremata		Dinosaur Cove	1993	L. Kool	Premolar. Slippery Rock Pillar
P208482	*Ausktribosphenos nyktos*	N. Gardiner	Flat Rocks #150	1999	L. Kool	Right. M2-3, badly crushed. From DD1998 rock
P208483	Ausktribosphenidae ?	N. van Klaveren	Flat Rocks #140	1999	L. Kool	Probably Left. x1 premolar & partial tooth
P208484	*Bishops whitmorei*	K. Bacheller	Flat Rocks #450	1999	L. Kool	Right. M2
P208526	*Teinolophos trusleri*		Flat Rocks #560	1994	L. Kool	Right. Edentulous
P208580	Mammalia	A. Maguire	Flat Rocks #200	2000	L. Kool	Jaw fragment. (unprepared)
P208582	Ausktribosphenidae	L. Irvine	Flat Rocks #500	2000	L. Kool	Right. M3
P209975	*Bishops whitmorei*	R. Close ?	Flat Rocks #387	2000	L. Kool	Right. Roots M1, worn M2. OK M3
P210030	*Teinolophos trusleri*			2000	L. Kool	Right. Edentulous
P210070	*Bishops whitmorei*		Flat Rocks	03 Dec 2000	L. Kool	Right. Badly broken M1, M2 and x6 Premolars. Rookies Day
P210075	*Bishops whitmorei*		Flat Rocks	03 Dec 2000	L. Kool	HOLOTYPE. 600my Exhibition display. Left. P2-6, M1-3. (P1 lost since initial preparation). Rookies Day
P210086	Ausktribosphenidae ?	J. Wilkins	Flat Rocks #250	2001	L. Kool	Right. Root fragment
P210087	*Kryoparvus gerritti*	G. Kool	Flat Rocks #620	2001	L. Kool	HOLOTYPE. Right. Rear half M1, M2-3
P212785	Mammalia	M. Anderson	Flat Rocks	03 Dec 2000	L. Kool	Fragment only. Rookies Day
P212810	*Bishops whitmorei*		Flat Rocks #300	2002	L. Kool	Left. M2-3
P212811	*Teinolophos trusleri*	D. Sanderson	Flat Rocks #187	2002	L. Kool	Right. Edentulous
P212925	Mammalia ?		Flat Rocks #222	1996	D. Pickering	Edentulous
P212933	*Teinolophos trusleri*		Flat Rocks #179	2001	L. Kool	Left. Edentulous. (Plus associated molar)
P212940	*Kryoparvus gerritti*	W. White	Flat Rocks #171	2003	D. Pickering	Referred specimen. Left. M1, M2-3
P212950	*Bishops whitmorei*	C. Ennis	Flat Rocks #292	2003	L. Kool	Left. P6, M1-3
P216575	*Teinolophos trusleri*	N. Gardiner	Flat Rocks #180	2004	D. Pickering	Left. x2 molars. Probably M2-3
P216576	Mammalia	A. Musser	Flat Rocks #500	2004	L. Kool	Isolated tooth
P216578	*Bishops whitmorei*	A. Leorke	Flat Rocks #600	2004	D. Pickering	Left. M1-3
P216579	*Teinolophos trusleri*	N.van Klaveren	Flat Rocks #635	2004	L. Kool	Edentulous jaw
P216580	*Bishops whitmorei*	G. Kool	Flat Rocks #800	2004	D. Pickering	Right. P6, M1-3
P216590	*Teinolophos trusleri*	J. Wilkins	Flat Rocks #447	2004	D. Pickering	Posterior part of right edentulous jaw
P216610	*Teinolophos trusleri*		Flat Rocks #557	2004	L. Kool	Left. Edentulous
P216655	*Corriebaatar marywaltersae*	M. Walters	Flat Rocks #142	2004	L. Kool	HOLOTYPE. Multituberculata. Left. P4
P216670	*Ausktribosphenos nyktos*		Flat Rocks #184	1999	L. Kool	Left. M2-3
P216680	*Teinolophos trusleri*	R. Long	Flat Rocks #132	2004	L. Kool	Right. Fragment
P216720	*Teinolophos trusleri*		Flat Rocks #648	2002	L. Kool	Right. Edentulous
P216750	*Teinolophos trusleri*	R. Long	Flat Rocks #162	2005	D. Pickering	Right. Edentulous
P221043	*Bishops whitmorei*	A. Leorke	Flat Rocks #100	2005	D. Pickering	Right. M1-2?
P221044	Ausktribosphenidae	C. Ennis	Flat Rocks #300	2005	D. Pickering	Left. M2
P221045	*Teinolophos trusleri*	J. Wilkins	Flat Rocks #395	2005	D. Pickering	Right. Edentulous
P221046	Mammalia	H. Wilson	Flat Rocks #480	2005	L. Kool	Isolated tooth
P221150	*Teinolophos trusleri*	J. Swinkels	Flat Rocks #340	2006	D. Pickering	600my Exhibition display. Right. x2 molars. Probably M2-3
P221156	Ausktribosphenidae	N. van Klaveren	Flat Rocks #360	2006	D. Pickering	Right. M2 (requires preparation to confirm)
P221157	*Bishops whitmorei*	M. Walters	Flat Rocks #585	2006	D. Pickering	Right. Edentulous with alveolae for P6, M1-3
P221158	*Bishops whitmorei*	R. Close	Flat Rocks #200	2006	D. Pickering	Right. P5-6, half M plus M2-3
P228432	Ausktribosphenidae		Flat Rocks	2009	L. Kool	Right. Molar talonid. From scrap rock
P228848	*Bishops* sp.	M. Walters	ETRW	10 Dec 2006	D. Pickering	Left. P6, M1, partial M2
P229037	*Teinolophos trusleri*	M. Cleeland	Flat Rocks #91	2008	D. Pickering	Right. Edentulous with alveolae for x4 molars and ultimate premolar
P229194	Mammalia	N. Barton	Flat Rocks #770	07 Mar 2007	D. Pickering	Isolated upper Premolar
P229408	*Teinolophos trusleri*	M. Walters	Flat Rocks #300	14 Feb 2008	D. Pickering	Left. Ultimate premolar, M1-4
P229409	Ausktribosphenidae	N. Evered	Flat Rocks #180	07 Feb 2007	D. Pickering	Possible new species. Left. P5-6, M1-3
P229410	*Teinolophos trusleri*	C. Ennis	Flat Rocks #90	2008	D. Pickering	Right. ?M1 plus M3
P229649	*Bishops whitmorei*	J. Tumney	Flat Rocks #330	2009	D. Pickering	Right. P2-3,5-6, M1-3
P231328	*Bishops* ?	A. Maguire	ETRW	29 Nov 2009	D. Pickering	Maxilla fragment with x2 molars
P232567	*Ausktribosphenos* sp.	M. Walters & J. Wilkins	Flat Rocks #270	26 Feb 2012	D. Pickering	Right. Broken premolars. M1-3
P232892	*Bishops* sp.	A. Werner	Flat Rocks	16 Feb 2013	D. Pickering	Left. ?M2
P252052	*Sundrius ziegleri*	T. Ziegler	ETRW #626	20 Feb 2015	D. Pickering	HOLOTYPE. Upper premolar
P252207	*Bishops* sp.	O. Campbell	ETRW #200	07 Feb 2015	D. Pickering	Posterior part of right mandible w x1 molar
P252730	*Corriebaatar marywaltersae*	W. White	Flat Rocks	11 Nov 2017	L. Kool	Refered specimen. Left. P4. Tragics Day.
P256479	Mammalia	M. Walters	Flat Rocks	15 Dec 2019	L. Kool	Fragment with single tooth. Tragics Day.
P257142	*Ausktribosphenos* sp.	M. Lowrey	Honey Locality	21 May 2021	L. Kool	Left. M2
P257716	Mammalia	M. Lowrey	E of Mary Anning	16 Dec 2022	L. Kool	Highly ferruginised. uCT scanned at Monash in May 2023
P?	*Bishops* sp.	J. Wilkins	Bass Coast	14 Feb 2025		?

