Buried Treasures of the Age of

from the Fishes

Story by Dr Alex Ritchie and Dr Zerina Johanson
Photos courtesy: Age of Fishes Museum Collection & Federation Fotos

Imagine.... a world ruled by fish!

About 360 million years ago during the Devonian geological period, most life on Earth existed in the water. On land at that time, you would have found primitive plants and insects, as well as spiders, mites, centipedes and millipedes, but the first tetrapods (four-legged animals) – the ancestors of all amphibians, reptiles, birds and mammals – had only just started their evolutionary journey, including the crucial move from water to land.

In the oceans, lakes and rivers, on the other hand, life was abundant and diverse. Fish dominated these environments, including the familiar ones (lobe-finned and ray-finned fishes, and sharks) and the very unfamiliar and long extinct placoderms. This was "The Age of Fishes!"

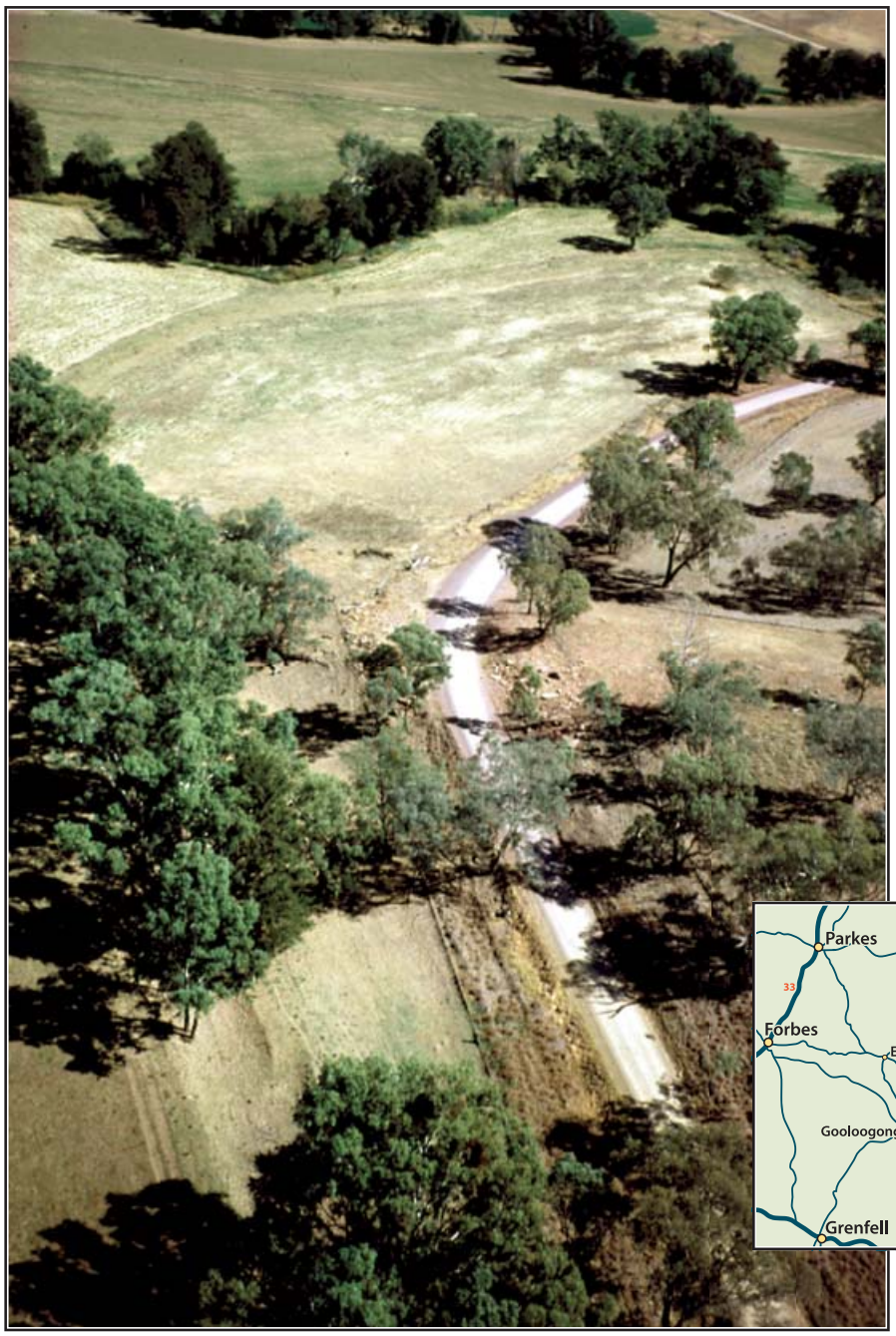
At Canowindra in the Central West of New South Wales, an amazing fossil discovery provides a window into that time. A massive fish kill during an ancient drought has been preserved in stone; including nearly 4,000 fishes on one layer of rock, giving us a unique glimpse into a Devonian fish community.

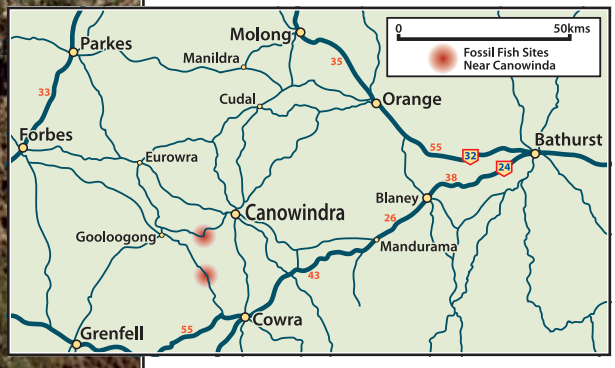
The Canowindra fauna at that time was dominated by armoured fishes (placoderms) that look very strange to us today because their heads and the front parts of their body, (and sometimes even their fins) were covered in bony armour. Several species of larger predatory fish, (lobe-finned, or sarcopterygian, fishes), have also been discovered at the site. These are of special interest to scientists because they include the ancestral group from which the first four-legged land animals (amphibious tetrapods) and all later backboned animals (amphibians, reptiles, birds and mammals, including humans) evolved.

The 1956 discovery

The Canowindra fossil site was discovered in 1956 during roadworks 10km west of the town of Canowindra in the Central West of New South Wales. Until 1956 a dangerous corner in the unsealed road from Canowindra to Gooloogong was the site of several accidents and the local council (then Boree Shire), hired a contractor called Jack Burge to remove it. A Caterpillar D8 bulldozer, under the guidance of Charlie Stevens, ripped up massive sandstone slabs; some weighing in excess of two tonnes, and pushed them over the embankment. Intrigued by strange marks on one large rock slab, Charlie Stevens saved it by moving it clear of the road against a fence. Whether he recognised the importance of his discovery will never be known, but regardless, the rock slab with the strange marks on its upper surface was moved aside and no further action was taken at the time.

