BEER 'N' BONES

Volume 15.1

March 2021

Artwork on Cover:
A Northern hairy nosed wombat meeting an old cousin
By Nellie Pease (See Page 33)

2020 Committee Members:

President: Phoebe McInerney
Vice President: Nathan Phillips
Treasurer: Cassy Petho
Secretary: Nimue Gibbs
Beer 'N' Bones Editor: Qamariya Nasrullah
Field Trip Coordinator: Diana Fusco
Palaeo in the Pub Coordinator: Lauren Alexander
Academic Representative: Aaron Camens
Honours/PostGrad Representative: Cassia Paragnani
Undergraduate Representatives: Mollie Flaherty and Panduka Amarasekara
Volunteer Coordinator: Carey Burke

https://www.flinderspalaeosoc.org/

Contents:

Letter from the Editor:

Hello everyone

My name is Qamariya Nasrullah, and it is my absolute pleasure to be your BEER'N'BONES editor for the next year! A huge thanks to Elen and Sam for editing B'n'B for the past few years; I've got diprotodon-sized trackways to fill!

My background is in palaeontology and evo-devo, particularly of marsupials. I hope to bring you a diverse collection of articles from Australia and even overseas, to showcase the variety of taxa, techniques, and possible career paths that palaeontology can take you to.

For this issue I decided to promote and celebrate women of palaeontology from the present and future! You will be hearing from the up-and-coming to senior leaders, covering topics ranging from Art to Zoo-archaeology.

I'd also like to introduce a few new "regular" segments: a Flinders University Student profile (to promote FU related research), a Museum Staff profile (to cover other careers paths); a Palaeo-artist profile and a Senior Researcher (to serve as a role model for budding palaeontologists!).

If you would like to write for BEER'N'BONES all authors are welcome! Please send your enquiries to flinderspalaeo@gmail.com.

Best wishes for 2021!

Qamariya
Twitter: @QamNas

Foraging a research career in Australian zooarchaeology

By Jillian Garvey

Dr Jillian Garvey
Tracey Banivanua Mar Fellow Senior Research Fellow
Department of Archaeology and History, La Trobe University
Twitter: @jillian_garvey
Facebook: Neds Corner Archaeology Project

I would like to start by acknowledging that I live and work on the lands of the Wurundjeri Woi Wurrung people and pay my respects to their Elders past, present and emerging. I acknowledge that sovereignty was never ceded, and that this was and always will be Aboriginal and Torres Strait Islander land. I am also proud and privileged to work alongside Aboriginal and Torres Strait Islander communities to help tell the story of their Country, their people, their animals and their plants.

Ever since I can remember I have been fascinated by animals and natural history, and actively started my own 'natural history' collection of animal bones, shells, and other objects whilst in kindergarten. This fascination led me to enrol in biological science at La Trobe University after completing high school. During my second year at uni (to avoid extra chemistry electives) I enrolled in a first-year archaeology subject as it sounded interesting and didn't involve adding additional long prac hours to my already full timetable. I enjoyed archaeology more than I anticipated and did surprisingly very well, meaning that I was offered a place in the archaeology department's honours stream. This happened to coincide with La Trobe introducing a BA/BSc degree, so I decided to change degrees to enable me to undertake more archaeology subjects. Although at this stage I transferred degrees motivated by interest, rather than as a strategic career move. It was during my second year that I enrolled in a subject called the 'Archaeology of animals', which was running for its second year having been introduced by Richard Cosgrove into the curriculum in 1996. This subject focused on the role of animals in the archaeological record, primarily on animal bone identification and taphonomy, and I was instantly hooked. The highlight of this subject was an impromptu field trip to the cultural and megafauna site of Cuddie Springs in western NSW, which Judith Field was excavating as part of her PhD research. It was during this subject that I decided that I really wanted to combine my interests in zoology and in archaeology to focus on Australian zooarchaeology; this idea was reinforced by the fact that up until then the majority of Australian archaeological faunal assemblages had been analysed by zoologists who did not have any training or background in archaeological theory. However, my lecturer told me that to secure future employment I would probably have to be prepared to relocate to Europe or North America as it was unlikely that I would find a job in Australia.

I went on to enrol in as many Australian archaeology and zoology subjects as possible. This was

Jillian excavating on the banks of the Kallakoopah Creek, Wangkangurru Country in 2014.

followed by a combined honours degree in zoology and archaeology supervised by Anne Warren and Richard Cosgrove studying the taphonomic history of small mammals from a late Holocene archaeological site in the midlands of lutruwita (Tasmania). I became the first person to graduate from La Trobe with a BA/BSc Hons, and then went on to enrol in a PhD supervised by Anne Warren researching the fossil fish, invertebrates, geology and taphonomy from the Early Carboniferous (Tournaisian) Broken River region on Taungurung Country, near Mansfield in Victoria.

Whilst I enjoyed my PhD, I did miss archaeology. It was towards the end of my PhD that I was awarded a research grant from the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) which enabled me to undertake a taphonomic analysis of the faunal remains excavated in 1981 from the late Pleistocene site of Kutikina Cave from southwest Tasmania. Located along the Franklin River, Kutikina (formally known as Fraser Cave) was rediscovered by cavers in 1979 who were surveying the region in response to the Tasmanian State Government's proposal to Gordon-below-Franklin Dam project. In 1981 Rhys Jones and colleagues from ANU and Parks Tasmania undertook a small excavation at Kutikina to establish its archaeological potential. This one metre-squared excavation yielded approximately 250,000 animal bones and 25,000 stone tools, with Rhys immediately drawing parallels between Kutikina and rich ice age sites in Europe. The archaeologists were even more surprised when the preliminary radiocarbon dates indicated that the cave was occupied between 15,000 and 20,000 years ago spanning the Last Glacial Maximum. This was the first evidence of people having lived within Tasmania's southwest, today home to the iconic southwest rainforest World Heritage Area. It was also the first indication that people had inhabited Tasmania during the late Pleistocene, as previously it was thought that people walked across the Bassian Plain during the Holocene. The significance of Kutikina was a pivotal factor in the High Court's decision in 1993 to stop the damning of the Franklin, as this would have destroyed this important cultural place.

During my year in nipaluna (Hobart), whilst based at the Tasmanian Museum and Art Gallery, I analysed more than 260,000 bone fragments from the 1981 Kutikina excavation. Most of the human prey from the cave consisted of the medium-sized Bennett's wallaby (*Macropus rufogriseus*), which were

Jillian and David Clark excavating a Holocene Aboriginal midden along the banks of the Millewa (Murray River) on Ngintait Country, northwest Victoria.

being hunted out on the nearby 'marsupial lawns' before being butchered and the lower limbs selectively transported back to Kutikina. Here the meat on the wallaby was consumed and the highly rich marrow extracted from the longbones to prevent protein poisoning from over-indulging in the extremely lean macropod meat.

To better understand the butchery patterns at Kutikina, and understand how people were using this important resource, I started conducting economic utility butchery experiments on modern wallabies which I collected as fresh roadkill. This allowed me to calculate how much meat, fat, and marrow a carcass provided, and which body parts contained the most of these resources. Not surprisingly there is more meat associated with the pelvic and upper leg region on a wallaby, with the femur and tibia providing the most marrow. There is also very little fat available on a macropod carcass. I also looked at the nutritional quality of this marrow, finding that the marrow moving away from the heart and out towards the extremities contains the most nutritious fats which are high in unsaturated fatty acids, particularly oleic acid, which is apparently more palatable and keeps you satiated for longer. I studied if the nutritional quality of the marrow varied across the year as had been found for caribou, a main human prey species in many northern hemisphere assemblages. Any seasonal changes may have helped explain the seasonal butchery of wallabies we (the late Anne Pike-Tay, Richard Cosgrove, and I) had previously identified from teeth annuli from several of the southwest Tasmanian archaeological sites. However, the results indicated that the Bennett's wallaby remained a stable resource of high-quality meat and fats across the year. I have since extended these modern butchery and nutritional studies to more than 40 species of animals including seals, emu, mutton birds, lizards, wombat, possums and shellfish. These Australian base-line studies are important in understanding how people selected, butchered, and cooked their prey. They allow us to make predictions as to which animals, and what body parts of these animals people may favour over other aspects of the carcass. This of course only considers the dietary contribution of an animal and does not include its other cultural values.

More recently I have been working with Ngintait and First People of Millewa Mallee Traditional Owners at Neds Corner and the adjacent Yanga Nowie (Murray-Sunset National Park) in northwest Victoria. This was initially part of a DECRA and will now continue under a new ARC DP. Here I have been undertaking surveys and excavations to better understand human occupation of this significant cultural landscape. I have worked on the mollusc fauna from several shell middens, and have also been researching an Aboriginal historic site where people knapped European glass to make tools, and a silcrete extraction quarry known as Berribee Quarry where people dug large pits to enable then to collect silcrete to make tools. Natural outcrops of rock is rare in this region so the silcrete would have been an important and protected resource. It is thought that people have been utilising the rock from Berribee Quarry for a very long time.

In 2021 I will be part of a new research collaboration between Yung Balug and Dja Dja Wurrung Traditional Owners in central Victoria and researchers from La Trobe Archaeology and Aboriginal Studies in central Victoria, funded by an ARC SRI. I hope to focus on the fauna from shell middens, oven mounds and rock shelters in the region, as well as possum skin cloak production.

Besides research, I have also tried to teach as much as I can. I have taught both in zoology and archaeology at La Trobe. Currently I am the course coordinator for the Masters subject Human and Animal Bones which focuses on zooarchaeology and animal morphology, and introduces students to the human skeleton. I also teach into several undergraduate subjects and I am a trainer for La Trobe's unique Certificate IV in Cultural Heritage Management which is designed solely for Victorian Traditional Owners. The course has now been running for more than 10 years and nearly 200 students have graduated. This course has been important in building capacity in Traditional Owner communities, and many of our graduates have gone onto prominent roles in the heritage industry.

During my archaeology research I have been privileged to work with several Aboriginal communities researching how their old people lived on Country for millennia prior to invasion. This experience has had an enormous impact on my perspective of natural science in Australia, and how researchers should conduct themselves. Specifically, my research has been influenced and greatly enhanced by the tangible and intangible continuing connection that these Traditional Owners have with the animals, plants and all aspects of their Country. As an archaeologist

Jillian dissecting an echidna!

I feel honoured that these communities have welcomed and supported me to help tell the story of how their old people lived on Country for millennia prior to invasion.

One of the biggest factors in being able to successfully forage a career in research is that I have been fortunate to have had several strong female mentors, all of whom have successfully combined research and having a family. My most important mentor has been Emeritus Professor Anne Warren who was both my honours and PhD supervisor. Following on from this I've been mentored by several prominent female archaeologists including Associate Professor's Judith Field and Nicola Stern, and most recently by Professor Susan Lawrence. I have also had the support and mentorship of Professor Richard Cosgrove as my co-honour's supervisor and then postdoctoral supervisor. All these people have understood the complexities of being part-time, juggling fieldwork-based research, and being the primary carer for small children.

In 2020 I was lucky enough to be awarded a La Trobe University Tracey Banivanua Mar Fellowship. Established in 2018, these fellowships are named in honour of an esteemed member of the Department of Archaeology and History, who passed away in 2017 leaving behind two young children. They are part of the La Trobe SAGE Athena SWAN project and are designed provide funding at a critical time in the careers of talented ECR and MCR academic staff and are aimed at reducing the impact of career breaks and/or care giving responsibilities have on research productivity. As a bizarre twist of fate, the day that I began my fellowship last year, coincided with the first day of Term 2 for Victorian school children, which was the first official day of remote learning in Victoria, which continued for almost 6 months.

I didn't have my children till after I finished my PhD, which is not always how life works out for many women. I was lucky enough to be awarded my ARC DECRA when my son was just over a year old, so the fellowship provided me with the opportunity to work part time while looking after him, and also provided important maternity leave when I had my daughter in 2015. Without the DECRA I would not have had the flexibility to be able to progress my research as well as spend quality time with my children when they were little. As my research is heavily field based, I also had to work this aspect of my career around school holidays and other family obligations.

