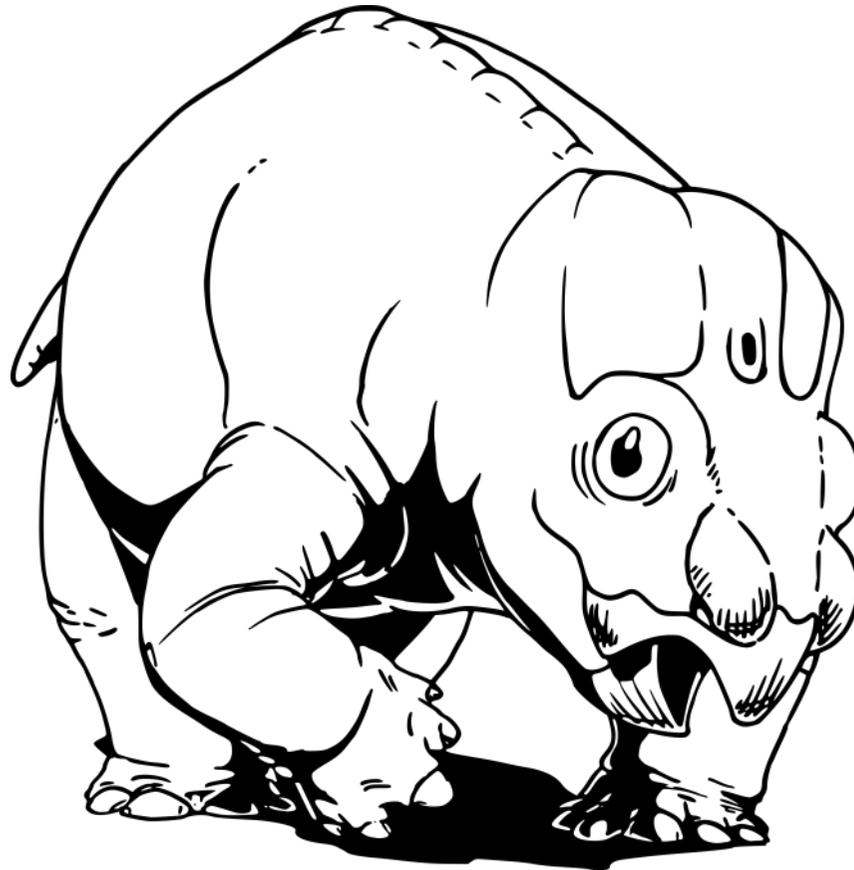


PalNews

Biannual newsletter for the Palaeontological Society of Southern Africa



Artists impression of a new Dicynodont that will be named in honour of ESI preparator, Pepson "Pepsi" Mokalenai.

Artist: Viktor Radermacher

Volume 22, Issue 1

March 2019

Announcements

PSSA2020 – MATJIESFONTEIN: SAVE THE DATE!

The next Biennial Meeting of the PSSA will be held at:
the Lord Milner Hotel, Matjiesfontein
on 7-10 SEPTEMBER 2020.

The post-conference excursion in the SW Karoo region will take place on 11-12 SEPTEMBER.
Further details will be posted on the PSSA Website in due course.

We look forward to welcoming you to what promises to be the most unforgettable palaeontological event in the Great Karoo since the Permo-Triassic Extinction.

PSSA Host Committee: Emese Bordy, Thalassa Matthews, Wendy Taylor, Claire Browning, Cameron Penn-Clarke, Madelon Tusenius and John Almond

#PSSA2020

! SAVE THE DATE !



This 4th Conference in the series is preceded by IMGRAD-1 in 2013 (Necsa), IMGRAD-2 in 2015 (SUN), IMGRAD-3 in 2017 (WITS)

IMPORTANT DATES:

| | |
|------------|--------------------------------|
| March 2019 | Abstracts & Registration open |
| June 2019 | Preliminary program |
| July 2019 | Abstracts & Registration close |
| Aug 2019 | Final program |
| Sept 2019 | Conference (2 days) |

WHO SHOULD ATTEND:

- Post Graduate students
- Researchers
- Engineers
- Scientists
- Industry
- Exhibitors: XCT systems
- 3D Software specialists

4th South African Biennial Conference on Imaging with Radiation (IMGRAD-2019)



Radiography
&
Tomography



VENUE: Necsa Visitor Centre

DATE: 16 and 17 Sept 2019



The South African Nuclear Energy Corporation SOC Ltd. (Necsa)

R104 Elias Motswaledi Street (old Church Street Ext West)
Pelindaba, Madibeng Municipality, Brits, South Africa, 0240

Contact details: Dr. Frikkie de Beer (Chairman of IMGRAD-2019)

Phone (+27) 12 305-5258

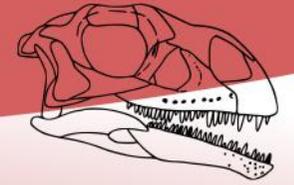
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A word from the Interim Editors

Lara Sciscio (UJ) and Viktor Radermacher (ESI)



A belated but very happy New Year to all PSSA members. We wish everyone a productive and fruitful 2019.