Some time later the Australian Museum in Sydney received a letter reporting a rock near Canowindra





***Site of the Canowindra fish fossil discoveries on the Gooloogong road, 18km from Canowindra** (left). "Under the bend in this quiet country road in rural New South Wales lies one of the world's great fossil sites, just waiting to be explored."*

with "what looks like a fossil reptile on it". The original letter has not been located in the museum archives but we do know who sent it. He was William (Bill) Simpson; a local beekeeper and carpenter of Holmwood, NSW.

Simpson died in 1965 before anyone thought to record his account of the discovery and it was long assumed that he had been alone when he found the fossil slab. Then, in 1999, Dr Alex Ritchie tracked down a living eyewitness to the 1956 discovery; Simpson's foster son Bob Scott, now living in Wagga Wagga, NSW.

Bob Scott remembers that it was a very hot day and ants were raiding their beehives and disturbing the bees. After poisoning (and stirring up) the ants, Simpson and Scott left the field, leapt the fence and sat on a large rock slab waiting to be picked up. As Bill Simpson rolled a cigarette, he realised that the strange marks he was sitting on were fossils and later wrote to inform the Australian Museum of his discovery.

***In 1956, Bill Simpson** (above left) **alerted the Australian Museum of a large slab of fossiliferous rock near the roadside, 18km from Canowindra on the Gooloogong road. The slab had been saved from burial by bulldozer operator Charlie Stevens while re-aligning a dangerous bend in the road nearby and was subsequently found by Simpson and his foster son Bob Scott. The slab was found to contain the imprints of more than 100 fossil fish and has been hailed as being one of Australia's most significant fossils. Bob Scott relates the story of its discovery to Dr Alex Ritchie over a replica of the original slab at the site of its discovery in 2000** (above).*

***Loading the fossil slab in 1956** (left and below) **for its journey to the Australian Museum in Sydney. The slab was to reside at the Australian Museum for 50 years before returning to Canowindra for display in the Age of Fishes Museum in 2006**.*

Moving the treasure to the Australian Museum

In 1956, 200 miles (320km) was a long way to go to check on what must have seemed an unlikely fossil report. Fortunately Mr Harold Fletcher, the Australian Museum's palaeontologist and his friend, Dr Ted Rayner from NSW Geological Survey, had planned to visit Condobolin west of Canowindra, and decided to check Simpson's report. When they reached the site and saw the fossil slab, they immediately realised its scientific importance. Cancelling the rest of their trip, they arranged for the slab, one of the most remarkable fossil discoveries ever made in Australia, to be removed to Sydney for scientific study and display.

The re-discovery

By the time the original slab was removed to Sydney in 1956, the road works on the Canowindra-Gooloogong road had been completed and the fossil fish layer covered over. It was then virtually forgotten until 1968 when Dr Alex Ritchie succeeded Harold Fletcher as Australian Museum Palaeontologist. With a specialist interest in fossil fishes, Dr Ritchie was intrigued by the Canowindra slab and the possibility of relocating the original site. He visited Canowindra at least six times between 1973 and 1990 in an attempt to relocate the fish layer, but without success. Heavy earth-moving equipment was clearly needed but the Australian Museum lacked the funds to hire such assistance.

It was not until 1980 when Alex recognized Groenlandaspis, the fourth type of fish on the original Canowindra slab, that his quest to relocate the Canowindra fossil site gained new impetus. However it was to be a further 12 years before fate stepped in, in the form of Dr Bruce Burns, a Sydney dentist who had recently bought a property near Canowindra. Bruce Burns saw the 1956 slab on display at the Australian Museum and where it had been found – Canowindra! After making some enquiries at the local pub, he approached Dr Ritchie at the Australian Museum and upon hearing about his long quest to rediscover the site, arranged for Alex to talk to Canowindra Rotary in September 1992 about the "Great Canowindra Fish-Kill". Alex seized the opportunity to stimulate local interest. His talk intrigued several local shire councillors who attended and shortly afterwards the local Cabonne Shire Council offered him the use of earth-moving equipment free of charge to try to relocate and excavate the 1956 fossil fish site.

Alex suggested a trial dig first to find out how much, if any, of the fish layer remained in the ground. In January 1993, with a 22 tonne excavator and its skilled operator Fred Fewings, the site was reopened. In less than three hours Fred and Alex located the original fossil layer at the side of the road and traced it for 20m up the bank. "It was one of the great moments of my whole fossil hunting career," said Alex. Every slab they turned over was covered with complete fish fossil impressions, confirming the enormous potential of the site that still contained thousands of superbly preserved specimens. The prospect of spectacular new discoveries was dramatically confirmed when parts of three very large sarcopterygian fishes; which must have been about 1.5m to 2m long when alive, were recovered in one hour!

From July 12 to 22 1993, Alex returned to Canowindra to carry out a major excavation of the site. The fossil dig, using the same Cabonne Council excavator and driver, received the full support of the Canowindra community - business people, farmers, lorry drivers, teachers, high-school

THE CANOWINDRA SLAB

The Canowindra slab illustrates a dramatic story of a mass fish-kill event around 360 million years ago, in Late Devonian times. Since 1966 the slab has been on permanent display in the Australian Museum; that is, until March 2006 when this remarkable fossil specimen returned to Canowindra for the first time to mark the 50th anniversary of its discovery.

The 1956 slab (2m x 1m) was spectacularly rich; covered with detailed impressions (natural moulds) of some 114 Late Devonian fishes. The fauna was dominated by two types of strange, long-extinct, armoured fishes: the antiarchs *Bothriolepis* and *Remigolepis*; both long known from finds in the Northern Hemisphere. But two other interesting types of fish were also present on the slab.


Remigolepis walkeri


Bothriolepis yeungae


Canowindra grossi


Groenlandaspis
2 juveniles

Near the middle of the slab lay a single, beautifully preserved specimen of a long-bodied, scale-covered fish seen in dorsal view. This was an air-breathing, lobe-finned fish belonging to a group called sarcopterygians (meaning 'fleshy-fin'), also well known from Northern Hemisphere finds.

The Canowindra sarcopterygian was not only new to science, it was also the first complete sarcopterygian specimen found in the Southern Hemisphere. In 1973 this unique specimen was described by Dr Keith Thomson and named *Canowindra grossi* after the town and in honour of a famous German fish palaeontologist, Dr Walter Gross.