In the last few years, I have come to the realisation that I hope part of my research and teaching legacy will be that I can help in facilitating the decolonisation of Australian archaeology and other related disciplines, and assist in truth telling. Australia is on the cusp of many changes, which is evident from current discussions on BLM, Indigenous Voice to Parliament, Treaty, and the Uluru Statement of Heart. Many Traditional Owner groups have established joint management plans with Federal and State Government agencies, and now have much more control over Country. These changes are likely to impact all researchers who want to conduct research on Country, including the removal, preparation, and long-term curation of fossils. I am encouraged at the number of palaeontology colleagues who have taken the initiative to forge meaningful collaborations with Traditional Owner groups, and also at the number of people interested in learning more about how to engage and work with First Nation communities. These are things that we need to start proactively incorporating into our research as well as ensuring that we discuss these import issues with our students.

I know that I am very fortunate to have been able to pursue a career in science and create my own research and teaching niche in Australian zooarchaeology working along side Australia's First Nation people. I use animal remains and material culture as a proxy for understanding how the Old People lived on Country, from deep time to the present. This work means that I am privileged to be able to help reestablish a tangible connection for Traditional Owners to the past and their ancestors. I therefore, consider it part of my responsibility as part of this research to ensure that I help tell the story of this significant cultural landscape, its people and its animals. Science communication to the public is an important part of this process as it helps gain support for research, and can inform on political and ethical thinking. Most importantly, discussing the wider implications of my zooarchaeological research with the general public, helps to decolonise STEM and aids in working towards reconciliation.

My advice to the upcoming generation: is to find something that your passionate about. For me discovering zooarchaeology changed my life. It is a vocation rather than a job, and I know that being able to make a living from something that I love is very rare. Don't say yes to everything as you can easily get overwhelmed but do say yes to the important things even if it's a bit out of your comfort zone. Try not to compare yourself to other people, as there will always be people who write more papers or earn more money. Everyone suffers from imposter syndrome- if you're not sure what that is look it up. It's perfectly normal. I know professors who have admitted to getting imposter syndrome periodically throughout their careers. There is a real gender bias in academia, but slowly the glass ceiling is being broken. I am constantly disappointed when I attend conferences to see how many brilliant female students there are, and how few females are employed in academia especially in senior roles. Find a good mentor, or several if possible. These don't have to be official mentors but can be people to help you with different aspects of your university life. Keep a running CV of all the little bits of volunteering, conference attendance etc. You never know when you will be asked for it. And most of all if you're not enjoying what you are doing then stop.

Jillian on fieldwork with her then 2-year old son Luca on Ngintait Country, northwest Victoria.

Fangaroos, kangaroos and education too!

by Dr Kaylene Butler

Cookeroo hortusensis, a macropodid (related to most modern kangaroos) from the Riversleigh World Heritage Area.

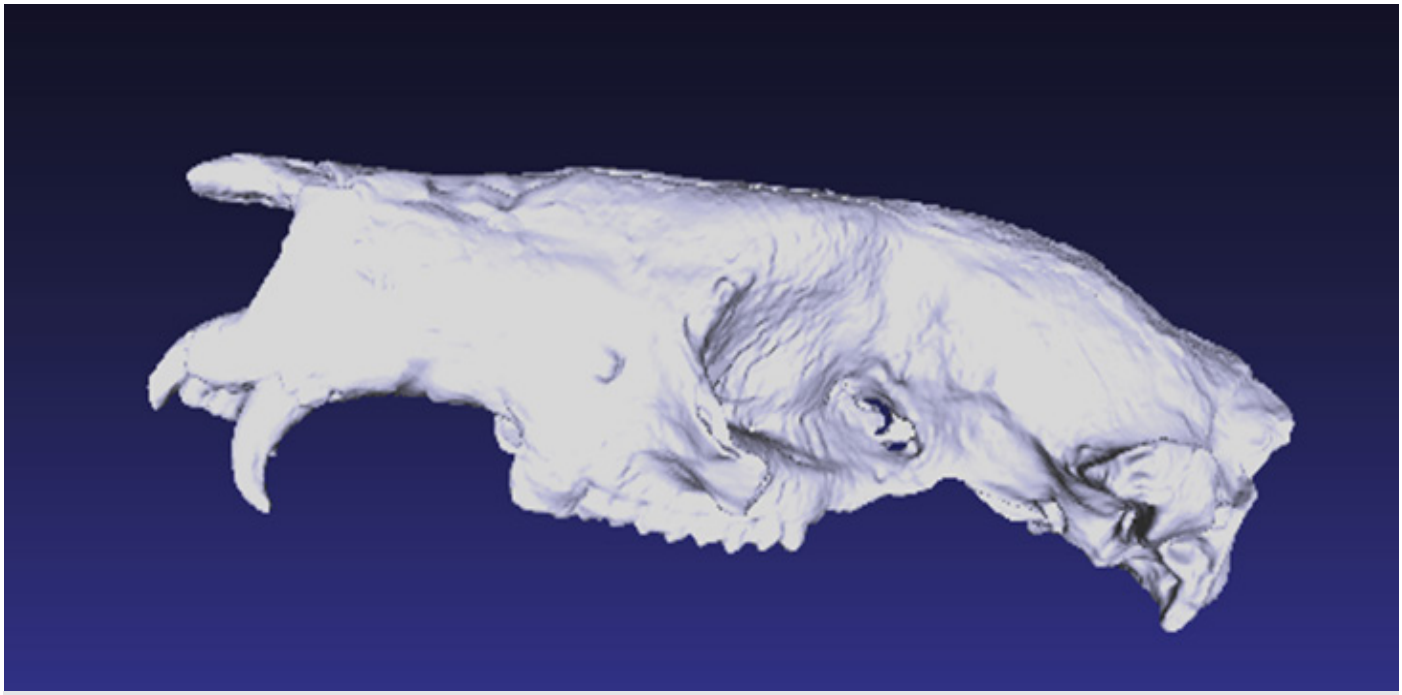
Growing up I was obsessed with Jurassic Park, an obsession which drove me to a career in palaeontology – a story which I am aware is incredibly common for my generation. I was convinced that I would study dinosaurs and become the next Alan Grant or Ellie Sattler, but with much less running from dinosaur clones in my life. This obsession drove me to complete an undergraduate degree in zoology. Flash forward 10 years and I have a PhD in palaeontology. Success! But in no way the success high school Kaylene envisaged. I now work in STEM education where I coordinate part of Wonder of Science, a series of programs which primarily mobilizes and sends over 100 PhD and early career researchers into schools to assist Year 5 - 9 students in completing term-long STEM inquiry-based tasks. To top things off my PhD didn't involve dinosaurs at all! As readers of this newsletter are more than aware, palaeontology is so much than dinosaurs. Instead, I found myself fascinated with Australia's incredibly unique mammal fauna and went on to complete a PhD studying kangaroos.

But what is a kangaroo? When we picture a kangaroo, most people picture the iconic red kangaroo or a species of grey kangaroo. Large, hopping creatures bounding through the Australian outback. As common as seeing on these kangaroos may be, they represent just a small part of the diversity of species within the "kangaroo" suborder which we call Macropodiformes. In fact the term "kangaroo" might be used to refer to tree kangaroos which are members of the same family as red kangaroos (Macropodidae) or even musky rat-kangaroos, the sole living member of an entirely separate family (Hypsiprymnodontidae). The macropodid family even includes the beloved and adorable quokka. However, there is an often-forgotten extinct family of "kangaroos" known for their extremely large canines.

The balbarids (Family: Balbaridae) are a group of extinct kangaroos which existed between the Late Oligocene (~25 million years ago) to the Late Miocene (~ 12 million years ago). Fossils of these "fanged kangaroos" have been uncovered from Queensland, South Australia and the Northern Territory. The are actually incredibly small ranging from 1 – 12 kilograms depending on the species and most-likely could not hop instead scurrying on all fours through the landscape. They also coexisted with members of the macropodid family and potential ancestors of modern kangaroos such as *Cookeroo hortusensis* (pictured on previous page), a species I had the privilege of naming after the late Dr Bernie Cooke. The balbarids are known for their large canines which are prominent on the skull of the most recognisable fanged kangaroo species *Balbaroo fangaroo* (Pictured below). Other species of balbarid also have large canines such as the tiny *Ganwamaya couperi* known from both South Australia and Queensland. This has led to the colloquial term for the group: "fanged kangaroos". Unfortunately hearing the word "fangs" can also lead to a misconception that they are "vampire roos" out for

Balbaroo fangaroo, a "fanged kangaroo" from the Riversleigh World Heritage Area.

A cast of the upper teeth of *Ganwamaya couperi* from the Ngapakaldi Local Fauna, South Australia with canines (labelled C1 meaning first canine) present.



A 3D model of a composite of fragments of the skull of *Balbaroo fangaroo.*

blood. In reality, research shows that the fangaroos are in fact, like most kangaroos, HERBIVORES (plant eaters)!

But how can we possibly know that fangaroo was an herbivore? There are a number of ways palaeontologists can determine diet of a kangaroo. The simplest way is to look at the animals back teeth. When we chew food - do we chew with our front or back teeth? We chew with our back teeth! So, by looking at the back teeth (premolars and molars) of an animal we can generally tell whether the teeth are for eating meat or eating plants (or both). The shape of fangaroo teeth are incredibly similar to that of a plant-eating kangaroos and generally similar in terms of tooth sharpness to those of tree kangaroos. We can also use 3D modelling to understand how the shape of kangaroo skulls related to diet. By comparing the overall shape of 3D models of fangaroo's skull with other species of kangaroos we can also tell that fangaroo has a similar skull shape to leaf eating (or browsing) kangaroos such a tree kangaroos and quokkas as well as other species of kangaroo which existed at the same time as balbarids.

This makes sense in context of when, and where, fanged kangaroos appear in the fossil record. One of the most common places balbarid fossils are uncovered is the Riversleigh World Heritage Area in north western Queensland. This area is home to many balbarid-bearing fossil deposits spanning the late Oligocene where there are several species of balbarid to late Miocene where only a single species remains. During this time, we see a transition from rainforests (perfect for leaf eating kangaroos but far different from north western Queensland today) to open woodland and grasslands. At Riversleigh we also see both balbarids and the ancestors of modern kangaroos. Both groups increase in body size through time. However, balbarids begin to decline in numbers while the ancestors of modern kangaroos thrive. This, their similar skull shape, and other factors may suggest that in fact the poor balbarids were simply out competed by the ancestors of modern kangaroos. Possibly suggesting that the balbarids became extinct due to the loss of habitat and competition with the ancestors of modern kangaroos.

So why the long fangs if not for eating meat? Having canines does not actually equate to eating meat. For example, male musk deer and water deer have canines that can range from 5 – 8 cm in length (far longer than fangaroos') despite being herbivores. In that case the males only have them and they are used in aggressive encounters with other males. It is possible that, like deer, only male balbarids had large fangs however we do not have enough complete skulls for any single species of balbarid to actually test this hypothesis. Others have suggested that the fangs may be used for digging fungi or roots out of the ground.

Perhaps this is a question for the next generation of

palaeontologists. While volunteering with Wonder of Science during my PhD I found that speaking about palaeontology wasn't the only thing I enjoyed. I found myself teaching topics ranging from climate science to the physics of lasers and that I absolutely thrived teaching others about the value and importance of STEM. At Wonder of Science I now work with all aspects of the Australian curriculum on a regular basis. However, I frequently see students in both primary and secondary school excited and inspired by the mystery of fangaroo and other extinct animals (be they dinosaurs, marsupial lions or giant kangaroos). Why the fangs? Why don't we have fangaroos today? How do we go from kangaroos that couldn't hop to the large hoppers we see today?

For many students, the same questions discussed in this article, as well as their burning questions about dinosaurs, fossils and yes, even the mysterious fangaroo can be a segue into understanding scientific inquiry. They inspire young students to begin asking questions and seek out answers to those questions. For many primary students, questions about dinosaurs are often, albeit unintentionally, their first interaction with science. For some, like me, this may inspire a career. For others palaeontology can simply be an interesting way to start a conversation about critical thinking, problem solving and scientific research before moving into important discussions about climate science, extinction, the environment.

