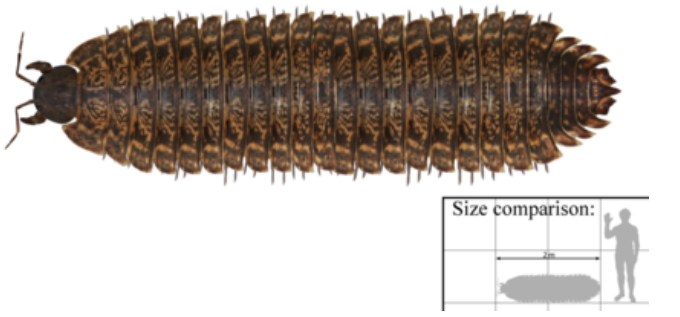
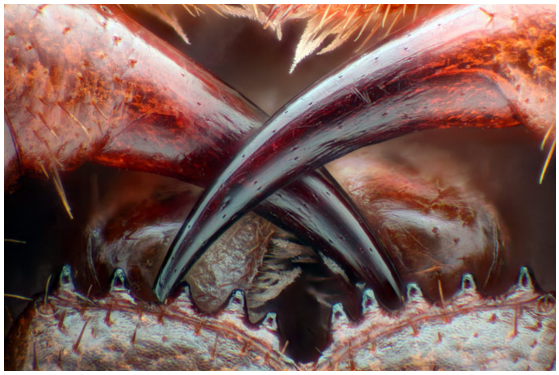
Ancient Tiri Part 8: The first Metazoans (Multicellular Animals)
From the Seas to the Land 3.

We are still exploring the Cambrian Period (650-420Mya) - a time when there was a veritable "explosion" of new species.
Speciation happens when hitherto unavailable ecological "niches" open up to organisms, and random variation in individuals in a population allows individuals with favourable adaptations/genes to "radiate out" and colonise new environments. As their different genes prevail, so a new species forms. This is called "Adaptive Radiation"
Animals were beginning to follow the plants onto dry land at this time, and many innovative solutions to locomotion, respiration and reproduction were appearing. It is a sobering thought that these adaptations are continuing to this day as natural selection still sifts the favourable variations occurring within populations, driven by environmental pressures. As we saw with the Crustaceans in Part 7, many present day species are at best only partially suited to life on dry land, and the struggle continues – and will always continue into the future. It is thought that evolution has no "end goal" in mind, and at all times acts in the "present moment" as ill-adapted individuals die, and only those who are suited to the conditions prevail and pass on their DNA to the next generation.
Looking back at the Cambrian Era, the world was a very different place. Oxygen levels were probably much higher than today, allowing dragonflies with 1m wingspans and gigantic millipedes to exist. When the oxygen levels later dropped these behemoths died out leaving us with todays air breathing invertebrates - a mere 1/10th of their size at most.
The **Myriapods** (= "Many legs") are a mostly terrestrial subphylum of Arthropods containing the **Millipedes** (Diplopoda) and the **Centipedes** (Chilopoda). The fossil record dates their appearance from the Silurian (440Ma). The millipedes are called Diplopods because they possess two pairs of legs per segment. They are slow moving detritivores whose only defence against predators seems to be the secretion of pungent quinones when attacked (although tieke seem to ignore this and gobble them down in great numbers!) Our Tiri millipedes rarely exceed 20-30mm in length. However, in the Carboniferous Period a giant millipede called *Arthropleura* grew to the size of a small car! **Centipedes** only have one pair of legs per segment and are voracious predators. The giant centipede found on Tiri, is *Cormocephalus rubriceps* It grows up to 25cm in length and is the top predator on some offshore islands. Nevertheless on Tiri fearless robins frequently include them in their diets. Their killing technique involves holding them by the tail end and thrashing the centipede's head on a branch until it flies off. You will often find one inside a "Weta hotel" using it as a convenient larder! Their bite is venomous and painful to humans. Any prey from skinks and geckos to wetas is taken. It would be unwise to poke ones fingers into holes in