The fourth type was *Groenlandaspis*, a Devonian armoured fish, first discovered in East Greenland 40 years earlier.

Dr Ritchie's quest to locate and excavate the Canowindra fossil site reached fruition in 1993 when major excavations were undertaken by the Australian Museum. More than 60 tonnes of fossil slabs were eventually recovered with the help and support of the Cabonne Shire Council and the Canowindra community. The photos *(right)* ***depict the dig in full swing and are*** *(clockwise from top left)*: ***volunteers at the site after the removal of overburden by a 22 tonne excavator; Fred Fewings, the driver of the excavator with a prize fish fossil; Bruce Loomes, a local farmer and keen fisherman with the latex covered imprint of a large fish and a group of local helpers working on the fossil layer.***

students and local residents. The dig created massive media interest and attracted hundreds of sightseers.

Results far exceeded expectations! Some 60 to 70 tonnes of fossil slabs were recovered, several of which weighed more than two tonnes! Since 1993, these slabs have been systematically cleaned, prepared and cast with the assistance of monthly groups of paying volunteers organised by Monica Yeung of Gondwana Dreaming of Canberra; an eco-science tour organisation. In 1993, Alex Ritchie invited Zerina Johanson to join the Canowindra research team and do her PhD on the Canowindra fauna. She has completed this gigantic task and also published several papers on the fauna and individual fish with Alex, Per Ahlberg (Uppsala University, Sweden) and Ted Daeschler (Academy of Natural Sciences, Philadelphia).

All of the new fossil slabs are stored at Canowindra where, to date, scientists have identified more than 3,700 fish specimens crammed together on them. Most of the specimens are almost complete and we now know that at least eight species of long-extinct fishes are present at Canowindra, with most of these known only from Canowindra. Many thousands more specimens must still be lying buried at the original site and it is a reasonable assumption that these include other types of fishes; and possibly even early tetrapods new to science. Canowindra is a fossil treasure trove with potential that has barely been scratched!

As foreshadowed by the 1956 discovery, the Canowindra fauna is dominated by two types of antiarch armoured fishes (*Bothriolepis* and *Remigolepis*) which form about 97 per cent of the fauna. Some 50 to 60 complete specimens of a third armoured fish, *Groenlandaspis*, were also recovered in 1993. In addition, five types of air-breathing, sarcopterygian fishes (more than 30 specimens) are now known to be present; some of them over 1.6m long. In many of these specimens the head region is almost uncrushed, thus preserving internal details of the braincase, gill arches, palate and other features in three dimensions.

The recovery of these remarkably preserved fossils is only the last link in a unique chain of events that began

***Dr Alex Ritchie and Harold Fletcher studying** Groenlandaspis **fish fossils from Antarctica at the Australian Museum in the early 1970s** (above).*

360 million years ago. It appears that a large billabong near a river; with tens of thousands of fishes living in it, dried up during a severe drought, tightly concentrating the fish in a small area where they perished. Soon after death, but before they fell apart, their remains were rapidly but gently covered with fine sand by a flood. Over time, they became buried deep underground by later flood deposits and the sand slowly turned to solid rock.

About 360 million years later, this unique evidence of a long-forgotten mass-mortality event was brought back to the surface by subsequent earth movements and erosion. As serendipity would have it, this occurred at the exact point where a country road intersected the fossil layer, to be spotted by a sharp-eyed bulldozer driver and saved for posterity. How many other such finds are never seen or reported, and are lost to science?

Window into the Devonian world

Australia is one of the richest areas in the world for Devonian rocks containing fossil fishes. Massive Devonian barrier reef complexes in the Kimberley region of Western Australia have produced a rich assemblage of fossil fishes; (the world-famous Gogo fauna) preserved in exquisite detail in limestone concretions. In the central west of New South Wales, thick sequences of Devonian rocks (still largely unstudied), have produced many fossil treasures, including a lower jaw of an early tetrapod from a site near Forbes, NSW. This specimen is still the only known skeletal remains of a Devonian tetrapod; not only from Australia but from the entire Southern Hemisphere. Together with the evidence of a fossil tetrapod trackway from Genoa River in eastern Victoria, the jaw from Forbes confirms that early tetrapods did live here and suggests that it is only a matter of time before we track down more fossil evidence. Canowindra must be high on any list of potential sites!

The Canowindra fauna provides an important snapshot of the Devonian world 360 million years ago, but it and other Australian Late Devonian fossil sites are also important in a worldwide context. Scientists examine fish fossils from around the world in order to better understand the distribution of continents through the Devonian Period. The fish fauna found at Canowindra is similar to that from Devonian fish sites in Antarctica, North America, Greenland and Europe. This suggests that during the Late Devonian, these Northern Hemisphere land masses and Australia lay much closer together than they are today.

Scientists also use similarities in these fish fossils to help them target sites that might be fruitful for further examination and Alex Ritchie and Zerina Johanson are particularly keen to find more Devonian tetrapod material in New South Wales. Intriguingly, the Northern Hemisphere fossil sites mentioned above also contain early tetrapods found in association with the lungfish, *Soederberghia*. A new species of *Soederberghia* has been described from Canowindra, and indicates that tetrapod material could be present at the Canowindra site still waiting to be discovered. This makes opening up the main site near Canowindra even more important.

Other sites close to Canowindra also have the potential to yield Devonian tetrapod fossils, and we know this because of a unique association in the fossil fish deposits. At sites near the town of Grenfell, NSW, Alex Ritchie discovered and named a very unusual type of placoderms belonging to the Sinolepida ("China-scale"); a group of antiarchs previously found only in China. In 2002, the first Devonian tetrapod fossil from Asia (Sinostega) was described in association with sinolepid antiarchs in China. This makes scientists suspect that there could well be Devonian tetrapods among the rich fossil layers near Grenfell and gives them a focus for future research and fieldwork.