My passion for Jurassic Park led me to study a PhD and my passion for understanding the mystery of a tiny fanged kangaroo somehow led me to a career in STEM education. Where, if it hasn't already, could palaeontology lead you?

Dr Kaylene Butler
Program Officer
Wonder of Science
Twitter: @kayleontologist

Dr Kaylene Butler is a vertebrate palaeontologist turned STEM educator who now works as a Program Officer for Wonder of Science at The University of Queensland. She completed a Bachelor of Science majoring in Zoology with First Class Honours in Geology 2013 and a PhD in 2018 from the University of Queensland, Brisbane, Australia. During this time Kaylene also described a new genus and two new species of ancient kangaroo from Riversleigh. She then went on to work as a Postdoctoral Research Associate at Queensland University of Technology before beginning work with Wonder of Science.

Dr Elen Shute

Palaeo-ornithologist

Describe your project in 3 words:
Unexpected extinct species

What were you studying before your PhD?
Originally? A BA (Hons) that combined arts and sciences. My Honours project was on Ground Parrot conservation. Then came a Masters in Quaternary Science (think ice ages, glaciers, mammoths, humans, pollen, etc.). Next came a long gap where I had actual jobs. Then I began a PhD in ancient DNA which was a dumpster fire, so I quit and started all over again at Flinders.

What made you decide to choose this topic?
I have a lifelong love of birds and palaeontology, plus a Quaternary Science background. When I was looking for a replacement PhD topic in 2011, all those stars aligned when Liz Reed told me that Gavin Prideaux had just brought back a big haul of Pleistocene bird fossils from the Nullarbor. I got in touch and he was really happy to have someone to work on them, and much like when you feed a stray cat, I now refuse to leave.

Are you a lab, field or computer based researcher?
Bit of each, but with the majority of time spent between lab and computer, plus a fair bit of time spent perusing bones in museum collections. I love going on fieldwork when I get the chance though, particularly if it involves caves. Variety – that's a good life, I think.

What were some of the biggest challenges you faced during your PhD?
Massive learning curve. There are 21 orders of birds in Australia (for mammals you only have four basic categories of furries – marsupial, rodent, monotreme or bat), so when you're starting out learning to identify bird bones it takes a long time to get your eye in. Studying and working part time was also a challenge and caused lots of wear and tear.

What was the most exciting or cool thing you discovered?
GIANT COUCALS! And a multitude of megapodes.

Where was the most exotic location you got to travel to for your research?
The Nullarbor Plain, now one of my spiritual homes. I had two trips out into this subtle, and really quite magical, landscape to excavate fossils. I clocked up five weeks of hardcore camping and digging there, which was pretty raw, but worth every discomfort.

What would your ideal job be?
Is this where I say palaeontology? Palaeo research is certainly an ideal job for me, but I am not single-minded about following this path and this path only. I think I will always combine it with other things, especially conservation, and hopefully writing as well. But really, I can be happy doing lots of things. My main requirements are that it's useful to society/environment and that there are great people to work with.

What are your interests outside of science?
Mostly hobbies that are physical/practical. Playing the cello, handicrafts like knitting and weaving, cooking, hiking, growing veggies, woodwork, photography, and hanging out with non-scientist friends who don't give a monkeys about my work. And then of course there's making puns.

What advice would you give to the future generation of scientists?
I'm not sure I'm sage enough to be handing out advice, but here goes. Reflect on what a successful life as a scientist would mean to you in the longer term, and what legacy you'd like to leave behind through your work. The science ecosystem currently favours short-term thinking – making people chase the latest hot topic, the next research grant, getting lots of citations. But at its best, science is a process of discovery with the purpose of advancing knowledge. Do work that you will feel proud of in 50 years' time, and do it with integrity. I will die on this idealistic hill, and I hope at least some of you will die with me.

If you could meet anyone dead or alive, who would it be?
Speaking as a biologist I'd love to travel back into the 19th Century to meet Thomas Henry Huxley, one of the most phenomenal brains of his age. On a more personal level I'd like to head back 50 or so years to meet my paternal grandfather, who died before I was born.

If you could bring back one extinct animal, what would it be?
A *Centropus maximus* is for life, not just for Christmas. I promise I'd look after it.

Wing bone of a living Brush-turkey Alectura lathami (left) versus that of an extinct giant megapode, *Latagallina naracoortensis*.

Find more about Dr Shute's research here:

Twitter: @LoneRangifer

The Conversation: https://theconversation.com/profiles/elen-shute-224906/articles

Flinders University: https://sites.flinders.edu.au/palaeontology/home/people/assistants/elen-shute/

Dating in the dark

by Priya

"All you have to do is contemplate a simple grain of sand, and you will see in it all the marvels of creation."

~The Alchemist, Paulo Coelho

Contemplate about 500 grains, and you'll get a burial age. Optically Stimulated Luminescence (OSL) dating is a technique used to measure the last time a quartz or feldspar grain was exposed to sunlight. OSL dating is applied to many palaeontological and archaeological sites around Australia. It is particularly useful in sites that are older than 50,000 years which is the limit of radiocarbon dating.

When buried, a grain of sand begins to build up a charge. This charge is trapped within the crystal lattice of the grain, and increases over time as a result of environmental radiation. These charges are light-sensitive. So we carefully extract them in the field, and process them under dim red light back in the lab. First, we isolate quartz grains through a series of chemical processes. We then put these individual quartz grains onto a disk, and zap them with a laser. This laser evicts the trapped charge within the crystal lattice, producing a photon of light, which we then measure. By measuring the trapped charges within the crystal lattice, we can then work out how long it has been since this grain was last exposed to daylight. This technique is useful in understanding the deposition of sediment through time.

I have had the privilege of working as a laboratory technician for a few years in the Prescott Environmental Luminescence Laboratory at the University of Adelaide, which has produced many of the OSL dates we see in publications today. Working in the lab inspired me to pursue a PhD on the technique.

As part of my PhD project, I've been focused on applying the OSL dating technique to two megafauna sites in South Australia: Naracoorte Caves and Lake

Acquiring an OSL sample in the field.

Working under red light conditions in the luminescence lab.

Callabonna. In addition to dating the sediments, I look at a series of different proxies to understand environmental changes through time. Counting charcoal can give us an idea of fire regimes, while identifying pollen allows us to reconstruct past vegetation. Studying the concentrations of various elements within the sediment can tell us how arid or wet the environment was in the past.

From here, we are slowly able to piece together our understanding of the relationships between fire, vegetation and fauna in the past through time.

I'm currently 2 years into my project, and have a year to go. I have to say through this journey I have undertaken, I have met many challenges and failed in so many ways, I've stopped keeping count. The one thing that always keeps me going, is the reminder of how weird and wonderful earth is. And that a single grain of sand, can tell us so much about the world and its processes.

Priya
PhD student
Earth & Environmental Sciences
The University of Adelaide
Twitter: @priya_storic
Blog: http://priyastoric.com/

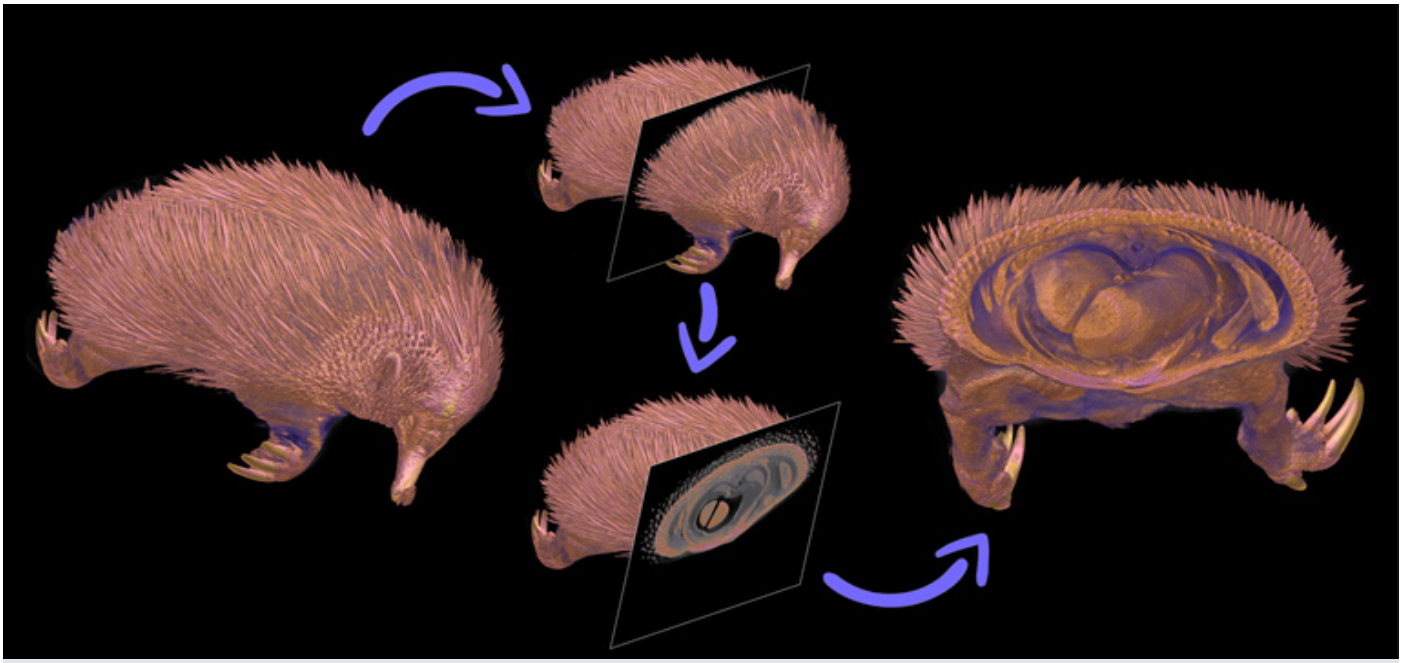
Unshelfing the Natural History of Vertebrates