The year has kicked off with our PalNews Editor, Dr. Pia Viglietti, leaving South Africa to take up a new postdoctoral research position at the Field Museum in Chicago (USA). As such, she has handed over the reins of the PalNews editing to Viktor Radermacher and me until further notice

Pia is on to new adventures in the USA where she will be working on all things Permo-Triassic under the guidance of Prof. Angielczyk. No doubt, her new position will enable her to acquire many new skills and hone old ones. I am sure she will also be dabbling in many side projects and keeping up with on-going work at the ESI. In the past year I have been fortunate enough to work closely with Pia. This has taken us on several field trips, working on a variety of projects, ranging from field work in the Eastern Cape (the amazing Qhemengha Bone Bed reported in September) to the sedimentology around Lake Kariba in Zimbabwe. Pia is a wonderful field companion – patient with me when I ramble to myself, always willing to lug palaeomag equipment up a hill (never for the faint hearted) or share her snacks. She has been an invaluable member of the ESI Choiniere Lab over the past ~2 years. It is bitter-sweet, but with Pia's 'go-get-'em' attitude we expect nothing but success and good adventures to follow her. I am sure we all wish her the very best in her new endeavour. May the weather stay in her favour!

On to the present, and Viktor and myself are acting as the interim editors of PalNews. We hope that our combined efforts will maintain the standard, quality and reputation that Pia set during her term(s) as editor. Herein, we hope to feed your curiosity about all things field and lab work related from the PSSA members around the world. And please, keep the articles flowing in.

Lara Sciscio

Oh boy, 2018 was really, *really* busy; and 2019 sure shows no sign of letting up! Last year's maelstrom was fantastic though, and all its shenanigans were endless sources of personal and career growth.

I started doing restorations of awesome new discoveries, presented at two conferences (it was great getting to meet you all!), TV and radio interviews, help launch the Palaeo Accelerator Programme (a programme aimed up-skilling members from previously underrepresented groups at the undergrad level) to great success, museum visits in the USA, wrote and re-wrote drafts of my first publication (now in review), and winning new international friends, future colleagues, and drinking buddies.

Pia did a great job of invigorating PalNews during her tenure as its editor and in keeping with her inertia, I have strived to do the same. You'll find that articles now have specific headings and this is to label some general themes. If you're strapped for time and want to find out the latest gorgon gossip, then track down the purple Permian section. Likewise for the red Mesozoic, green Palaeobotany, etc etc. (see next page for section themes). This redesign is still in its infancy and I welcome (preferably precise) feedback on any changes that could be made. Please do let me and Lara Sciscio know and we will consider them.

December 2018 also saw the retirement of the much beloved Pepson "Pepsi" Mokalena, and this issue is dedicated to him.

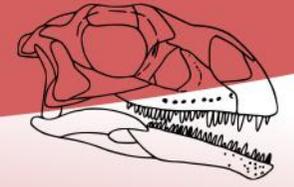
It is an honour to serve at the helm of the nexus of our country's palaeontological news source, and it is a task Lara and I both take seriously.

We hope you enjoy the new format and this latest issue of PalNews.

Viktor Radermacher

Content themes

Lara Sciscio (UJ) and Viktor Radermacher (ESI)



Human interest pieces/ Updates



Invertebrate contributions



Devonian / "Pre-Permian" contributions



Sedimentology and Trace fossil contributions



Palaeobotany contributions



Permian / Therapsid contributions



Mesozoic / Archosaurs and other diapsids contributions



Palaeoanthropology / Plio-Pleistocene fauna contributions

Honouring Pepsi

Viktor Radermacher (ESI)



This edition of PalNews is dedicated to the work of Mr. Pepson Mokalena, ESI head preparator, who retired in December of 2018.

To say that Pepson “Pepsi” Mokalena is part of the ESI furniture would be a severe underestimation of his influence on our department, and our discipline. Recruited to the, then, BPI in 1991 with no prior training in fossil preparation, Pepsi soon became incredibly adept. Charlton Dube, the head of the ESI’s fossil preparator team, remarks that specimens that would take lesser men years to prepare, Pepsi would do in months. Frieda, the beautiful *Tapinocanius* that guards our fossil study hall and took over two decades to exhume, was mostly prepped by Pepsi while simultaneously juggling prep work on other specimens. He has recently freed a giant temnospondyl from an even larger boulder found by David Groenewald, an incredibly large *Rhachiocephalus* found by Marc

van den Brandt, and a new Mesozoic dicynodont found by Jonah Choiniere—the latter find being named in Pepson’s honour. None of these are small or trivial tasks or discoveries; and Pepsi’s efficiency and attention to detail are only outclassed by his work ethic.