Image courtesy of P Vickers-Rich

DinoQuest in Chengdu

By Pat Vickers-Rich

February 2024 to May 2025.

The renowned DinoQuest Exhibition has travelled to Guixi Ecological Park in Central China. Underpinning commitment to fostering cultural exchange and scientific knowledge, it launched in Chengdu, China on 16 February 2024. The launch was complete with a dragon team (see QR code).The journey of the DinoQuest Exhibition from its world premiere at the Science Centre Singapore to the Guixi Ecological Park in Chengdu not only signified the resilience of cultural and scientific endeavours but also underscores the strong and collaborative relationship between Singapore, Australia and China.

Despite the challenges posed by the COVID-19 pandemic, the successful showcase of this blockbuster exhibition underpins the commitment of all three nations to cultural exchange and sharing scientific knowledge. The blockbuster experience enthralled guests in Singapore by bringing them millions of years back to the Cretaceous period (and even to the Precambrian) to encounter the Australian polar dinosaurs. An immersive adventure for young and old, the DinoQuest Exhibition is another initiative by the Science Centre Singapore in cooperation with Monash University and Museums Victoria to create entertaining yet educational STEM+ experiences for all ages, not just in Singapore, but also beyond. DinoQuest exhibition was Guixi Ecological Park's latest interactive venture. It explores the history of these elusive dinosaurs spanning across seven thematic zones, designed to reimagine the attraction's visits of the future using storytelling and cutting-edge experiential technology.