Arthropleura grew to the size of a small car. *Wikimedia Commons*


Millipedes have TWO pairs of legs per segment. *J.S.*


Centipede – Jaw details. *Wikimedia Commons*

trees or seemingly empty kakariki burrows on Tiri. On the NZ mainland large specimens are rarely found due to rat predation.
The Arthropods contain a large group called the ***Hexapoda*** (= six legs), to which the **insects** belong. Their segments are grouped according to function. For example, 5 segments make up the head, 3 the thorax and 11 the abdomen – each with specialised internal structures and functions.
Each segment may also have external "customized appendages" allowing them to be used for sensory, feeding, locomotory, and reproductive purposes. Modern insects have lost many of these segmental appendages, but the more primitive crustaceans have retained them.
Ancient land-dwelling insects were inconspicuous and wingless, scavenging decomposing plant material amongst the leaf litter much like the **bristletails** and **silverfish** do today on Tiri. Look out for them as they form part of the diet of robins, saddlebacks and whiteheads as they forage through the leaf litter looking for food. Bristletails usually only become visible as they jump out of the way of probing beaks. They can leap up to 30cm into the air as they do so. They are especially abundant in damper areas like the Nikau Grove on the Wattle Track. Their 520Ma pedigree is evident when you look at their crustacean like abdominal appendages (see photo). They belong to the Order *Archaeognatha* (= "Ancient jaws") as their mouthparts are unlike any other living insect.

Cormocephalus rubriceps in a Weta box. *J.S.*

A Bristletail insect showing primitive crustacean like abdominal appendages. *J.S.*

Side view of a springtail. *J.S.*

A springtail approx 1mm in length. *J.S.*

Other ancient Hexapods present on Tiri include the **springtails** (Subclass Collembola). They are small (1-5mm) and hide in damp leaf litter where, like the bristletails they form part of the teeming multitudes loosely described as "detritivores" which consume the decaying leaf litter on the forest

floor. Their vast numbers underpin the forest food chains that sustain birdlife on Tiri. Like the bristletails they are capable of jumping out of the way of their predators. The use a forked lever tucked under their abdomen (see picture), which has a springy pad of rubbery “resilin” protein at its base to store elastic potential energy which is released as the animal jumps. If you have ever watched a robin as it pounces on seemingly invisible prey, it is probably after a tiny springtail.

So about 500Mya many plant and debris-eating invertebrate animals such as annelid worms, primitive insects and millipedes followed the plants onto dry land. A little later the first predatory invertebrates such as centipedes and other extinct groups were feeding on these earlier colonists. However the **Arachnids** were yet to appear in any great numbers. The arachnids belong to the Subphylum ***Chelicerata,*** which includes spiders, scorpions, false scorpions, whip and camel spiders (scorpion-like “spiders”) and the horseshoe “crabs”. The latter were excluded from the Chelicerata by many authorities in the past (hence the “crab” label), but molecular analysis in 2019 confirmed their status as true members of the Chelicerata.

Limulus the horseshoe crab emerging to spawn. A present day representative of the ancient Chelicerates. *J.S.*

Although the horseshoe “crab” ***Limulus*** was present 450Mya, the spiders and scorpions would have to wait another 30Ma or so until the Devonian Period. Modern **winged** insects would also not be present for at least another 100 million years.
It is known that not just scorpions, but whatever they were preying on were already present in the later Devonian Period. We now know that by the end the Devonian, Gondwana (like Laurasia to the north), had a complex terrestrial ecosystem, comprising invertebrates and plants which had all the elements to sustain terrestrial vertebrate life that emerged later.

In the next chapter of “Ancient Tiri” we shall look at the Fungi and Lichens and their vital role in ancient ecosystems, together with the invertebrate animals of their day.

John Sibley 2019