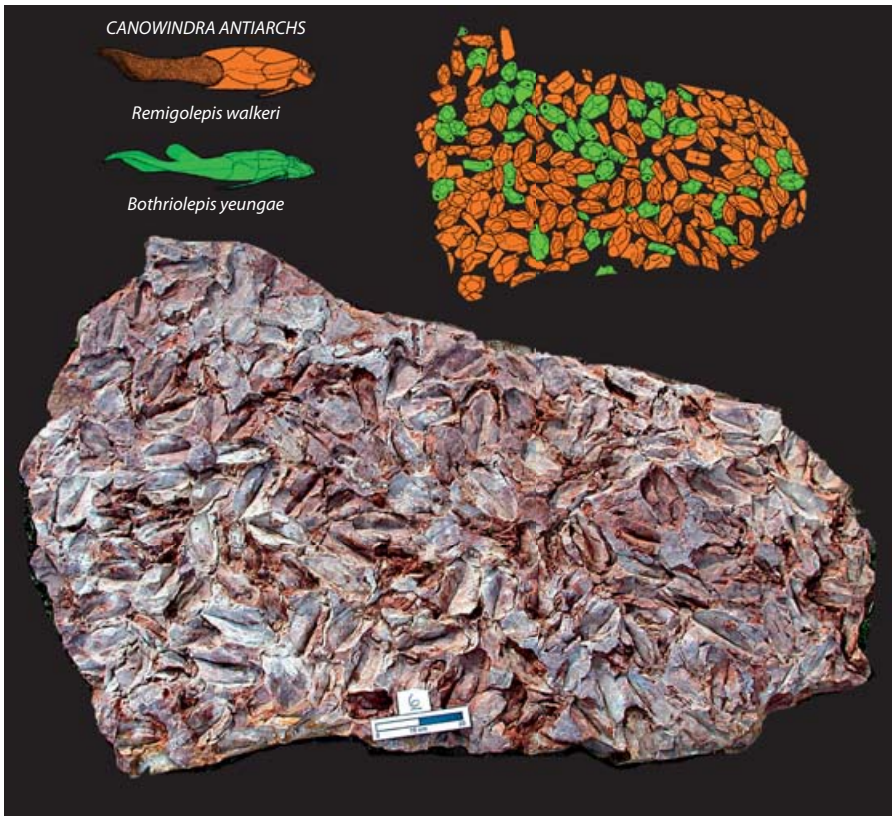
From 'Fishes' to 'Tetrapods'

The Devonian Period, although often called "The Age of Fishes", was also the time when one of the most dramatic transitions in evolutionary history took place, when fishes with fins evolved into animals with four legs (or tetrapods) capable of living on land. Tetrapods include amphibians, reptiles, birds and mammals, all of which trace their common ancestry back to Devonian air-breathing fishes. Since we ourselves are mammals, our early history is written in Late Devonian rocks like those at Canowindra.

Canowindra is important because several of the new fishes described from there belong to the air-breathing sarcopterygians, the fish group most closely related to tetrapods.

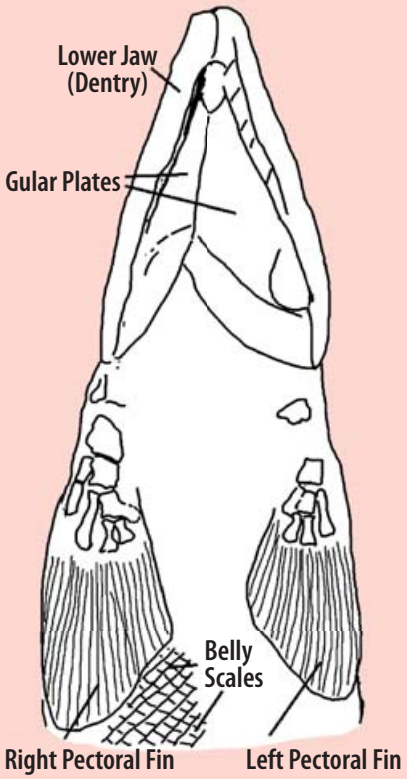
Other major groups of fish such as the cartilaginous shark group and the modern bony ray-finned fishes (eg tuna, goldfish and eels) are less closely related to tetrapods.

Scientists believe that sarcopterygian fish and tetrapods are related because certain bones in the paired fins of sarcopterygians closely match

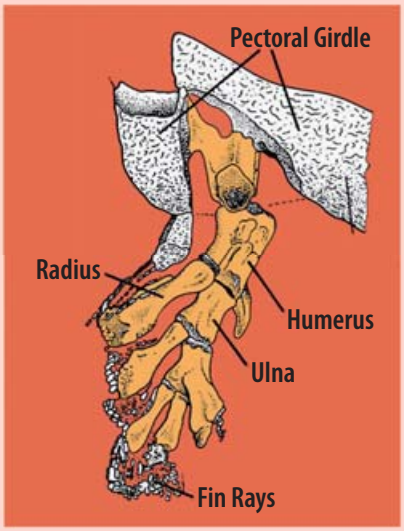


***One of the spectacular fish fossil slabs recovered in 1993 and its colour coded inhabitants** (left).*

Mandageria fairfaxi, Late Devonian, Canowindra

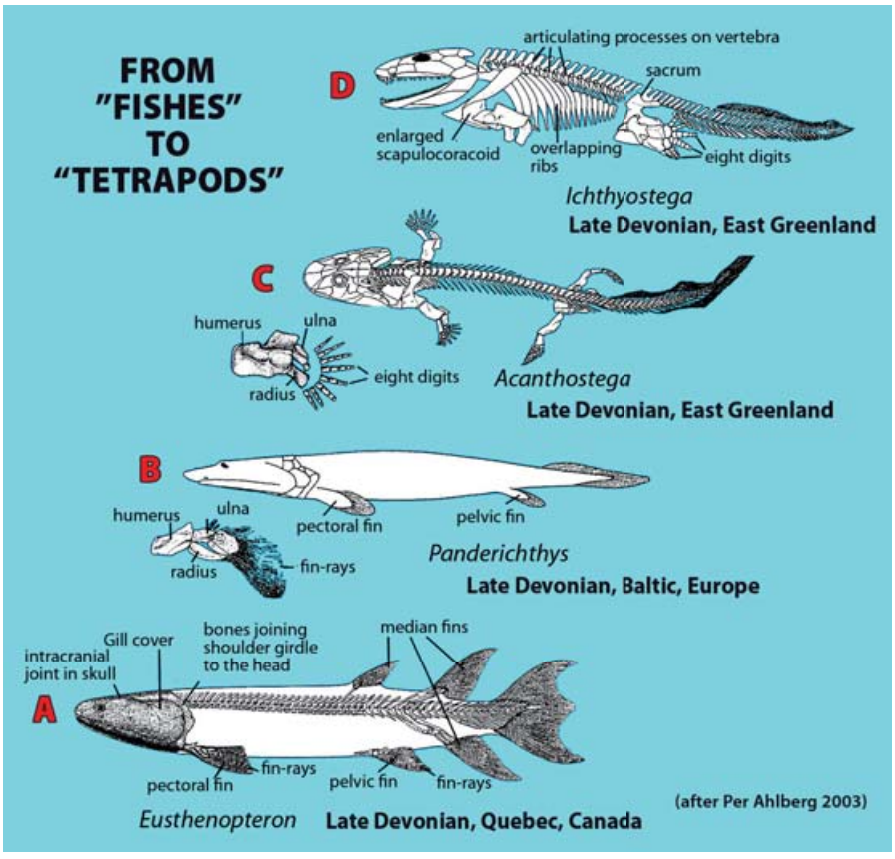


Compare the bones in** Mandageria's **pectoral fin** (left) **with those in the fin of a close relative**, Eusthenopteron, **a sarcopterygian fish from the late Devonian of Miguasha, Quebec, Canada** (below). **We have the same bones in our arms.** Mandageria **was our distant relative!