The 1000 m^2 interactive exhibit was curated by the Science Centre Board in partnership with Emerita Professor Patricia Vickers-Rich and Dr Thomas H. Rich, who provided the expert knowledge and collection of fossils, in an immersive setting created by DF Experiences brought to life through the power of multi-sensory technology by Digimagic Communications. Through the latest multimedia technology, from holographic mapping to mixed reality environments, guests were able to join virtual guides, palaeontologist Professor V and her assistant Rex (actually Pat and Tom Rich!), on a multi-sensory quest through a world of the long extinct. DinoQuest exhibition is a culmination of more than 40 years of work that took place (and continues) in Victoria, Australia, involving over 700 volunteers. One of the most unique things about this assemblage of polar dinosaurs is that they were living close to the South Pole in a cold and dark environment that doesn't exist today. The mix of dinosaurs living in such an area is unusual, giving visitors an opportunity to follow the studies of palaeontologists working on a truly incredible and unique piece of evolutionary history.

Guixi Ecological Park brought these polar dinosaurs to life combining authentic storytelling with interactive game play, supported by sensory sights and sounds.

'It was truly an emotional experience watching this research amplified this way," said Emerita Professor Patricia Vickers-Rich.

"DinoQuest pushed DF Experiences to rethink the reusability and portability of an exhibition without compromising on the contents and showcase. The exhibit was designed in a modular format and used less raw materials for overall theming through careful planning, selection and various execution approach," said Mike Chong, Chairman of DF Experiences.

"What makes DinoQuest so different is that guests were part of the action as they explored different

Image: P Vickers-Rich

L-R: Exhibition entrance; Dinosaur coffee; Quantum Field; Exhibition tunnel zones. Instead of being lectured to or reading a textbook, people experienced what it is like to be there on the spot, discovering fossils — evidence of dinosaurs who died out millions of years ago through the use of technology and gamification — playing the role of a palaeontologist, digging for fossils and discovering the secrets of the dinosaurs," said Donald Lim, Founder of Digimagic Communications.

The exhibition brings together discoveries from Dinosaur Cove, including the most updated reconstruction of *Timimus*, a tyrannosauroid discovered in 1994 by Emerita Professor Patricia Vickers-Rich and husband Dr Thomas Rich and named after their son, Timothy Rich. *Leaellynasaura*, a small herbivore, named after Tom and Pat's daughter is also highlighted. Spanning seven thematic zones, this expo provided a multi-sensory experience like no other

Zone 1: Explorer's Hut
At the start of the epic exhibition, guests were introduced to their holographic guides through a Diorama Projection that showcased how Australia's first dinosaur fossil was discovered by geologist William Ferguson in the early 1900's. Guests were also registered with their RFID i-DinoTag to kick-off the quest to uncover the Polar Dinosaurs of Australia.

Zone 2: Dinosaurs of Darkness
Through a projection show coupled with animatronics and 4D elements, guests travelled back millions of years to explore Australia in the Early Cretaceous about 120 to 105 million years ago. They were able to take a tour into the world of dinosaurs and come face to face with prehistoric creatures including the big amphibian *Koolasuchus*, dinosaurs *Leaellynasaura* and *Timimus* and flying pterosaurs learning more about their habitat, behaviour and diet!

Zone 3: Extinction Theatre
In an immersive 4D theatre, visitors were able to experience the disaster that wiped out dinosaurs in an apocalyptic display of volcanic eruptions and meteorite strikes amplified by sound effects, smoke and atmospheric lighting.

Zone 4: Dig Site
In a replica of an actual dig site, guests experienced more science of palaeontology and the process of fossilisation. Through a hologram show, visitors discovered how dinosaur fossils formed and learned to identify different parts of their anatomy. Visitors were able to find out if they have what it takes to be a Dinosaur Detective!

Zone 5: Laboratory
In a recreation of a palaeontologist's high-tech laboratory, guests witnessed the exciting dinosaur preparation process featuring actual equipment and tools. At the Giant Megalania Alive Studio, a beast that lived long after the dinosaurs in Australia, visitors were able to experience how 3D Holographic Mapping brought this giant lizard to life. Visitors then moved to the hands-on activity at the Bone Station where they could drill into rocks from Dinosaur Cove to discover actual fossils!

Zone 6: Dinosaur Dreaming
Here, guests were welcomed by a replica display of dinosaur skeletons found at Dinosaur Cove including the worldwide premiere of the most updated reconstruction of *Timimus*, a tyrannosauroid discovered at Dinosaur Cove in 1994. Visitors were able to take a journey across time and were enthralled by the myriad colours and forms of the natural history specimens from the time of the great extinction. Visitors were able to meet today's living dinosaur descendants, the birds. They were taken there by the cartoons of Tom and Pat Rich and their two kids Tim and Leaellyn.