By Dr Jaimi Gray

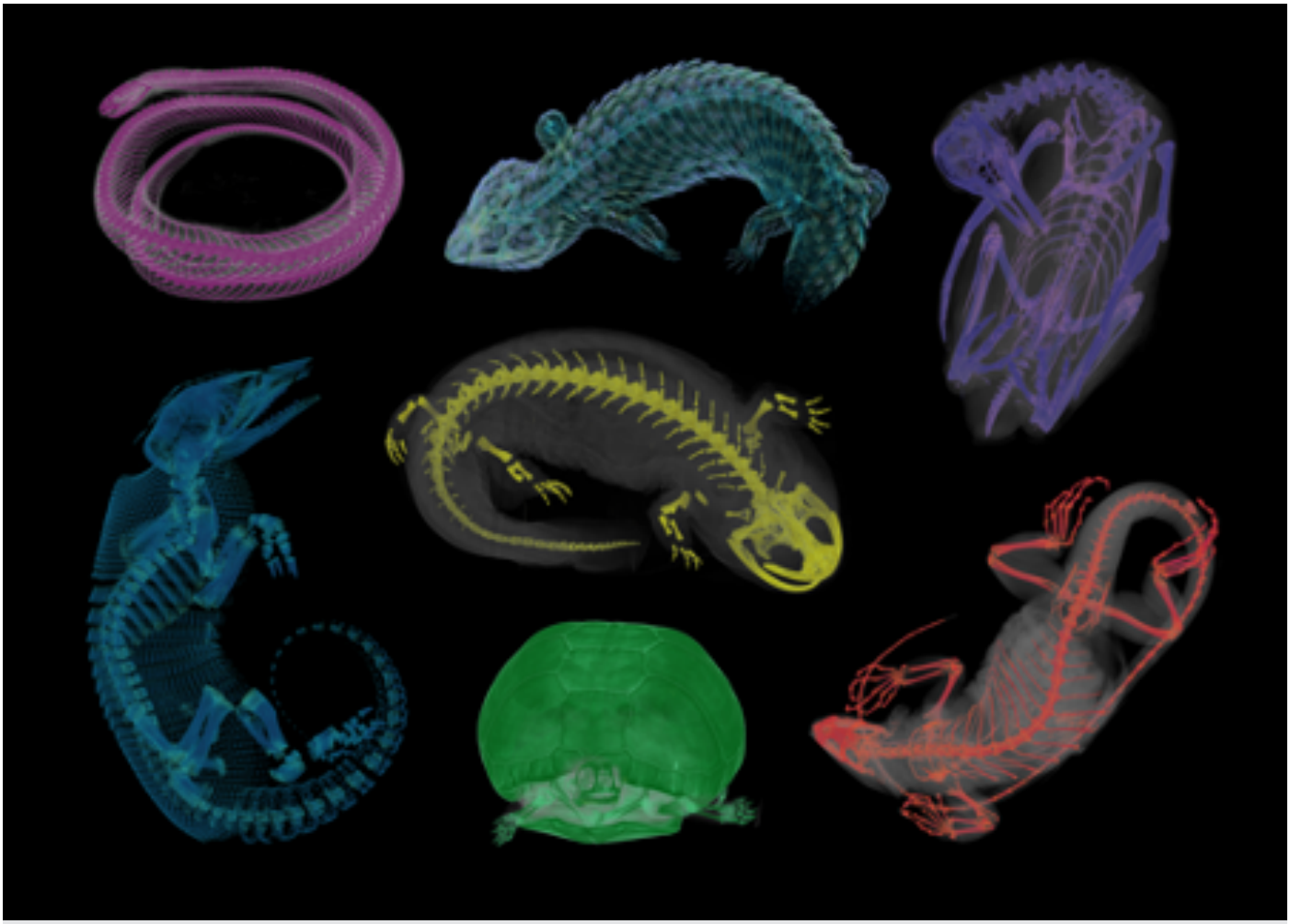
When I say "natural history collection", what do you picture? Perhaps you imagine a room full of rows of shelves, and cabinets, packed with containers and jars of specimens. If you're a regular visitor to our very own South Australian Museum, perhaps you imagine taxidermied animals, skeletons, or fossils in glass cases, frozen in time and on show for you to observe from the other side of the glass. If you wish to study any of the objects in a natural history collection in further detail or use them as comparative material in your palaeontological endeavours, it's not always easy to get access. If you have specific specimens in mind, accessing them often involves money, travel, and knowing the right people.

Whatever you picture, you probably don't imagine being able to examine natural history collections from the comfort of your own home. I'm working as part of a team making that possible. The "open Vertebrate" (oVert) project is based at the Florida Museum of Natural History, and in collaboration with 15 other institutions, we aim to facilitate open exploration of vertebrate diversity in 3D. To achieve this aim, a massive digitisation effort is underway. We use scanners to bombard specimens with X-rays from every direction, and then use the resulting X-ray images to reconstruct the skeleton and any other dense tissue in 3D. We call these Computed Tomography, or CT scans, and we've been doing tremendous amounts of them.

3 years into the project, a massive 8,300 specimens have been scanned from around 50 different natural history collections, representing approximately 4,300 genera in over 700 families of vertebrates. The most exciting part is that these have been made available online in partnership with the Morphosource digital repository at Duke University. There are also many CT scans of fossil specimens on Morphosource. Once you find the CT scans and other 3D media you want, you can download them directly to your own computer. Then you can view it in



DiceCT scan of a short beaked echidna, sliced through the middle to reveal internal anatomy.



A small taste of the CT scans available thanks to MorphoSource and the oVert project: cobra (pink), sleepy lizard (light blue), Galapagos penguin (purple), nine-banded armadillo (dark blue), Japanese giant salamander (yellow), eastern box turtle (green), green iguana (orange).

3D, make animations, measure it, use it in analyses, dissect out parts that interest you to make detailed models, use it as comparative material for palaeontological projects, and 3D print it. Or sit there and stare at it because it's just that beautiful. If you think this all sounds amazing, just wait, because we're taking even further.

If you manage to gain access to physical specimens in a museum collection, your research prospects are often limited to measurements or observations you can make very carefully on the external parts of the specimen. With good reason, no museum curator will let you take a scalpel to unique or rare specimens or alter them in any way. But we can use reversible staining techniques that increase the densities of soft tissues in predictable ways. Take any specimen, submerge it in a specially prepared solution of iodine, leave it there for long enough, and the solution will diffuse into the soft tissues to make them visible in a CT scan. We call this contrast-enhanced scanning process "DiceCT" (Diffusible iodine-based contrast-enhanced CT). Now we can build another detailed 3D replica, but this time you can examine the soft tissue anatomy of that specimen, where before you could only see the skeleton. Along with the skeleton, you can now measure, analyse and dissect muscles, internal organs, circulatory and respiratory systems, eggs, stomach contents, parasites, and whatever else you can think of. The ability to look at specimens in fine digital detail, along with the vast numbers of specimens available, means that you could complete entire research projects without having to leave your house.

We're still going, and eventually we'll provide digital representatives for more than 80% of vertebrate genera. And even when it is over, it's not! Along with the uprise of CT scanning, the oVert team are spreading the 3D love among as many researchers and budding scientists as they can. By training other researchers in the best practices for scanning and managing scan data, we hope to ensure that the digitisation of natural history collections will continue beyond the life of this project, and that global access to this ever-growing resource can

always remain. For budding young scientists, we have developed teaching resources for comparative anatomy of vertebrates, which are frequently used by educational institutions. Through Dave Blackburn's (lead project PI) Lab Sketchfab page, we have published over 330 3D models that can be viewed directly through your internet browser, without the need for any fancy software or 3D modelling expertise. The reach is broader than the scientific community - oVert specimens commonly feature in special exhibits and artwork. And of course they do. Have you seen them?

If your interests lie in evolution, morphology, anatomy, palaeotology, art, or looking at beautiful things, I suggest you begin your exploration of the 3D world. Onwards to 3D wondery!

Get CT scans on MorphoSource:
https://www.morphosource.org/

Examine 3D models from the Blackburn Lab Sketchfab page:
https://sketchfab.com/ufherps

Read more:
https://www.floridamuseum.ufl.edu/overt/

See recent oVert activity on Twitter under the hashtag #oVertTCN

Dr Jaimi A. Gray
Postdoctoral Researcher
Florida Museum of Natural History
University of Florida
Twitter: @jaimiAgray

Dr Jaimi Gray is an evolutionary biologist who specialises in morphology and 3D imaging, with a particular fondness for reptiles. She completed her PhD at the University of Adelaide in 2018, and has since completed postdocs in New Zealand and Oklahoma. She is currently working for The Florida Museum of Natural History at the University of Florida on the NSF-funded oVert Thematic Collections Network project.

Cassia Piper

Registrations Officer

Western Australian Museum

Yes, I am one of those people who loved dinosaurs as a kid. I read Dinotopia, and watched Walking with Dinosaurs, and Walking with Beasts, and the Land Before Time, and owned lots of dinosaur toys and figurines and drew dinosaurs and wrote about dinosaurs whenever I could. However, if you'd asked me what I wanted to be, I would have said a vet. I knew palaeontologists were people who studied dinosaurs, but, since all my palaeontology input was American-based (and let's face it, predominately male), I had very little idea that it was something I could be.

Fast-forward to my late-teens, and I'd shifted my career interest from cats and dogs to more exotic animals. I studied at the University of Western Australia and started out in a Bachelor of Science in Wildlife Management. In my second year of uni, I did a unit on animal structure and function that started with six weeks on oesteology.

Now, I had always loved bones. I find them fascinating. One of my earliest memories is when my family were on a holiday in the Flinders Ranges (we lived in Adelaide for 5 years) and I found a ram skull with beautiful curving horns, a specimen many a skull collector would drool over. I picked it up and insisted on taking it home. My mum, who isn't a fan of dead things, ended up letting me, and has very patiently dealt with skull collections ever since.

So, I studied this unit with a will. I didn't end up getting the best marks in it. But my friends would constantly joke about my "boner for bones", and I started applying the knowledge of anatomy into my art hobby and drawing skulls and skeletons and speculative anatomy of fantasy creatures. I still have the textbook because it's a topic I found so fascinating I can't bring myself to get rid of it.

My third year rolled around and it was time to pick an Honours topic. I had no idea. I had such a general love for all things science and ecology and biology. So I spoke to one of my lecturers and she told me to pick something I was interested in. Honours can be challenging so it was best to pick something you were truly passionate about. And I instantly thought bones.

The uni organised a social event for all the Honours candidates and potential supervisors to get together and talk about projects. I knew who I needed to talk to. Jamie O'Shea, the lecturer of that second-year unit I loved so much. I was filled with anxiety and spent 10 minutes plucking up the courage to talk to him. But I did it. And I always think that that courage got me to where I am today.

Jamie told me that there were two ways I could work with bones; work on modern day animals, or work with extinct animals. He arranged some contacts at the Western Australian Museum for me, so I could do some volunteer work and find out which I liked more. I sent those emails (again, full of anxiety), and got replies from both the Mammology department and the Palaeontology department. The Mammalogy department didn't have enough staff to supervise a volunteer, but the Palaeontology department was happy to take me on board, provided I came in for an informal interview first.

That was how I met Mikael Siversson. I went to the Museum and had a chat with him, and he deemed me a good enough person to work on the collections, even though I was more interested in working on mammals than working on sharks. In fact, there was a HDR (Higher Degree by Research) student who was after some volunteer help. Maybe I could help her as well and get a feel for what she was doing, and meet her supervisor and see if he had anything for me?

The student I ended up helping was none other than Kailah Thorn, who at the time was working on measly mammals, and not 25-million-year-old lizards. The supervisor was Alex Baynes, a man with an endless supply of natural history information stuffed into his brain. I spent three months at the Museum sorting sieve fractions for Kailah, cleaning marine reptile vertebrae for Mikael and discussing prospective projects with Alex.

I ended up splitting my Honours year into 18 months (because no one told me I couldn't) and spending the first semester getting units out of the way and continuing to volunteer at the Museum while I figured out what to do. From there, I found my Honours project. I was going to work on the sieve fractions from Morgan's Cave in the Montebello Islands. Morgan's cave was one of three caves excavated by a team of archaeologists in the year I was born. But since it contained no archaeological material, it was left in the Museum collection, unanalysed and unloved.

So started, in total, approximately 9 months of reading, writing, sorting, cleaning, identifying, spreadsheets, graphs, microscope work, labelling, editing and more writing. I finished my Honours and graduated from University. Now to get a good job that paid good money……..right?

After university I spent my time working for Alex and working in retail while applying for jobs. I knew I didn't want to do a PhD, at least not straight away. While I enjoyed my Honours well enough, I was also quite glad to be done with it all. I kept volunteering at the Museum. In fact, I loved it so much I would usually turn down paid work to go and clean fossils. I loved science and valued being treated like a scientist and not some dumb check out chick so much I changed my availability so that I could go to the Museum once a week. It was something my retail managers never understood, especially when I kept going in for free. "When does it stop being about love and being about money?" I never had an answer to that question. Who does?

My enthusiasm did end up paying off. Helen Ryan, the Palaeontology Technical Officer, was due for maternity leave for her second child, and wanted to be away for a whole year. She told Mikael that her job couldn't be undone for a year and suggested me as a maternity leave cover.

I would say that that was what gave me my true break into the Museum. The skills I gained while covering for Helen, the chance to impress the Boss (in this instance, Mikael) and meet, talk and email researchers and other collection managers and curators was a fantastic opportunity and a fantastic experience. I was lucky enough to be involved in the Perth Museum "decant" (basically a fancy term for everything being moved out of the Museum Perth site to make way for the new building and galleries). I still remember deinstalling the dinosaur cabinet

and holding real dinosaur bones! It was also the year I got to go on my first paid field trip (a UWA trip), and not one but two WAM field trips, where I found my first marine reptile vertebra (and many more after that, don't you worry)! I reorganised the entire vertebrate palaeonotology specimens, and cleaned them up, repacked them in neat boxes, and made sure all their tags and catalogue entries were up to date.