Cast of the anterior half of a complete specimen of** Mandageria fairfaxi (above left) **showing the ventral (belly) surface of the head, pectoral fins and anterior trunk. The original of this specimen is still buried under Fish Fossil Drive at Canowindra.

those in the limbs of tetrapods. Human beings have retained these bones in their arms and legs. Our upper arm bone, the humerus, also occurs in sarcopterygian fish and can be clearly seen in the fossils at Canowindra (eg. *Mandageria*). Similarly, the bones of our lower arm, the radius and ulna, are present in sarcopterygian fish fins but are absent from the fins of all sharks and ray-finned fishes.



Although these similarities between sarcopterygian fishes and tetrapods have long been known, discoveries over the past 20 years by Per Ahlberg and his colleagues have thrown new light on the finer details and timing of the fish-tetrapod transition. The earliest known tetrapods come from Late Devonian rocks of the Northern Hemisphere and the transition appears to have taken place over a comparatively short period of about 10 million years in the early part of the Late Devonian.

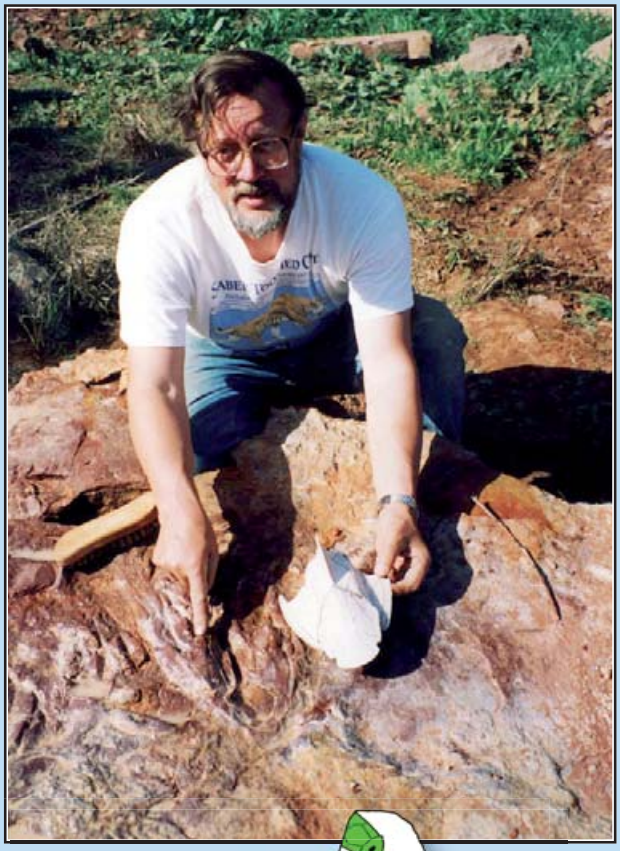
The age of the Canowindra fauna is thought to fall within the early part of this transition period. This is why one of the main goals of the Canowindra research program is to explore where our Australian sarcopterygian fish fit into the global picture and also to search for the remains of early Devonian tetrapods at Canowindra and other prospective sites in New South Wales. Australia may well have important evolutionary information regarding the fish-to-tetrapod transition hidden in its rocks, only a hammer blow away…

1993. Alex Ritchie with a little problem; so many rocks and fish and only one lifetime!

From Greenland's Icy Mountains.....

One of the armoured fishes found at Canowindra was the main reason for Alex Ritchie's long search to re-locate the Canowindra Fish Fossil site.

Alex explains why: "In 1970-71, shortly after coming to Australia, I joined a New Zealand university expedition to Antarctica to search for Devonian fossil fishes. In addition to extinct fishes well known from other continents (eg. *Bothriolepis*), we found remains of a strange armoured fish that I could not recognise in the field.



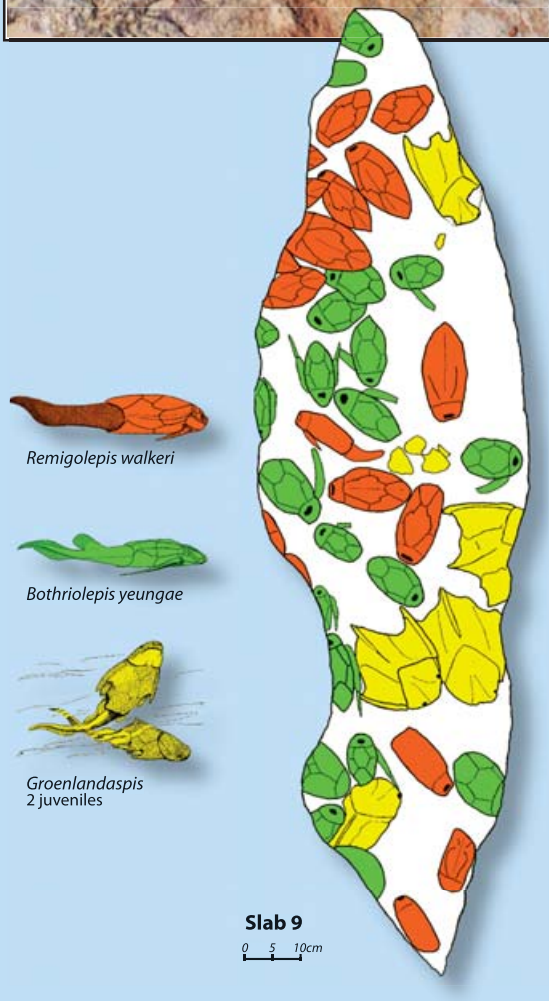
"Back in Sydney the scattered remains were cleaned up and slowly pieced together, using a cardboard model to work out how they fitted. A search through the scientific literature revealed that this fish had already been discovered elsewhere, at the other end of the world, in East Greenland in the 1930s. It even had a name, *Groenlandaspis* (meaning 'Greenland-shield') although there was not enough material to reconstruct it.