Zone 7: Activity Zone
The journey ended with another hands-on activity zone where guests created new species by doodling and bringing them to life at the virtual animated Dinosaur Park. They printed out the creature, coloured it and swiped it onto the projection screen where they watched it join the rest of the creations! This activity was linked to the art of Peter Trusler on show throughout the exhibition.

Image: P Vickers-Rich

L-R: Megalania*; Panel with Lesley Kool; Palaeo lab; Professor V and Rex; Dragon at the opening*

BREAKING ROCK AT THE CLEELANDS'

Image: S Madder

Image: A Pentland

Hard at Work

Image: L Nink

The garage

Image: W White

Washing rocks

Image: Z Landes

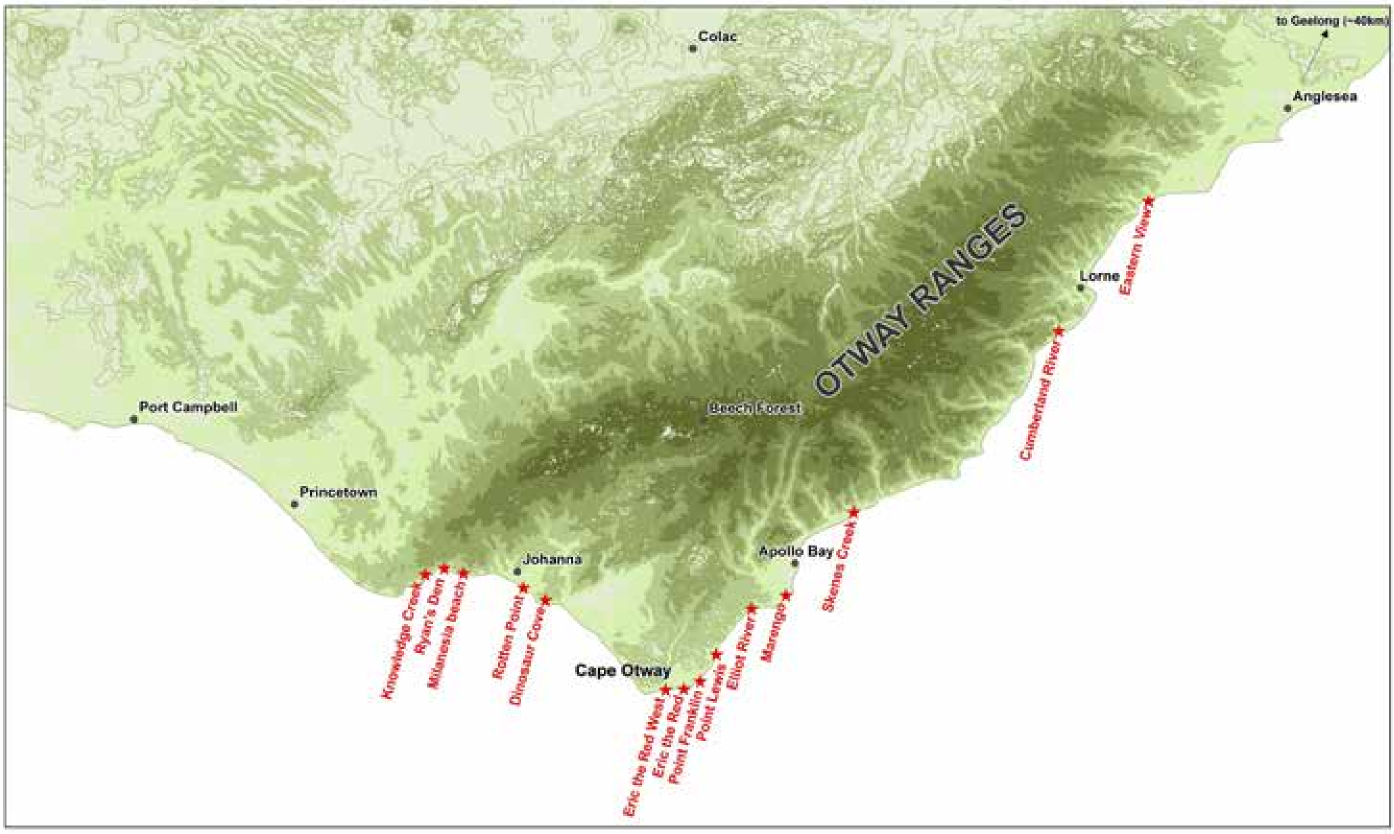
A dinosaur in the back yard

Re-enacting Jurassic Park

Image: J Edwards

Adele breaks the wrong rock!