This was probably what really gave rise to my desire to work in collections management; I loved being able to see a large range of specimens, and being able to organise them and retrieve them with ease for visitors made me feel very accomplished. If I had been given more time, I would have completed tasks like verifying physical tags and electronic data, cross checking registration numbers, and moving on to the invertebrate collection. Alas, Helen was very keen to return to work, and so my time with the palaeontology collection drew to a close. However, there was another Museum job just advertised. All the skills I had picked up covering for Helen were applicable.

I want to say that was it, I'd made the dream work, and it was onwards and upwards from there. I applied for that job, Registration Officer for the New Museum Project, and got turned down. I still remember getting the email in the break room at my retail job. I had to duck into the bathrooms because I started crying. I felt like I wasn't going to get where I wanted to go. I also applied for a summer position at the Royal Tyrell Museum of Palaeontology, and got turned down for that too (not at all surprising, it is SUPER competitive). But by then, I had become so fixated on the idea of going to Canada, I decided to go anyway.

2017 was a year of traveling for me. I may have missed out on the NMP job, but I also spent 6 weeks in Canada, including one week in the Badlands around Drumheller, home of the Royal Tyrell Museum of Palaeontology. I hired a car, and drove on the wrong side of the road out to the Badlands. To say I loved it is an understatement. I would go back there in a heartbeat. The landscape was phenomenal, you just know there are dinosaur bones in that stratigraphy. The museum was so good I went twice. And I also got my very first tattoo in Drumheller, a small, simple, line art Triceratops, because what else would I get?

A moa bone was found on the CAVEPS post-conference field trip. Everyone was very excited.

A closer view once it had been dug out a little bit.

I came back from Canada feeling much better about life, and that I could do anything. Several months and a field trip later, I was on a plane (again) to Queenstown, for the CAVEPS conference. I presented the results of my Honours thesis, plus the extra analyses I had been working on with Alex after I finished my project. I was the last talk of the day, and I was so nervous, I kept stuttering over my notes. Everyone else had been so confident and had known their research back to front, how was I so bad at this?!

I mustn't have done too bad though, I was offered several PhD projects. That still amazes me to this day. I still wasn't sure what I wanted to do, but it was so nice and quite validating to have them as an option. All that hard work had paid off.

With the travel bug still feeding on me, I applied for another summer internship in North America, this time at the Mammoth Site of Hot Springs, South Dakota. Unfortunately I didn't get this one either,

Top Left: Standing out the front of the Royal Tyrell Museum, with approximately CAD$100 worth of souvenir shop purchases and glad wrap around my fresh tattoo.

Top Right: Posing with a Centrosaurus vertebrae at Dinosaur Provincial Park.

Left: The stratigraphy of Horseshoe Canyon, about 10 minutes' drive from Drumheller.

Bottom: There's so many they just leave them lying around?!

The nodosaur was put on display about a month before I arrived at the Royal Tyrell Museum, Canada. So lucky!

This is me posing with the first ever ichthyosaur fossil I ever found! My Mum still has this photo on the fridge.

but, this was more due to visa problems than experience problems. In fact, when I asked for feedback, I was told that my skills and experience put me on par with their top applicants. Hellooooooo ego boost. I looked into the visa requirements and thought to try again at a later date.

I also found a job to apply for a little closer to home; Technical Officer of Palaeontology at the Australian Museum in Sydney. I got to the interview stage for this one, which was still very good experience. Interviews, particularly government interviews, can be tricky. I always feel like I'm back at uni studying for an exam when I prepare for government job interviews. I always find it best to get as much practise in as possible. You never know when it'll pay off!

You know what they say, when it rains it pours. While I was applying for this job, I was also offered a position at the WA Museum. It was covering for someone who was going to another government department on secondment. I would be backfilling the role of Registration Officer. Yes, the same one I was turned down for a little over a year ago. Sometimes, what is for you will not pass you by.

That was the year I could say I had made the dream work. I covered the Registration Officer job for 5 months, and when it was readvertised, I was the successful applicant. A whole 18-month contract on a massive, world class building! What an experience! I made a name for myself by finding objects within the collections with ease ("Hufflepuffs are good finders") and keeping track of them throughout the process (I was told I have a slightly eidectic memory, which is very useful when it comes to collection management). I was able to attend two more field trips and find more specimens. I am very pleased to say that the very first ichthyosaur vertebra I found is on display in the New Museum, in the Wild Life gallery. When it came to the staging area to have a mount designed and be packed to send to site, I showed everyone and talked ears off about how I found it, and about ichthyosaurs, and about palaeontology in general. I would talk about the Gogo fish, and the megafauna, and even my own research, to anyone who would listen. And thankfully, because everyone at the Museum is a nerd like me, most people did.

As the project draws to a close and stress levels and tensions rise, it can be easy to forget my love of museums and collection management. Obviously, the palaeontology collections are my first love, but

I have come to greatly appreciate the cultural collections as well, particularly the collections regarding Aboriginal culture. It was a great honour to be allowed in those collections, and even learn about some of the objects from the curators and registrar. It has been an honour and a privilege to work with several STEM women on this project as well. One of my fellow Registration Officers wrote a PhD in sexuality in late 1800's to early 1900's literature. The conservation department is run by a chemist. One of the conservators wrote a masters dissertation on maritime archaeology, the other has worked all over the world applying her conservator skills, including at the British Museum. The Technical Officer for Palaeontology juggles full-time work, study and parenting children and stepchildren; just the thought of doing all that makes me tired! The Executive Director for the site I worked at, and the Project Director of the New Museum are both women, and I have met amazing women in science at many conferences and seminars.

While the WA Museum, like most museums, is starting to look at collection digitisation, and data verification, I think there is still much to be said about being in a museum collection and looking after it from there, rather than a computer desk. There are people out there who might disagree with me, but there is something about walking into a collection, turning the lights on, and feeling the quiet, the history and the significance. The stories just waiting to be told.

As my contract drew to a close, I started to worry about further employment. At the suggestion of a friend at the Museum, I applied for an Expression of Interest for a Ministerials role. The manager offered to catch up for a coffee and informal interview, and her first question was "with your background, why did you apply for this?" and I answered honestly; "my contract finishes in 3 weeks and a girl needs to pay her rent somehow"! So, after a chat, and the offer of supporting me during my studies, I handed in my first ever resignation letter to the Museum. After 7.5 years floating around the Museum, I was leaving. My friend Jessica organised a farewell morning tea for me and I received a card full of lovely messages, as well as many words of kindness and encouragement and gratitude for my work and enthusiasm at the Museum, all of which I will treasure no matter where I end up. I found out that several people at the Museum, including a couple of curators, also had ministerial role experience, so you never know, maybe it is a rite of passage I need to go through?

Sometimes I feel like my career might take me elsewhere, maybe even away from palaeontology, and the thought of this does make me a little sad. Palaeontology will always be my first love. But I also have a love of many topics of science and would be quite happy doing fieldwork to monitor populations and save species from the same fate as some of my Honours species, and so many other species palaeontologists work on: extinction. But I guess you never know until you try. My role with the Museum has drawn to close for now, but I hope to continue, for at least part of my career, in collection management, and help those stories be protected and preserved, and shared for generations to come, and maybe even discover things that con stop not only animal, insect and plant species but also cultural stories and memories, from being lost and forgotten.

Western Australian Museum Boola Bardip (Noongar language for "many stories") is open with free entry for 18 months. I hope the borders work in your favour, so you can come and see all our hard work!

Cassia Piper is a vertebrate palaeontologist with interests that include anatomy, palaeoecology, paleobiology, conservation biology, ecology and collection management. She completed a Bachelor of Science at the University of Western Australia and completed a Second Class Honours thesis on palaeoecology at the Western Australian Museum.

She has worked as Technical Officer for Palaeontology for the Western Australian Museum as a maternity leave cover, and has spent numerous hours, both paid and unpaid, finding, cleaning and organizing fossils in the Palaeontology collections.

After seeing the New Museum Project to near-completion, she is now doing something completely different and working in a Ministerial role at the Department of Local Government, Sport and Cultural Industries and has started her Masters of Biological Science at the University of Western Australia.

Australia's Enigmatic Dragons

by Adele Pentland

Ferrodraco lentoni, the most complete pterosaur reported from Australia. Image credit: Adele Pentland

Life restoration of *Ferrodraco*. Palaeoart by Travis R. Tischler

We're so lucky to be studying palaeontology in Australia. Unlike the Americas and Europe, there's so many incredible discoveries to be made, and taxonomic mysteries waiting to be solved. At the very least, this is true for my field. My main focus is researching pterosaurs, which are winged reptiles that lived during the time of the dinosaurs (i.e. from the start of the Triassic, ~252 million years ago to the end of the Cretaceous ~66 million years ago). Pterosaurs are the first vertebrates to achieve powered flight, millions of years before the first birds did, lived on every continent and range in size from 25 cm wingspans to the behemoths with wingspans greater than 10 m. Some had beaks without teeth, whereas others had hundreds of fine needle-like teeth more akin to a baleen and others had spike-shaped teeth taller than the height of their own jaws. Despite the name ending in "saur", they are not dinosaurs… although it still makes me kind of happy when a kid tells me that their favourite dinosaur is a pterosaur.

Although the first Australian dinosaur fossil, the Cape Paterson Claw was discovered back in 1903, the first pterosaur fossils weren't scientifically described until 1980 by Ralph Molnar and Tony Thulborn. Molnar and Thulborn weren't working on a partial skeleton either, instead, they were describing three bones found isolated from one another. That paper was published in a small journal called Nature (maybe you've heard of it?) The first Australian pterosaur taxon wasn't named until until 2007, and that is *Mythunga camara*, which is based on a partial skull found by Phillip Gilmore in 1991, near Hughenden, Queensland. The lag between initial discovery and scientific publication is in part, due to the original and sole copy of the manuscript being lost by an editor; back in the day when manuscripts solely existed as physical copies and were sent in the post. Since the 1980s, Australia's pterosaur discoveries been much the same; the occasional pterosaur bone gets described or if you're lucky, a handful of bones from different locations. That is to say, everything had been found in isolation, and was difficult to place within a broader, palaeobiogeographic context. So far, all Australian pterosaur fossils are from the Cretaceous. That's not surprising, given that there is very little Triassic and Jurassic outcrop exposed at the surface in Australia.

Before I started my PhD in late 2017 fewer than 20 pterosaur bones had been formally described from the entire continent, and the biodiversity was seemingly low but difficult to estimate based on the limited material. At this point, only two species of pterosaur had been named from the continent; the second, *Aussiedraco molnari* was named based on the tip of a lower jaw by Kellner and colleagues in 2011. It was only a matter of time before someone found something more complete, and I just happened to be there in the right place at the right time.

The right place was (and as far I'm concerned, for Cretaceous vertebrate palaeontology, still is) Winton, and the time was 2017. After finishing my honours at Monash University studying Eocene age amber (which was published last year in Scientific Reports), I had thought that studying plant and insect fossils found in the Winton area would be a logical next step. However, after being given the opportunity to study a partial skeleton of a pterosaur, the most complete in the country no less, I did a hard 180o. That became my number one priority for my PhD, but when I started, I knew next to nothing about vertebrate palaeontology, having done barely any vertebrate biology in undergrad. Thankfully, pterosaurs aren't overly complicated in terms of their anatomy, they're just really weird to look at.