"Shortly afterwards, in 1971-2, I discovered the first *Groenlandaspis* fossils from Australia (near Grenfell and Forbes, NSW). Over the next few years, I tracked down other examples from England, Ireland, Byelorussia, Turkey, and Iran as well as from several other sites in Australia (NSW and Victoria). By 2005 more than 30 sites; including some from South Africa and the USA (Pennyslvania), were known.

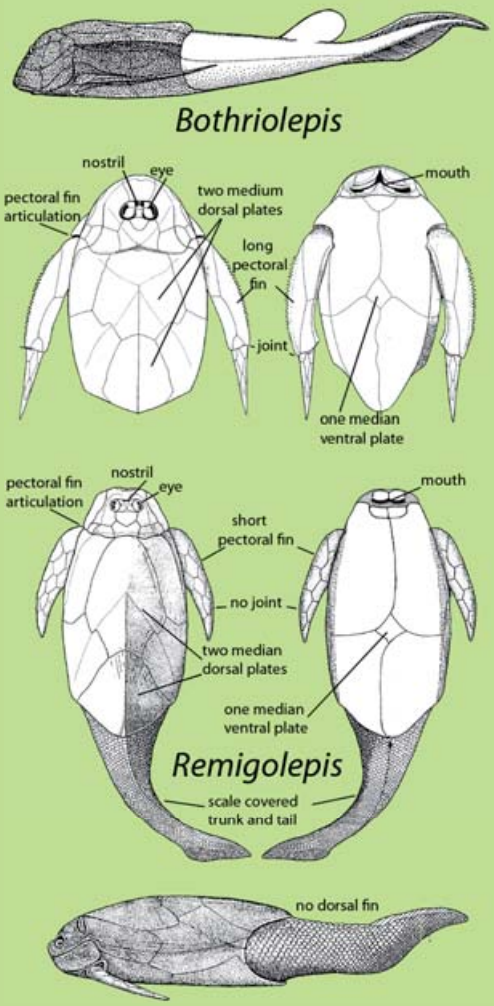
"So, my 1980 discovery of two small partial specimens on the 1956 Canowindra slab was very exciting. Because the other fish on this slab were almost intact, I hoped to find a complete *Groenlandaspis* to check my earlier reconstruction.

"One of the most memorable moments during the July 1993 dig at Canowindra came when the bulldozer turned over a slab with impressions of the head and trunk shields of five adult *Groenlandaspis* preserved almost uncrushed (shown below with corresponding mould). After the fossil impressions were cleaned out, my cardboard model turned out to be an almost perfect fit. I had got it right!"

The Canowindra site has so far yielded more than 50 *Groenlandaspis* specimens, representing an almost complete growth series from juveniles to adults around 45cm long.



The Strange Fish Found at Canowindra



THE ANTIARCHS

By far the most common fishes found at Canowindra are the antiarch placoderms, *Remigolepis walkeri* and *Bothriolepis yeungae*. More than 1,500 specimens have been found of each species, raising questions about what type of ecological niche each species lived in. They belong to a group of placoderm fishes called the Antiarchi, which display many distinctive features in their bony armour. Most unusual are their front (pectoral) fins, which were encased in bony plates (just like the head and trunk shield) and were hinged against the trunk armour. Antiarchs are distinguished from other placoderms by having two median dorsal plates and only one median ventral plate in the trunk shield. Only the antiarchs have their pectoral fins completely encased in bony plates.

Remigolepis walkeri
Pronunciation: Remi-go-lee-pis walker-i

Remigolepis gets its name (meaning 'oar-scale') from its short pectoral fins, while the fins of *Bothriolepis* are longer. In both cases the pectoral fins could be extended sideways at up to 90 degrees to the body, to act in much the same way as aeroplane wings, to generate lift. The tail of *Bothriolepis* was also much longer than *Remigolepis*, giving the impression of a fish that was a more active swimmer. By comparison the shorter, scale-covered tail and short fins of *Remigolepis* seem more related to a largely bottom-living (benthic) lifestyle. *Remigolepis walkeri* was named after its oar-like fins and for Kevin Walker, the founding president of the Age of Fishes Museum.

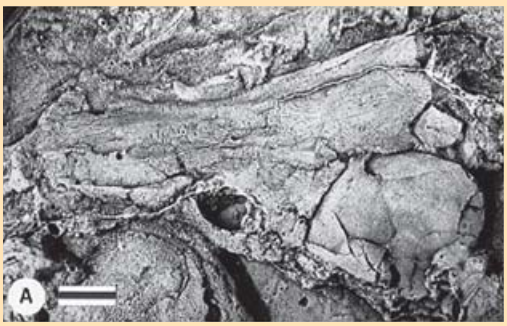
Bothriolepis yeungae
Pronunciation: Both-ree-oh-lee-pis young-ee

Bothriolepis was perhaps the most successful and widely distributed of all placoderms and its remains are found in Devonian rocks on every continent. Its name (meaning 'pitted scale') reflects the ornament on its bony plates and the species, *B. yeungae*, is named after Monica Yeung of Canberra whose ecotourism organisation, Gondwana Dreaming, provided hundreds of volunteers to help prepare the Canowindra fossils.

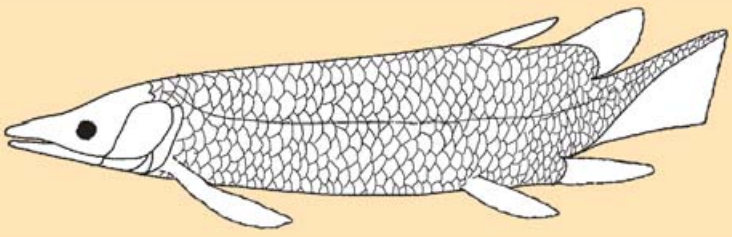
Soederberghia simpsoni
Pronunciation: Soda-burg-i-a simpson-i

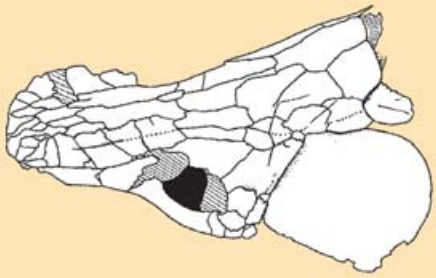
Soederberghia is the only member of the sarcopterygian group Dipnoi (or lungfishes) found at Canowindra and is related to *Neoceratodus forsteri*, the living Queensland lungfish. *Neoceratodus* and two other lungfish groups from Africa *(Protopterus)* and South America *(Lepidosiren)*, together with the coelacanth *Latimeria* (East Africa, Indonesia), are the only living sarcopterygian fishes.