Cretaceous Vertebrate Localities in the Otways



TAXA	Knowledge Creek	Ryan's Den	Milanesia Beach	Rotten Point	Dinosaur Cove	Eric the Red West	Eric the Red	Point Franklin	Point Lewis	Elliott River	Marengo	Skenes Creek	Cumberland River	Eastern View
Mammalia:														
Sundrius ziegleri						X								
Tribosphenic (Unidentified)						X								
Bishops sp.						X								
Monotremata (Unidentified)						X								
Kryoryctes cadburyi					X									
Dinosauria:														
Dinosaur (Unidentified)		X		X	X	X	X	X	X	X	X			X
Ornithopoda (Unidentified)		X		X	X	X		X	X	X	X			
Atlascopcosaurus loadsi					X				X					
Diluvicursor pickeringi						X								
Fulgurotherium australe					X									
Leaellynasaura amicagraphica					X									
Ankylosaurs/nodosaurs					X									
Neoceratopsian					X									
Theropoda (Unidentified)					X	X		X						
Elaphrosaurinae							X							
Carcharodontosauria									X					
Tyrannosauroidea					X									
Timimus hermani					X									
Megaraptoridae					X	X								
Unenlagiinae									X					
Other Vertebrates:														
Plesiosauria (aquatic reptiles)					X	X							X	
Crocodylia (crocodiles)					X									
Pterosauria (flying reptiles)					X	X								
Testudines (turtles)		X			X	X	X	X	X					
Otwayemys cunicularius					X									
Dipnoi (lungfish)					X	X			X					
Neoceratodus nargun					X				X					
Actinopterygii (ray finned fish)					X	X								
Trace Fossils:														
Dinosaur footprints	X		X		X							X		
Bird footprints					X							X		
Dinosaur Burrows	X													

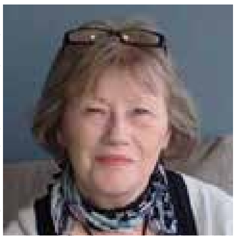


Image courtesy of USNW Sydney

Kryoryctes: a semi-aquatic, burrowing lifestyle

By Suzanne Hand

In 1993, a small, fossilised right humerus (upper arm bone) was found at Slippery Rock Site at Dinosaur Cove in southern Victoria by a team led by Tom Rich, Pat Vickers-Rich and Museums Victoria. The humerus (measuring just 4.6 cm in length) was recovered from a section of the Slippery Rock dig known as First Pillar and, at the time of discovery, the fossil was thought to possibly represent a turtle.

After careful preparation by Lesley Kool, this fossil humerus was recognised to actually belong to a mammal, and in 2005 it was described as the holotype and only known specimen of *Kryoryctes cadburyi* (NMV P208094) by Peter Pridmore, Tom Rich, Pat Vickers-Rich and Petr Gambaryan (Pridmore et al. 2005). A partial tooth (premolar) was also found at the same locality at the same time, possibly belonging to the same species. The humerus and the premolar are the only mammal fossils to be found at Slippery Rock.

In their 2005 study, Peter Pridmore and colleagues compared the *Kryoryctes* humerus to a range of mammals and "pre-mammals" (including groups such as dicynodonts, non-mammaliform cynodonts, and early and modern mammals), and concluded that the *Kryoryctes* mammal humerus was most similar to that of living monotremes – the platypus (*Ornithorhynchus anatinus*) and four echidnas (species of *Tachyglossus* and *Zaglossus*).

As the world's only surviving egg-laying mammals, Australasia's egg-laying platypus and echidnas are among the most extraordinary animals on Earth. They are also quite different from each other, and are morphologically and ecologically quite specialised.

The platypus (*Ornithorhynchus anatinus*) has a streamlined body, large, soft bill, very thick fur, webbed hands and feet, and a long, flattened tail. It is well-adapted for a semi-aquatic lifestyle, spending up to 20 hours a day swimming in eastern Australian waterways to forage for freshwater invertebrates.

On the other hand, echidnas (*Tachyglossus* and *Zaglossus* species) are fully terrestrial, widely distributed across Australia and New Guinea, and adapted for feeding on termites, ants and earthworms. They have long, narrow beaks, long, sticky tongues, short tails, back and sides covered with spines, and hands and feet without webbing.

A stem-group monotreme

Although Peter Pridmore and colleagues found that *Kryoryctes cadburyi* was most similar to modern monotremes, they also found that it lacked several features of the distal humerus (elbow joint) that platypus and echidnas share with each other. In these particular elbow features, living monotremes are thought to be more specialised than in *Kryoryctes cadburyi*. For this and other reasons outlined in their study, Pridmore and colleagues tentatively assigned *Kryoryctes cadburyi* to the order Monotremata, as an echidna-like stem-group monotreme.

This was the conclusion also reached by Celik & Phillips (2020) in their subsequent comprehensive phylogenetic analysis of Mesozoic mammals, which included *Kryoryctes*.