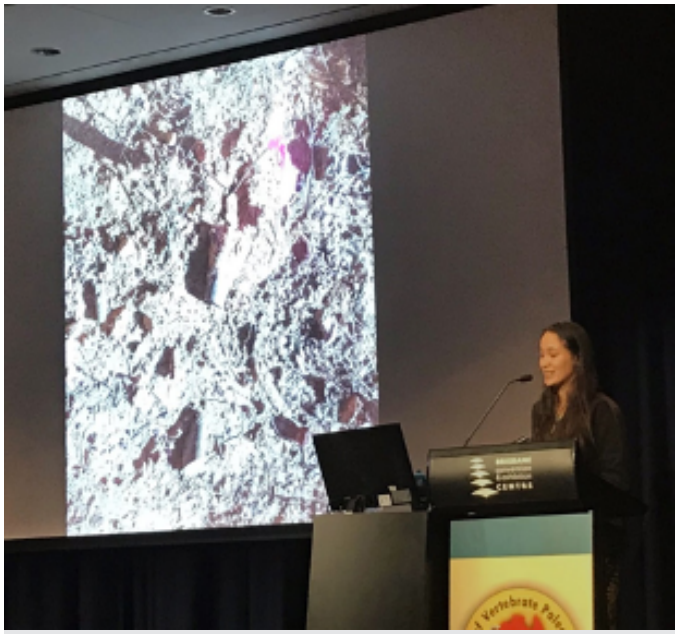
Tim Ziegler (Museums Victoria), Adele Pentland (Swinburne University), Suzanne McNestrie and colleague (St Vincent's Hospital Melbourne) take a different approach: using a medical CT scanner to analyse a 100 million year old fossil. Photo credit: Dr Steve Poropat

After delving into the literature I felt confident that the Winton pterosaur did represent a new species, but I couldn't be sure without directly comparing it to other fossil specimens. So that fossil went with me on a few plane trips, first to Brisbane to visit Queensland Museum, and later to Melbourne for scanning at St Vincent's Hospital and the Australian Synchrotron. The folks at Longreach airport are pretty good at spotting fossils through their security scanner! Well… at least, compared to some of the other major airports in Australia…

After meeting *Mythunga camara* in person I made the decision to write up a re-description and sort out its taxonomy, reallocating it from the Archaeopterodactyloidea (typically smaller sized pterosaurs with wingspans less than 3 metres) to the Anhangueria. This is concordant with the estimated wingspan of 4.7 m, and the authors who named Mythunga also agree with this assignment. With that out of the way, I could turn my attention back to the Winton pterosaur, with the aim of having the specimen published before the 79th Annual Meeting for the Society of Vertebrate Paleontology. I cut it a bit fine, with the paper appearing online at 3am on the Friday the week before the conference started. Although I'm grateful that everything worked out, I hope I never feel as stressed out as I was during the 2 weeks leading up to the conference. On the bright side, it was a great conversation starter and I got to meet a bunch of other PhD students from other universities, include some of the Flinders University crew.

The new pterosaur named *Ferrodraco lentoni*, translates to "Lenton's Iron Dragon" to acknowledge and honour the contributions made by former Winton

Eric the Elaphrosaurine, Australia's newest dinosaur discovery. Palaeoart by Ruairidh Duncan, also a co-author on the paper.



From the field, to the world stage: Adele Pentland talks through the initial discovery of Ferrodraco at the 79th Annual Meeting of the Society of Vertebrate Paleontology in Brisbane. Photo credit: Australasian Palaeontologists

Shire Mayor "Butch" Lenton. The paper describes a partial skeleton, roughly 10% of the entire animal comprising part of the skull, some neck bones and parts of the left and right wing. It was published in Scientific Reports and was in the top 100 performing articles for this journal, based on number of reads, of the almost 20,000 papers from that year. If you took the time to check the paper out, I just want to say thank you, because it means a lot to me, and our museum.

Ferrodraco, or "Butch" as its nicknamed can be seen on permanent public display at the Australian Age of Dinosaurs Natural History Museum in Winton, along with a bunch of other amazing holotype specimens. That includes two giant sauropods, *Diamantinasaurus matildae* and *Savannasaurus elliottorum*; as well as the meat-eat- ing predator, *Australovenator wintonensis*. If you haven't been to visit the museum but you have a real passion for Cretaceous fossils, you should definitely check it out. Even if your expertise lie outside the Cretaceous, the museum has fossils of different ages from Australia in its collections. Ultimately the hope is that a bigger museum complex will be built, which will display fossils throughout the ages from Australia.

While I was putting the finishing touches on the *Ferrodraco* manuscript in 2019, I was doing some preliminary work on pterosaur material from Victoria, housed at Melbourne Museum. Unfortunately,

I made the realisation that one of the "pterosaur" bones from Victoria was in fact not a pterosaur at all. Bit of a bummer, considering we thought it was a tapejarid, a toothless pterosaur hypothesised to eat fruit, which is not known from Australia (although they are now known from South America, Africa, China and England). Instead it turned it turned out to be an elaphrosaurine, a weird type of theropod dinosaur, which we published last year in Gondwana Research. Unlike most other theropods, this little guy probably ate plants, although, without a head that's our best guess for now. What we do know, is that it provides unambiguous evidence for these types of dinosaurs surviving into the Cre- taceous, and represented the first evidence of this clade in Australia. Considering it's one isolated neck bone, we were thrilled with the results.

I've still got a lot of work ahead of me, which is great in that I'm doing my PhD part-time. At the moment I'm writing a full osteological description of *Ferrodraco* for pterosaur nerds to nerd out over, and then I'll start work on either material at Kronosaurus Korner Marine Fossil Museum in Richmond (a few hours drive from Winton), or some of the pterosaur material that's been collected during Dinosaur Dreaming digs at Melbourne Museum. If I can't do that, due to border closures then I guess I'll pick up my long-neglected literature review if all else fails.

REFERENCES

Kellner, A.W., Rodrigues, T. and Costa, F.R., 2011. Short note on a pteranodontoid pterosaur (Pterodactyloidea) from western Queensland, Australia. Anais da Academia Brasileira de Ciências, 83(1), pp.301-308.

Molnar, R.E. and Thulborn, R.A., 1980. First pterosaur from Australia. Nature, 288(5789), pp.361-363.

Molnar, R.E. and Thulborn, R.A., 2007. An incomplete pterosaur skull from the Cretaceous of north-central Queensland, Australia. Arquivos do Museu Nacional, Rio de Janeiro, 65, pp.461-470.

Pentland, A.H. and Poropat, S.F., 2019. Reappraisal of Mythunga camara Molnar & Thulborn, 2007 (Pterosauria, Pterodactyloidea, Anhangueria) from the upper Albian Toolebuc Formation of Queensland, Australia. Cretaceous Research, 93, pp.151-169.

Pentland, A.H., Poropat, S.F., Tischler, T.R., Sloan, T., Elliott, R.A., Elliott, H.A., Elliott, J.A. and Elliott, D.A., 2019. Ferrodraco lentoni gen. et sp. nov., a new ornithocheirid pterosaur from the Winton Formation (Cenomanian–lower Turonian) of Queensland, Australia. Scientific reports, 9(1), pp.1-13.

Poropat, S.F., Pentland, A.H., Duncan, R.J., Bevitt, J.J., Vickers-Rich, P. and Rich, T.H., 2020. First elaphrosaurine theropod dinosaur (Ceratosauria: Noasauridae) from Australia—A cervical vertebra from the Early Cretaceous of Victoria. Gondwana Research.

Stilwell, J.D., Langendam, A., Mays, C., Sutherland, L.J., Arillo, A., Bickel, D.J., De Silva, W.T., Pentland, A.H., Roghi, G., Price, G.D. and Cantrill, D.J., 2020. Amber from the Triassic to Paleogene of Australia and New Zealand as exceptional preservation of poorly known terrestrial ecosystems. Scientific reports, 10(1), pp.1-11.

Adele Pentland
PhD Candidate
Swinburne University of Technology, Australian Age of Dinosaurs Natural History Museum
Twitter: @AdelePentland

Adele Pentland is a palaeontologist based on a sheep and cattle station outside of Winton, central western Queensland. She is currently undertaking her PhD part-time at Swinburne University of Technology,

Balance and flight: a bird's-ear perspective

by Phoebe McInerney

Phoebe McInerney
PhD Candidate in Avian Palaeontology
Flinders University
FUPS President
Twitter: @Phoebyornis

How do you keep balance while walking or running? How does a bird keep balance or maintain its posture during flight? Well, it's all these are thanks to a small pair of organs located near the back of the skull, called the inner ear.

In all vertebrate taxa, inner ears are functionally important, but not for hearing or sound as you may think. Instead, they help an animal stabilise its head, control body movements, and maintain its visual focus. Ultimately, the information the inner ears collect, helps with adjusting the placement of the head to changes in environmental surroundings. Have you ever seen an owl move its body but not its head? As the environment changes, for example, the stick it is perched on moves in the wind, the owl uses information from the inner ears to stabilise its head in space and keep its eyes focussed on the prey.

Inside a bird skull, just next to the brain, there are bony canals which join to the ear opening on the external surface. Within these canals are soft tissue semicircular ducts, the organ which makes up the inner ear. There are three membranous ducts, the anterior, posterior and lateral semicircular canals, essentially representing the X, Y and Z axes. They are filled with liquid and sensitive hair follicles which detect movement of the liquid caused by changes in the position of the head. This detected movement is translated into information and is sent through nerves into the brain.

Combined with other sensory cues such as vision, the brain can then create a 3-dimensional impression of the movement of the head through space, for balance control and posture, or stabilisation of a visual image for better vision.

Due to these attributes, the semicircular ducts are hugely important when it comes to locomotion, with variation in the shape of the ducts linked to specialised locomotory abilities. This variation occurs because the shape and orientation of the ducts influences the sensitivity and mechanical properties of the organ. For birds, with their specialisation for flight, the shape of the ducts differs greatly from other vertebrate groups like mammals. Moving through air, rather than on land, has different requirements for the understanding of space and the arrangement and placement of the body and head. The shape of the semicircular ducts is therefore modified in birds to accommodate for flight, and further modified in different avian groups which specialise in a specific flying style.

But we're interested in palaeontology, you say? Its BEER 'N' BONES you say?

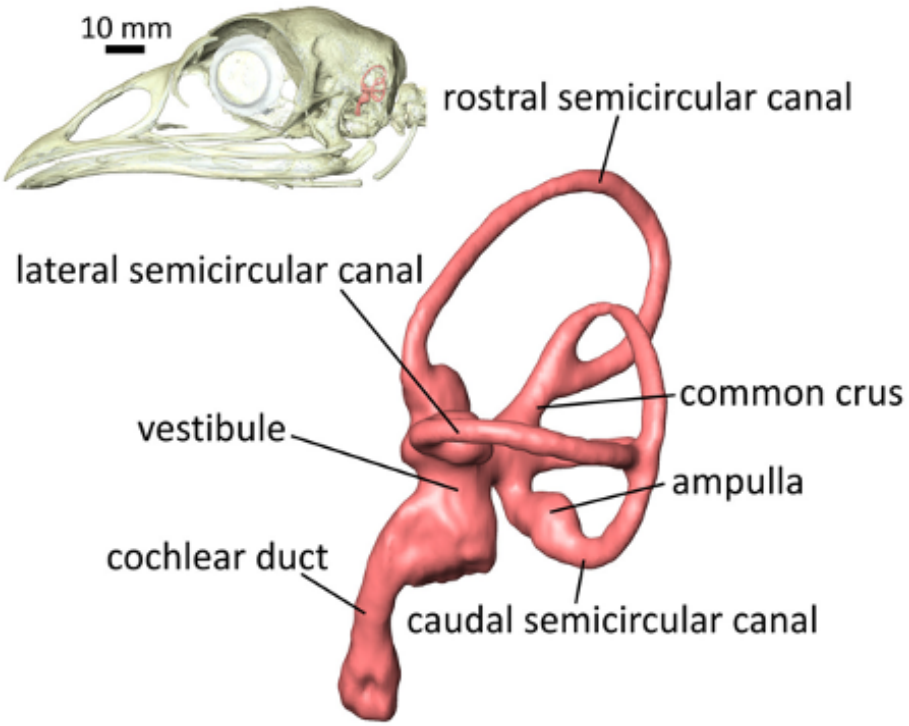
As with most soft tissue, this organ is not preserved in the fossil record, so what is the point of this tiny organ, nestled within the skull, in the world of palaeontology?