Soederberghia was first discovered in East Greenland and was named after a Swedish palaeontologist Gunnar Säve-Söderbergh. The Canowindra species, *S. simpsoni*, commemorates the contribution of Bill Simpson, who reported the fossil discovery to the Australian Museum in 1956. *Soederbergia* is one of the rarest fishes in the Canowindra fauna and is known from only two specimens - both incomplete. *Soederberghia* is also recorded from Late Devonian rocks of Pennsylvania, USA and from near Forbes, NSW.



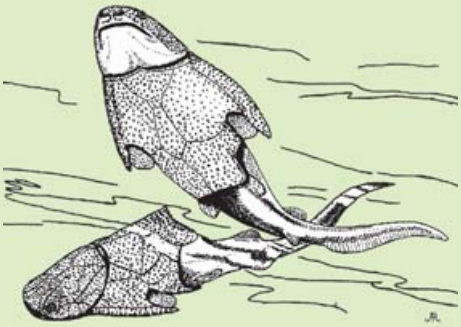
Soederberghia simpsoni **Ahlberg, Johanson and Daeschler 2001**
Late Devonian dipnoan, Mandagery Sandstone, Canowindra, NSW.





Groenlandaspis sp.
Pronunciation: Green-land-as-pis

This small-to medium-sized armoured fish belongs to another group of placoderms, the arthrodires ('jointed-neck'). Arthrodires have one median dorsal and two median ventral plates. This fish was first found in Greenland in the 1930s and has since been discovered on six continents. It grew to about 50cm in length and had a narrow, bony dorsal ridge on its trunk shield. The Canowindra site yielded about 50 specimens of this fish; from juveniles to adults, with some of them the best examples in the world. This species is currently under study by Dr Alex Ritchie.



THE SARCOPTERYGIANS

Cabonnichthys burnsi
Pronunciation: Cab-on-ik-this burns-i

This fish was a medium-sized carnivorous lobe-finned fish. It had strong jaws, two rows of teeth and reached about 70cm and belongs to the family Tristichopteridae. *Cabonnichthys* is closely related to *Mandageria fairfaxi* (also from Canowindra) and to a genus named *Eusthenodon* first found in the Northern Hemisphere but now also known from Devonian rocks in Australia. Such faunal links tell us a great deal about the biogeographical distribution of ancient fishes and the shifting continents on which they lived. *Cabonnichthys burnsi* is named after Cabonne Council for their ongoing support, and the species is named for Bruce Burns who instigated the 1993 rediscovery of the Canowindra site.

Gooloogongia loomesi
Pronunciation: Goo-loo-gong-ee-a loo-mes-i

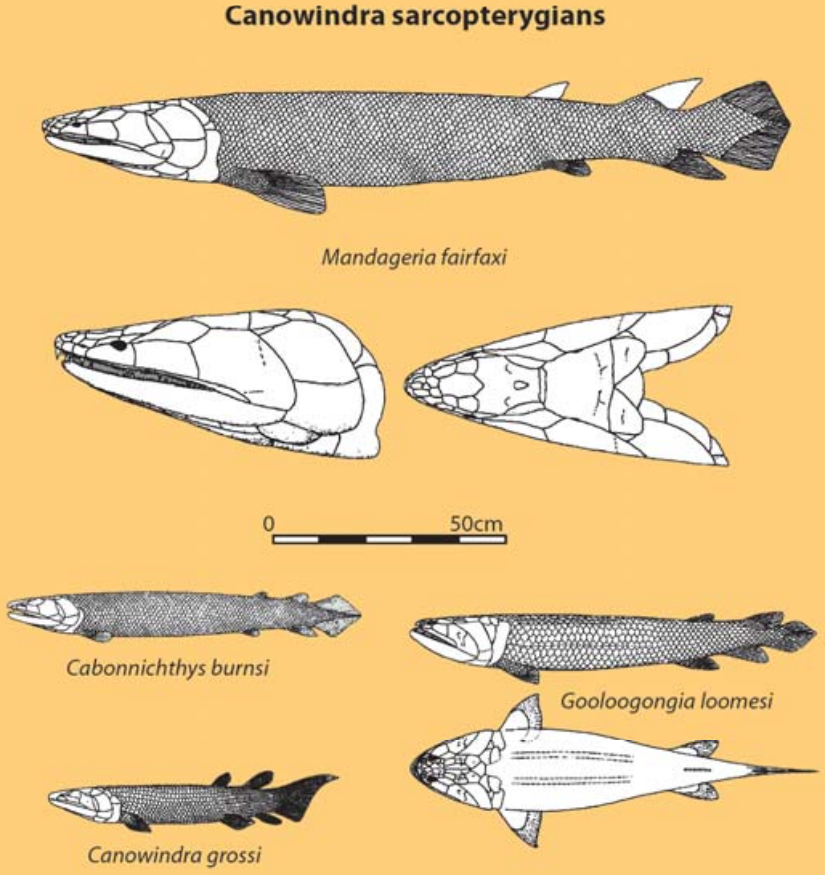
This was a large carnivorous lobe-finned fish, the largest measuring 70cm in length. It belongs to the family Rhizodontida because of its elongated fin rays in the front or pectoral fin. We know that *Gooloogongia loomesi* is one of the most primitive members of the Rhizodontida because other members of this family have elongate fin rays in all fins, but in *Gooloogongia* these are only found in the pectoral fin. *Gooloogongia's* other fin rays are jointed or separated into small segments like those in the fins of other sarcopterygian fish. *Gooloogongia loomesi* is named for the town of Gooloogong located west of the fossil site, and the species name honours Bruce Loomes of Canowindra as supervisor of the 1993 excavation, and for his invaluable support of the Canowindra Project ever since.

Mandageria fairfaxi
Pronunciation: Man-daj-ee-ree-a fair-fax-i

Mandageria, the largest member of the Canowindra fauna and its top predator, grew to between 1.6m and 1.9m in length. The shape of its tail tells us that it was probably an ambush predator capable of rapid acceleration, rather than a constantly swimming fish. The tail of the latter type of fish, such as tuna, is very narrow where it connects to the rest of the body. In *Mandageria*, this region is much wider (as it is in all sarcopterygians in the Canowindra fauna). This impressive sarcopterygian fish was named after the Mandagery Sandstone in which the fossils are found, and for Mr James Fairfax, acknowledging his generous funding of Alex Ritchie's and Zerina Johanson's research work on the Canowindra fauna, for the first crucial six years.