When *Kryoryctes cadburyi* lived, during the Mesozoic era, Australian monotremes and monotreme-relatives were more common than they are today. Glimpses of this past diversity are found in the fossil record in southern coastal Victoria at sites like Dinosaur Cove and Flat Rocks, and at Lightning Ridge in northern central New South Wales. From these important Australian Mesozoic sites, several stem-group monotremes and monotreme-related genera are now recognised (for example in Flannery et al. 2024), including species

Image: Museums Victoria

Kryoryctes cadburyi *(NMV P208094), holotype, a right humerus, in ventral view.*

Image: Peter Menzel (menzelphoto.com)

Dig at Dinosaur Cove, Victoria. Arrow indicates "First Pillar" where the holotype of Kryoryctes cadburyi *was found.*

of *Dharragarra*, *Kollikodon*, *Kryoryctes*, *Opalios*, *Parvopalus*, *Steropodon*, *Stirtodon, Sundrius* and *Teinolophos*.

Nevertheless, all Australian Mesozoic mammal fossils are exceedingly rare, and most consist of just teeth and jaws. Rarer still are skeletal remains, and especially those that can positively be assigned to specific species. *Kryoryctes cadburyi* is the only Australian Mesozoic mammal species known from a limb bone, and this provides significant information about its identity, relationships and lifestyle.

Echidna-like humerus morphology

Recently a group of palaeontologists (Hand et al. 2025) undertook several additional analyses on this unique fossil humerus in order to find out more about the nature and natural history of *Kryoryctes cadburyi*.

In our recent study, we first included *Kryoryctes* in a phylogenetic analysis to help establish its place among extinct and extant mammals and pre-mammals. We used a large dataset that included 77 mammals and mammal-like taxa and 536 morphological characters. We included only species known from their humerus, to ensure that at least some scored characters overlapped between *Kryoryctes cadburyi* and the other taxa.

Like Pridmore and colleagues, we found that *Kryoryctes cadburyi* was probably a stem-group monotreme. We also found that similarities in humerus shape between *Kryoryctes* and some pre-mammals and early mammals (such as the Jurassic docodontids *Haldanodon* and *Castorocauda*) are probably due to morphological convergence in habitually digging and swimming species rather than close relationship.

Our analyses, like that of Pridmore et al., also found that the shape of the *Kryoryctes* humerus was more similar to that of echidnas than the platypus, and in fact was most similar to the long-beaked echidnas (*Zaglossus* species). The areas of greatest difference between *Kryoryctes* and living monotremes corresponded to the greater degree of proximal bending (flexion) of the humerus in the echidnas, and the greater twisting (torsion) in the platypus humerus, as well as the unusual articulation evident between the humerus and the two lower arm bones (radius and ulna) in the platypus and echidnas (as noted above).

***Kryoryctes cadburyi* bone microstructure**

In our 2025 study, we were also able to examine the internal bone microstructure of the *Kryoryctes* humerus. The internal microstructure of a bone can provide significant information about an animal's way of life, such as whether it is terrestrial, semi-aquatic, aquatic, or a burrower.

Before our study, the internal microstructure of the *Kryoryctes* humerus had not been examined. That is because destructive sampling is typically needed to analyse microstructure/histology in a bone, and this wasn't possible for a unique fossil like *Kryoryctes cadburyi*.

Instead we used several kinds of nondestructive 3D scanning techniques to reveal the internal microstructure of the fossil bone. These included microCT (at Monash University and UNSW), helical scanning (UNSW) and thermal-neutron scanning (ANSTO) which, combined, enabled us to describe and measure important characteristics of the internal bone architecture of the *Kryoryctes* humerus.

In doing so, we found something unexpected. We found that the bone walls (cortex) of the *Kryoryctes* humerus were significantly thickened and the internal cavity (medulla) was reduced. This was unlike that found in echidnas, which have quite thin bone walls, and was much more like the bone microstructure seen in platypuses.

Using data about humerus microstructure already available for many living mammals, we quantitatively compared characteristics of the *Kryoryctes* humerus microstructure to those in the platypus, echidnas and

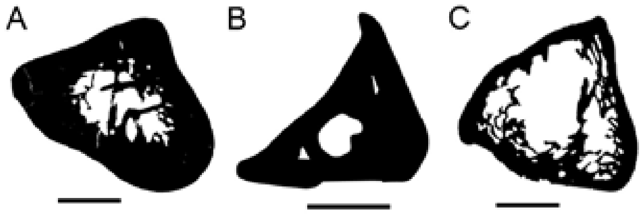


Image: S Hand

Cross-sections of humeri at mid-shaft illustrating their internal bone microstructure: A, Kryoryctes cadburyi*; B, the platypus* Ornithorhynchus anatinus*; C, the short-beaked echidna* Tachyglossus aculeatus*. Scale bars represent 5 mm.*

74 other mammal species, ranging from hedgehogs to dolphins. These analyses confirmed that the *Kryoryctes* humerus had internal bone features like semi-aquatic burrowing mammals (such as the platypus, muskrat and Eurasian otter), rather than land-living burrowing mammals such as echidnas.