Fortunately, the bony canals of the inner ear, in which the semicircular ducts sit, closely resemble the shape this organ. This means that the bone surrounding the semicircular ducts will display the same shape adaptations as the ducts, and so palaeontologists can find this feature preserved in fossil skulls!

As the canals are buried within the skull bones, scanning technologies let palaeontologists model the internal shape of the canals and thus, the shape of the semicircular ducts. Inferences can then be made about how animals moved, possibly how fast they could run, or whether they flew more like a raptor or couldn't fly at all. In dinosaurs, modelled inner ears have been shown to detect bipedal or quadrupedal locomotion. Similarly, studies have used inner ears to identify evolutionary adaptations for the appearance of bipedalism in various hominid lineages.

Ultimately, we might be able to determine the exact flight or walking style an extinct species evolved to use. However, there is still so much we don't know about the semicircular ducts, such as what happens to flight-adapted inner ears in birds which lose the ability to fly.

Overall, it is a cool organ, and even cooler that it's shape can be preserved in the fossil record. With more research, this organ could become a major research point for new skulls to make inferences about the lives of animals which no longer walk (or fly) the Earth.



The inner ear as located in the skull of the extant wild turkey, *Meleagris gallopavo*, and an enlarged model made from a CT scan of the skull, for visualisation of the elements of the semicircular ducts (Cerio and Witmer 2019).

Drawing on the Past:
Scientific Illustration in Palaeontology

By Nellie Pease

Nellie Pease is an aspiring scientific illustrator and palaeontologist from Brisbane. She recently graduated from the University of Queensland, where she studied Archaeology and Zoology, and is now jumping ships into the Palaeontology and art world.

You can find her on:
Twitter: @marsupialtapir
Istagram: @gondwanarama

When I was asked to write an article about palaeoart for the FUPS newsletter, my first thought was, Nice! I love palaeoart! My second thought was Uh oh. I'm not actually a palaeoartist. My third thought was Oh damn. Does this make me a palaeoartist? My fourth thought was that's awesome, no takebacksies, and then my fifth thought and onwards were all various forms of who am I, existential crisis, and deadline procrastination.

Let me start by introducing myself. My name is Nellie Pease, I'm a palaeontology student at UQ, and at some point I started doing art and never stopped. When I'm really confident I optimistically call myself a scientific illustrator, which is the job I'm hoping to one day have. Unfortunately it's not the sort of profession you usually get a degree in, so it's kind of hard to know when you have it – you can't hold a piece of paper in your hand to prove you're qualified for it, or post an achievement on LinkedIn to fend off the imposter syndrome. As far as I can tell, when you write in your Twitter bio that you're a scientific illustrator, you become one. So here I am, a newly-fledged, internet-official scientific illustrator, here to tell you how I got here, why it's a really cool job, and that you can do it too, if you believe in yourself and follow your dreams. And if you don't want to do that, well, that's what I'm here for.

I'll start by explaining what scientific illustration is. We've all used it, whether we know it or not – not just as scientists, but in our everyday lives too. It can take a lot of forms: graphs, flow charts, labelled diagrams for scientific reports all count; so do intricate botanical watercolours, illustrations in medical textbooks, and taxidermies. The nice, neat bird drawings in field guides are scientific illustrations; so are the anatomy models you see in the dentist's office, and almost any nature documentary; and photography and 3D-visualisations count too. The choice of medium is endless; the only rules are that the illustrations need to be technically-accurate, and they need to communicate science.

Crested pigeon (Ocyphaps lophotes) in pencil, now owned by FUPS' very own Elen Shute.

And when scientific illustration intersects with palaeontology, you get palaeoart. Not all palaeoart is scientific illustration – I'm pretty certain The Land Before Time technically counts as palaeoart, even though you wouldn't see it in a journal – but there's a really exciting region where the Venn Diagrams cross, and to me, that's the Holy Grail of artistic careers. Within that Venn Diagram are the illustrations you'd see in Walking With Dinosaurs, or on the cover of Australian Geographic, or on Peter Trusler's megafauna stamps that I know we all collected back in 2008. Picture that really accurate dinosaur atlas you had as a kid – that's the sort of illustration I'm talking about.

To really explain what gets me excited about palaeoart though, I want to talk about the Queensland Museum. When I was about 5 years old, there used to be a whole megafauna exhibit on the top floor. It's a minor tragedy that none of you got to see it at SVP last year (it's since been packed up into storage), because it's one of the coolest exhibits I've seen, and a really great example of how to illustrate science.

Here's how I remember it, to the best of my 5-year-old ability: picture a diorama the size of a room,

showing a dry, scrubby patch of the outback. At the front of the scene, a steep gully cuts through the red-brown dirt, so you're looking up at a high, grassy bank, complete with crumbling edges just held together by the roots of a scraggly gum. Right in front of you lies the body of an enormous diprotodon. This will be gruesome, so bear with me - it has clearly fallen down the bone-dry gully, and it's staring up at you, glassy-eyed, bleeding from the nose, with two animatronic crows perched on its head, already pecking at its fur. And standing on the top of the cliff is the biggest *Megalania* you've ever seen (inaccurately big, actually - it was 2002, so we were data-deficient and optimistic). You'd better believe there are animatronics in that too – it turns its head slowly back and forth, tongue flicking out, as two kangaroos watch on in the background, clearly very glad there's a better offer on the menu.

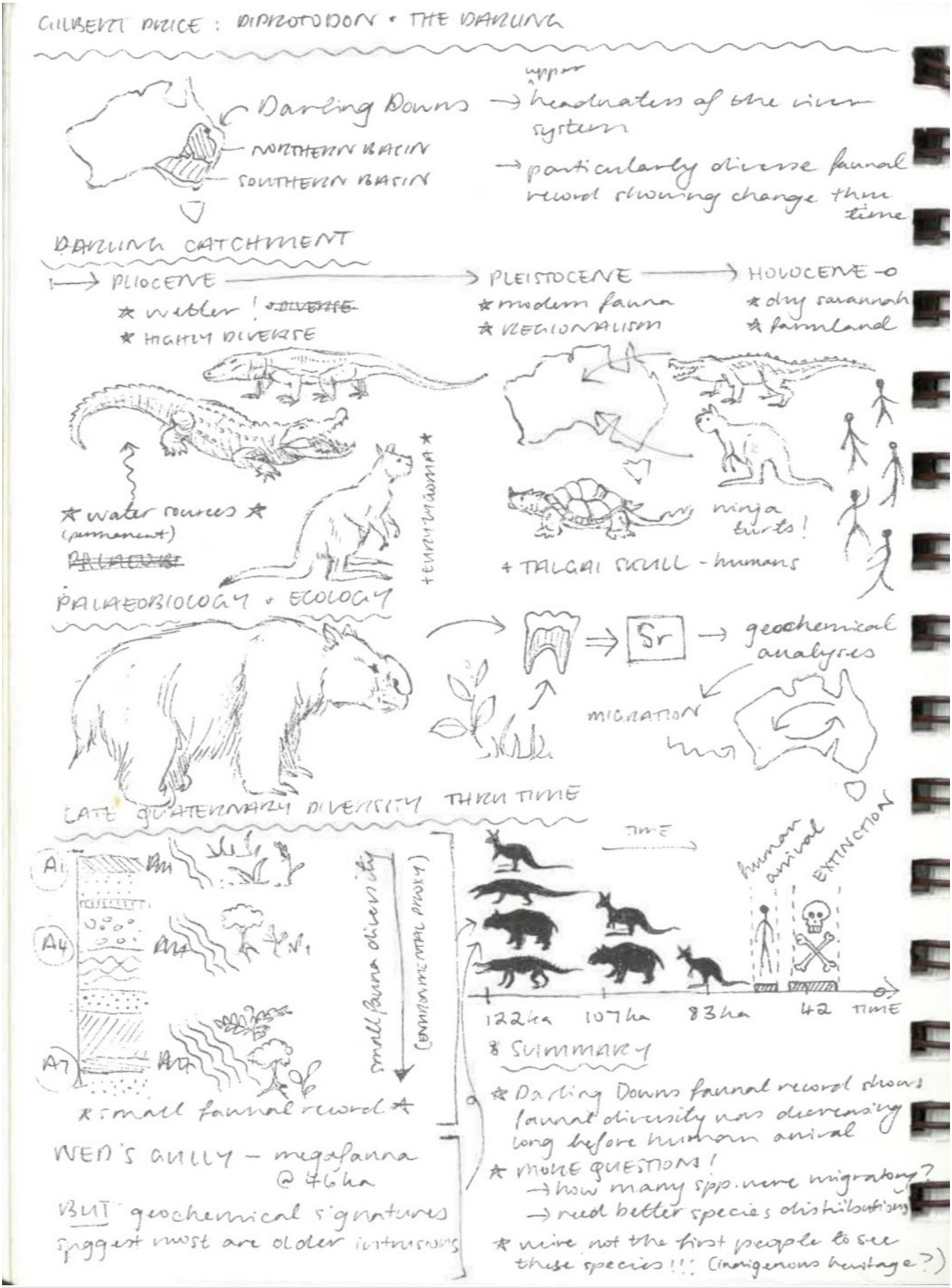
I remember all these details, despite having only seen it once or twice, because it made an immediate, profound and unforgettable impression on me – which is to say, I was terrified out of my mind. (I think I actually had a similar reaction to the Riversleigh museum as a kid in Mount Isa, which I've since repressed, and we don't need to talk about how I felt about the *Kronosaurus* statue in Richmond. Needless to say it took a few more years for me to process the connection between "extinct", "made of plastic" and "not going to eat a 5-year-old in a public place".) Either way, the point was: those intricately-made animatronic statues had me absolutely, positively convinced that these extinct animals were real, and a very, very, very big deal.

But more than that, I got a pretty good idea of how they interacted with each other in this ancient, long-lost ecosystem. There was no doubt in my mind that Megalania was a predator, and Diprotodon spent its days trying not to get eaten. In hindsight, I think the familiar sight of the crows and kangaroos was the coolest part – you could tell that the ecosystem back then was different, and full of unfamiliar giants, but it was also the same Australia; the ancestor to the one we see every day. It was harsh, too – you could read drought and struggle in the dryness of the scene, and I think the story they were going for was of species pushed to the brink of survival by climate change. In a lot of ways, the scene was the spitting image of the bush outside my central Queensland backyard, which is probably what creeped me out at the time.

To me – and I'm definitely not a seasoned palaeoartist yet, so take my idealistic enthusiasm with a grain of salt – but to me, that's what good palaeoart should do. I was vaguely aware we'd had giant wombat-things roaming around the savannahs some time before I was born, but there's a difference between being told and seeing one, lifelike and freeze-frame-posed, in front of you. "There used to be giant wombats here" is a fantastic start to a fairytale, and seeing their bones is great, but it was seeing it in a visual way that made it make sense. And even if I'd known nothing about Diprotodon going in, that diorama would have taught me a fair few of the basics. Day in, day out, people who'd never had the chance to look at a scientific article in their lives walked past that display and got a 2 second crash course in prehistoric Australia, without having to decipher any scientific literature at all. I guess can't speak to the accuracy of the reconstruction, but it definitely communicated a lot, and to people who otherwise might not have had the chance to learn.

The point is that illustration is a crucial part of science. We use it to communicate our data to each other, but also to explain it to people outside our field. I know that I always skip to the diagrams when reading journal articles that I don't understand, and that kids always gravitate to the visual displays in museums. Illustrations condense complex science into understandable ideas, and communicate a lot in very little space. They're crucial in palaeontology in particular, because we can't photograph the animals we're talking about, and we can't film them in their ecosystems. If we want to see them as they were in life – or at least, our closest approximation of it - we have to turn to art.