Canowindra grossi
Pronunciation: Ca-noun-dra gross-i

Canowindra grossi was the first sarcopterygian fish to be discovered at Canowindra. It was 50cm long and belongs to a class of fishes known as Sarcopterygii or 'fleshy-finned' fishes. Strangely, although at least 3,700 fish specimens have now been recovered from Canowindra, the specimen on the 1956 slab remains the only known example of *C. grossi*. We know this because its body scales are covered in small tubercles, quite unlike those of any other lobe-finned fish in the Canowindra fauna. Professor Keith Thompson studied and named *Canowindra grossi* in 1973 for the town of Canowindra, and to honour the German palaeontologist Professor Walter Gross.



Age of Fishes Museum

After the spectacular success of his 1993 dig, Alex Ritchie suggested that an Age of Fishes Museum (AOFM) should be built in the town of Canowindra to house the most important discoveries. In 1991 he had visited a similar museum at Miguasha, in Quebec, Canada, which attracts 40,000 visitors a year, despite only being open for four months each summer. Alex felt that a similar museum, featuring local discoveries and open year-round, could prove to be an enormous economic boost for Canowindra and the whole region!

With substantial financial support from Federal, State and Local Governments, a suitable block of land was acquired in the town and Stage 1 of the Age of Fishes Museum was planned and built, opening in February 2000. Since then, with corporate and private sponsorship, Stage 2 – including another exhibition area, a timeline and a picnic area – has been added and the surrounds landscaped.

The museum's displays include 'The Canowindra Story', illustrated by the most important local fossils and detailed information about these ancient fishes, as well as general displays on geological time, rocks and fossils and live aquarium displays. A well-stocked souvenir shop supplies original fossils and replicas, local products and produce, some of it branded with the Age of Fishes logo, to help raise funds for the museum.

To date, the Canowindra community has raised more than $1,000,000 to create their museum, with strong support during the past decade, particularly from Cabonne Shire Council. Like many rural museums, the AOFM struggles to find recurrent funding for its staff and relies heavily on volunteers, donations, sponsorship and grant funding. Despite this, it is steadily developing its range of services to the local educational community and to the tourism industry.

When additional funding becomes available, the immediate aim is to complete Stages 3 to 5 of the museum, including a theatrette and additional display areas. Also planned are special fossil storage facilities and scientific work areas where visiting students can safely experience hands-on activities on real fossils such as cleaning, moulding and casting.

The long-term aim of Canowindra's Age of Fishes Museum is to display not only the spectacular local fossil discoveries, but to illustrate how these relate to finds from other parts of Australia, Antarctica and other continents. Australia has a rich heritage of fossil fish discoveries and these

Opening to the public in February 2000, the Age of Fishes Museum** (left and below left) **is now an important part of Canowindra's identity as well as being a major tourist attraction to the town. Dr Alex Ritchie hopes one day to reopen the Canowindra fossil site for public display, but until funding becomes available to develop the site, fossils such as this magnificent fish specimen being measured by Dr Ritchie and a student** (right), **will remain buried.

fossils dramatically illustrate the evolutionary history of fishes through 500 million years of geological time. Once the Age of Fishes Museum is completed and on a solid footing, Dr Ritchie hopes to be able to reopen the original fossil site and make it an integral part of the unique Canowindra experience for all visitors.

Alex Ritchie's dream

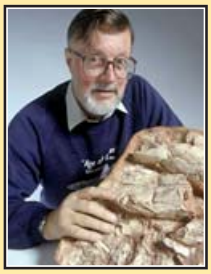
In 1993, nearly 200 rock slabs of varying sizes were collected from the Canowindra locality, but attempts to record how these fish slabs fitted together before they were removed from the layer were largely unsuccessful because of time limitations. Fortunately, much of the bottom surface of the same fossil layer remains *in situ*, thus preserving detailed impressions of the under-surfaces of all the fish and, most importantly, their distribution in the deposit. Before being temporarily reburied to protect it from vandalism, the lower surface of the fish layer was carefully cleaned and protected with plastic sheets and a layer of hay. It is not currently available for examination.

Although the 1993 excavations at Canowindra confirmed the enormous potential of this site; both scientifically and as a unique tourist attraction, most of the Canowindra story will remain buried below Gooloogong Road until sufficient funding becomes available to reopen it for conservation, detailed scientific study and public display. Alex Ritchie believes that making the original site accessible to the public is essential for the Age of Fishes Museum's eventual success and worldwide recognition. Around the world, visitors flock to sites to see rare and spectacular fossils lying where they were buried. Dinosaur National Monument, Utah, USA, Rancho la Brea Tar Pits, Los Angeles, USA, and Zigong Dinosaur Museum, Szichuan province, China, are good examples. Australia has very few such sites; eg. Naracoorte Caves in South Australia and Lark Quarry dinosaur stampede near Winton, central Queensland. Canowindra is potentially in this league.

One day (and having just turned 70 he hopes it won't be too far off), Alex hopes to see the Canowindra site become an integral part of a visit to the Age of Fishes Museum. After reopening, the site would be enclosed in a secure building with walkways from which visitors could view the whole mass-kill fish layer, watch the scientists and volunteers at work and use zoom cameras to view the fossils close-up. By continuing to excavate towards the centre of the original pool, many more fish slabs could be recovered, with cleaning and casting carried out on-site as both an attraction and participation opportunity for visitors.

It works elsewhere, so why not at Canowindra? All it needs is vision and funding (government, corporate and/or private) and the educational and tourist benefits for the central west of New South Wales would amply repay such support.

The Authors



Alex Ritchie studied geology (B.Sc) at Edinburgh University and received his PhD for palaeontological studies on Scottish Silurian fishes. He was the Australian Museum's Palaeontologist from 1968-1995, and is now a Research Fellow at the museum. His main research interests are Devonian fishes (Australia and Antarctica) and Ordovician fishes (central Australia). Rediscovering the Canowindra fish site in 1993 and receiving the 1996 ABC Eureka Prize for Promotion of Science were highlights of his later career.

Zerina Johanson received her B.Sc and M.Sc (Palaeontology) at the University of Alberta, Edmonton, (1989-1992) and received her Ph.D (1998) from Macquarie University, Sydney for work on the Late Devonian fishes of Canowindra, NSW. Her studies, published in a series of papers, were funded first by Mr James Fairfax (1994-97) and by two Australian Research Council Fellowships (1998-2005). Zerina is currently at Macquarie University (Biological Sciences) researching lungfish development.

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