These microstructural features include a particularly thick bone wall (cortex) and a very reduced bone cavity (medulla). This microstructure results in markedly increased bone mass, which is known to increase ballast and help decrease buoyancy in extant semi-aquatic mammals (such as the sea otter and platypus) and in aquatic but slow, shallow-diving mammals (such as the dugong).

This particular bone thickening (known as osteosclerosis) makes long bones relatively heavy and more susceptible to fracture, and makes locomotion on land energetically expensive. Hence, this specialization is rarely found in mammals that move efficiently on land. It also occurs in some small subterranean mammals, such as naked mole rats and some moles, but in these mammals, despite the thick bone wall, the cavity remains relatively free of bone struts (trabeculae).

A semi-aquatic lifestyle

Among aquatic mammals, markedly increased bone mass is most common in semi-aquatic, shallow-diving and bottom-walking taxa (such as coypu and dugong). It is not seen in fast-swimming, highly manoeuvrable, or deep-water predators (such as dolphins and seals), which instead have a spongy type of bone internally

Image: Peter Schouten

Peter Schouten's reconstruction of Kryoryctes cadburyi *at Dinosaur Cove ~108 million years ago.*

that more evenly distributes mechanical stresses on their bones.

Based only on its humerus, the inner bone structure of *Kryoryctes* is consistent with it using both aquatic and terrestrial locomotion, as in extant semi-aquatic burrowers such as muskrat, river otter, clawless otter, coypu, and the platypus.

The inner bone structure in the *Kryoryctes* humerus is also very similar to that of the semi-aquatic sea otter *Enhydra lutris* (and to a lesser extent to those of some early fossil whales). The sea otter *Enhydra* spends almost all of its time in the ocean and is very clumsy on land. Other extant otters, which are agile on land, show a lower degree of bone thickening than does *Kryoryctes*.

When *Kryoryctes cadburyi* lived, during the Early Cretaceous, Dinosaur Cove lay within the Antarctic Circle, at ~70°S. This high-latitude position implies prolonged periods of complete winter darkness despite a relatively mild, wet, cool- to warm-temperate climate.

The living semi-aquatic platypus famously has receptors on its bill which are sensitive to tiny electrical pulses that help it to locate its freshwater prey, irrespective of available light. Echidnas retain similar but less numerous receptors on the beak, although how these are used for foraging in soil is unclear.

Electro-sensitivity may have been an important adaptation for southern polar life in *Kryoryctes cadburyi* and other stem group monotremes or relatives such as Lightning Ridge's *Steropodon galmani* and *Kollikodon ritchiei*, which also lived within the Cretaceous Antarctic Circle and which may also have been semi-aquatic.

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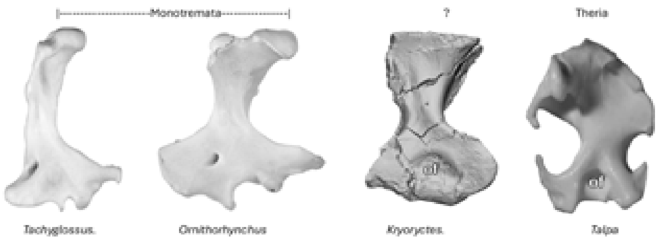
Image: Museums Victoria

Kryoryctes cadburyi is a monotreme — for sure... maybe

By Tom Rich

Based on a detailed morphological analysis of the holotype, a partial humerus, Pridmore et al (2005) concluded that *Kryoryctes cadburyi* was highly likely to be a monotreme. However, they did point out that this was provisional, owing to the nature of the elbow joint. In this feature, they regarded it as more theiran-like than monotreme-like.

A particularly salient feature supporting this allocation to the Theria is the presence of an olecranon fossa (of) on its posterior distal surface. This feature is unknown in monotremes.



Dorsal view of mammalian humeri. OF = Olecranon Fossa

Hand et al (2025) carried out a further morphological analysis of the holotype. Together with a detailed parsimony analysis, they, too, concluded that *Kryoryctes cadburyi* was most likely to be a monotreme.

A parsimony analysis carried out by Robin Beck based on 535 characters of the mammalian skeleton grouped *Kryoryctes* with the monotremes. A parsimony analysis based only the 19 characters available on the holotype of *K. cadburyi*, 3½% of the 535 total for the entire mammalian skeleton,placed that species closer to, but outside of, a group of all therian mammals and some other mammals in the sample than to the monotremes.

The 535 character parsimony analysis thus seems to be sensitive to the overall morphology of the holotype of *Kryoryctes cadburyi*. In contrast, the 19 character parsimony analysis appears to be sensitive to the morphology of the elbow joint.