I didn't process all of this at the time, obviously. Back then, Land Before Time fanart from kindy was about the extent of my palaeoart portfolio. Once I'd recovered from the terrifying diorama ordeal, I dabbled in some palaeoart by accident – my mum had a collection of Australian Geographic issues that I used to copy the covers of, and I specifically remember reconstructing Peter Schouten's prehistoric Patagonian platypus out of pillow stuffing (I don't have any more answers for that now than I did at Grade 2 Show and Tell). For a long time, though, I never gave palaeoart much thought. Apart from drawing animals for fun, I never really expected art to be a big part of my life in any form. I'd dropped it by senior high school to make room for more



Notes taken during Gilbert Price's presentation at 2019 SVP.

science subjects, which at the time I thought were more useful to me – which seems ironic in retrospect, now that art is one of the most useful and precious parts of my life.

It's also ironic because, to me, art and science have always been two sides of the same coin. People often say "that's an unusual combination", but I've always found it really natural; I think they're just different ways of talking about the same thing. Every time I've been really excited about science, palaeontology especially, there's been someone's art behind it. I still have an entire collection of Peter Trusler's megafauna stamps, which set off my big palaeontology phase in Grade 7 (he's also done a fascinating reconstruction of the notorious weirdo, Palorchestes); I love the work of Laurie Beirne, who does beautiful illustrations for the Australian Age of Dinosaurs magazine and has a knack for painting scenes that look like they could be from a modern nature documentary. And when I eventually rediscovered art as a regular hobby, I was using it to illustrate diagrams in my uni biology notes. Scientific illustration makes a lot of sense to me, because both science and illustration are things that I love, and I wouldn't enjoy either one anywhere near as much without the other.

So far, it still seems too good to be true that illustrating extinct animals can even be a career. It's a relatively recent development for me – things only got serious last year, when by fate of chance the Guild of Natural Science Illustrators met in Brisbane, and I went along on a whim. It was the first time I'd realised that scientific illustration was a profession you could go into, and I was sold right away. Then SVP met in Brisbane a few months later, and the same thing happened with palaeontology. That's also where I met a few members of FUPS, and got the chance to sneak into this club all the way from Queensland.

I hadn't been planning it at the time, but SVP was a great chance to do art too. My friend Holly got me onto drawing little cartoony flow-chart notes of people's talks (she's @palaeophd on Twitter, and a great follow for conference season). We started drawing them for fun (and to keep ourselves awake after several long, long, conference nights), but as I posted them on Twitter I realised how much the presenters loved seeing their talks written down, even as scribbly as they were, and I realised that we were doing science communication – taking complex, technical data, and boiling it down to its clearest, most easy-to-follow form. It's one of the most fun and satisfying forms of illustration, and I'd love to do more of that in the future. This year hasn't been a great one for conferences, but if anyone out there is keen for a graphical abstract, I'm keen and ready to go.

After that, things started to happen by themselves. I'd already been drawing all the time, but I started sharing my artworks on Twitter and Instagram, and people slowly started buying them. Twitter especially has been really useful for connecting me with people – I have a really good network of followers there, who are really keen to support young artists (shoutout to FUPS' own Elen Shute, who bought one of the first artworks I ever sold), plus I get to see work from really accomplished palaeoartists like Gabriel Ugueto (@serpenillus) and Mark Witton (@markwitton). Recently I got my first ever journal commission from Pietro Viacava and Vera Weisbecker, and the artwork ended up on the cover of Ecology and Evolution. It's still surreal to think about, especially since I literally got paid to draw quolls, which is basically my favourite pastime. If you'd told 12 year old me that one day I'd be paid for sitting on the floor of my room drawing dasyurids, it wouldn't've taken me this long to set up an Etsy.

Right now, I'm just back from doing archaeological fieldwork with UQ on Mithaka country, on the edge of the Simpson Desert, where I became the unofficial site illustrator. I spent almost the whole time sitting in holes drawing the stratigraphy, or the rock art, or the artefacts, or animals we saw, or plants on the ground, and it was the best field trip I've been on. You know something's right for you when you can be covered in flies and dust in 39 degree heat and still want to stay out longer, and I think it's a good sign I'm here to stay.

Things definitely still feel fresh and unofficial, with palaeoart especially – it's a very specific subset of scientific illustration, and not one that I feel super confident with yet. I learn to draw most animals and plants by copying them very closely from photos, and that's not an option in palaeontology. I'm really aware that even small anatomical features can be taxonomically important, and a small twinge of a shape can make a whole reconstruction inaccurate. You feel like you need a lot of background information before you trust yourself enough to make any artistic interpretations, and that can be daunting. But I'm steadily chipping away at my own inhibitions, and palaeoart is exciting enough that I have a

lot of incentive. I find starting with cartoony versions helps – I even started making little diprotodon charms out of clay to get used to their basic shapes, and I think they'll be a hit on Etsy once I've made enough of them. The progress isn't linear, and I sometimes feel like I'm going backwards, or stuck in a rut with no inspiration, but in general the more I draw the more confident I get, and the more excited I get about drawing more.

I'm saying this to reassure all of you aspiring artists out there – it really is about practice. If you love drawing, and you do it all the time, things will snowball by themselves. I went years without drawing, and only picked it up again in uni; and at the time it was purely a procrastination activity ("when stressed, draw nice plants" is a great motto for exam season). Now, I'm drawing all the time. I'm a terrible person to take to zoos, because I can fill up a whole notebook in 5 hours just sitting outside the penguin enclosure. My old sketches are lumpy and awkward, and now hidden far, far away from the world, but there's no better feeling than watching yourself improve at something, and art is great for that – every time you draw something, no matter what it is, you feel the connection between your eyes and your brain and your hand get a little smoother, and you feel a little bit less like a four year old with a crayon. And as a bonus, you get a paper record of your progress to cringe over later.

It's probably clear by now how much I love talking about illustration. I hope my enthusiasm doesn't sound too much like the crazed ramblings of a fresh-faced postgrad, and instead makes other people excited too, because it's the kind of field that thrives off collaboration. My Twitter DMs are always open for people looking for commissions, or advice on what I've learned so far. I'm nowhere near an expert yet, but working my way towards it has been a very fun ride. One day I hope to have a career where I can do art and palaeontology at the same time, and that really will be the best of both worlds.

Two Northern Quolls (*Dasyurus hallucatus*), commissioned by Pietro Viacava from UQ as part of his PhD research.

Terraforming Mars

by Diana Fusco

With everything going on in our world, Mars is looking pretty good right now. With this in mind, let's get in to Terraforming Mars (TFM), a game that has become a staple for many gamers since its release in 2016.

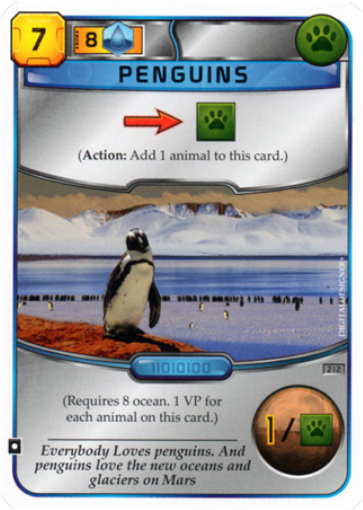
In TFM, your chosen corporation competes to make Mars great again. Each corporation has unique abilities like extra starting resources or being able to use your heat as money. To terraform the red planet, you need to build cities, establish oceans, plant trees to raise O2, and release greenhouse gases to raise the temperature. You also need to build a solid resource engine to generate money, steel, titanium, plants, energy and heat as the resources required for terraforming.

The game mechanics work together to create something pleasantly complex and strategic. Many of your actions revolve around buying and playing project cards. Project cards include events that have instant effects for you and sometimes other players, active cards that give you an extra action or ongoing effect, and automated cards that boost your resource engine. Extra terraforming points are gained by fulfilling awards and milestones. There is some player interaction. Some cards allow you to steal resources from other players or dent their engines by reducing their production. A well-placed tile can earn you some side-eye if you are siphoning points off another players greenery tiles. Otherwise, there is very little direct conflict in TFM.

One of TFM's strengths is its numerous corporation and project cards that give umpteen combinations. Every play is different! Then there's five expansions (Prelude is a must have) and numerous promo cards that you can add in. TFM is an infinitely replayable game that doesn't get old! There's even a solo mode – perfect for pandemics!

TFM is a fantastic game, but it isn't perfect. Every so often you'll play a game where you just don't get the cards you need to boost your engine. Which gets kind of frustrating and rude! There's also a couple of cars with off-the-planet rewards, but you can always remove them from the deck.

My rating: 9/10
Complexity: 3.5/5
Players: 1 – 5
Age: 12 +



Penguin promo card. Just $25 on ebay.
The intimidating Giant Ice Asteroid from the basic game deck.

Terraforming Mars has an engaging eco-tech-space theme.

Coopers Vintage Ale (2010)

by Dr Kailah Thorn

A decade has aged this beer to perfection. Aside from a few accidentally poured chunks making it into the glass, this beer still poured well with enough head to fill my Palaeo in the Pub glass.

This beer was cracked this evening in memory of our friend James Moore. James lovingly cellared this beer at his house in Whyalla until a couple were bequeathed to me and Carey in 2015 when we visited to announce the James Moore Memorial award to students in Whyalla. Since then it has been cellared at my house (mostly in my fridge because each year I've forgotten to crack it with others).

Tonight it was opened to bring in the new decade, before I leave Flinders to become Curator of the Earth Sciences Museum at UWA.

This beer may have lost its hoppy zing, but it packs a malty punch. Smooth, sweet flavour like an aged liqueur. I am now rather regretting not cellaring my own vintage ales for the last ten years.

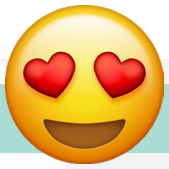
Diana: almost fortified. It had lost some of its carbonation, but the flavour and memories came through to more than compensate for the reduction in carbonation. A lovely beer.

Gully: the malt has developed deliciously however any zest in the beer has gone. having drunk many of these over the years, I think 4 or 5 years is max on these and thereafter they decline in complexity.

Aaron: I remember having discussions with James about the complexities of malting beers. I still have a blend of his favourite malted barley blend on my shelf. The maltiness of this brew is a poignant reminder of these discussions. Delicious!

Althea: Smooth and lovely.

FUPS NEWS!



Itching for a scratch? Feel like you need a little Lovenia?

Pack yourself a picnic lunch and come spend an easy day scratching around in the dirt of the Mannum Formation with Flinders University Palaeontology Society. You can expect to find **23-million-year-old marine fossils** including echinoids, shells, fish, and maybe even shark teeth.

Our guide, Kym, is from the Murrylands Gem and Mineral Club and is well-versed in local geology and the palaeontology we will encounter.

When: Sunday March 28th, 10 am start at Mannum.

Cost: Free

Gear: Appropriate clothes for the weather, hat, sunblock, sturdy shoes, water, packed lunch, a small geopick or a screwdriver and hammer.

Who: Must be over 18 yrs or enrolled at Flinders if under 18 yrs. Must be a paid-up member of FUPS. We do not expect to max out numbers on this trip, but if we do, then Flinders students will get preference.

What: We will meet in Mannum at 10am, drive to one location, return to Mannum for lunch and drive to a second location. We will be fossicking at each location.

Carpooling is encouraged. More information will be emailed to participants closer to the date.

Sign up here: https://form.jotform.com/210532073401035

Got Qs? fupsfieldtrips@gmail.com

Nominations for FUPS committee positions!

In **April**, we will be hosting our **Annual General Meeting** and will be **appointing new committee members**!

All position are open for applications, with all executive positions required to be filled:

Executive Positions
- President
- Vice President
- Secretary
- Treasurer

Non-Executive Positions
- Volunteer-Coordinator,
- Three Undergraduate Representatives, Honours/Post-Graduate Representative and Academics Representative
- Palaeo in the Pub Coordinator
- Field trip Coordinator

If you have no previous experience, that doesn't matter, members of the 2020 and previous committees will be available to assist and answer any questions throughout the year. All you need is an interest in palaeontology and the society.

If you would like to nominate yourself for a position, or have any questions about the requirements or responsibilities, please email flinderspalaeo@gmail.com.

For nominations, please **include a short statement** about what position you would like to nominate for, and why you think you would be a good fit for the role, and a photo of yourself.