This suggests that although it is highly likely that *K. cadburyi* is a stem monotreme, the alternative that it might be more closely allied to the therians should be kept in mind. But if that unlikely alternative is the case, to what therian is *K. cadburyi* most closely allied?

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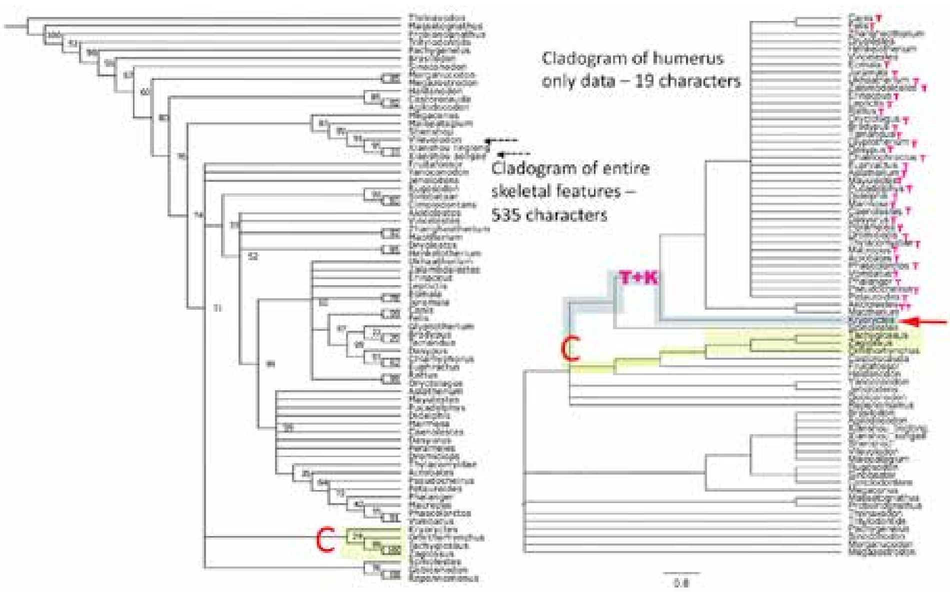

Abbreviations:
C common points on cladogram linking Kryoryctes *and monotremes.*
K+T common points on cladogram linking Kryoryctes *and all therians*
T therians

2025 FIELD CREW

Marion Anderson
Geordie Ball
Darren Bellingham
Jack Biggs
Annie Chisholm
Mike Cleeland
Amber Craig
Adam Dellal
Ruairidh Duncan
Jon Edwards
Caroline Ennis
Alan Evered
Alyssa Fjeld
Liam Grech
Adam Hopkins
Sally Hurst
Sachi Kerr
Jörg Kluth
Lesley Kool
Jake Kotevski
Zev Landes
Tom Lawler
Melissa Lowery
Astrid O'Connor
Adele Pentland
Prahaladh Reddy
Tom Rich
Doris Seegets-Villiers
John Swinkels
Alan Tait
Nick van Klaveren
Pat Vickers-Rich
Mary Walters
Astrid Werner
Wendy White
John Wilkins
Corrie Williams
Marlonique Wolormans

WEEK ONE

Image: W White

Back row: John Wilkins, John Swinkels, Marion Anderson, Corrie Williams, Jack Biggs, Adam Hopkins, Sachi Kerr.
Front row: Caroline Ennis, Mary Walters, Doris Seegets-Villiers, Alan Tait, Alan Evered, Nick van Klaveren.
Behind the camera: Wendy White. Absent: Mike Cleeland, Liam Grech, Melissa Lowery, Tom Rich, Pat Vickers-Rich, Lesley Kool.

Week Two

Image: W Turner

Standing: Lisa Nink, Alan Evered, Ruairidh Duncan, Corrie Williams, Sally Hurst, Mary Walters, Jon Edwards, Lesley Kool, Wendy White, Pat Vickers-Rich, Tom Rich, John Wilkins
Kneeling: Zev Landes, Alyssa Fjeld, Adele Pentland, Jake Kotevski, Doris Seegets-Villiers, Adam Dellal
Absent: Mike Cleeland, Melissa Lowery, Alan Tait

Week Three

Image: Z Landers

L-R: Prahaladh Reddy, Tom Lawyer, Mary Walters (peeking), Astrid Werner, Geordie Ball, Wendy White, Alan Evered, Corrie Williams, Darren Bellingham, Astrid O'Connor, John Wilkins (also peeking), Marion Anderson, Melissa Lowery,
Kneeling: Doris Seegets-Villiers, Adele Pentland, Alan Tait.
Absent: Mike Cleeland, Amber Craig, Tom Rich, Pat Vickers-Rich, Lesley Kool.