A typical day for Pepsi would start around 4 AM. He had arranged for the same driver to arrive in the same taxi at the same time every day. He would then arrive at the ESI around 5:45 AM and begin preparing fossils (6:05 AM was late by his standards). At around 7 AM he’d water his plants (the ESI looks as beautiful as it does because of Pepsi’s ‘green thumb’), his match-sticked smile greeting us on our way in, and later spoil the department of his own volition by preparing coffee at 10. The rest of his day was then spent beautifully preparing specimens we’d all use for our research. Our world-class fossils and research

could very well exist without such adjectives was it not for the skill and diligence of preparators like Pepsi.

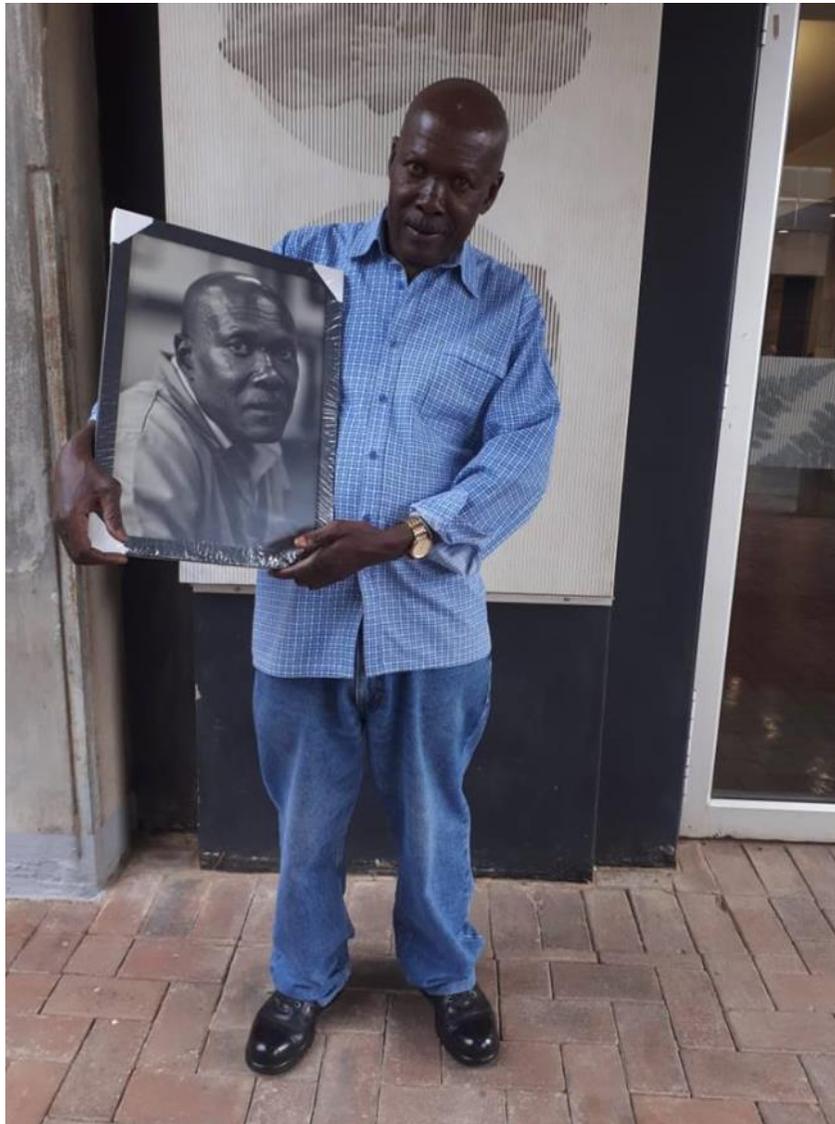
Pepson has since made a few appearances back at the ESI since his retirement, and with a purple silk shirt and black fedora, looks as charming as ever.

Pepsi’s selflessness, his contribution to the internationally envied ethos and beauty of the ESI, his discipline, and his work ethic are all hallmarks that we should strive to emulate.

I believe I speak for the whole ESI when I thank you for the decades of hard work and care, we miss you around here but we all hope you have a relaxed and enjoyable retirement .

Honouring Pepsi

Viktor Radermacher (ESI)



Goodbye for now

Pia Viglietti (Field Museum, Chicago)



The last couple months of 2018 were not quiet.

In the first week of October I was invited to take part in a storytelling event sponsored by Naked Insurance (@naked_insurance), organised by Angie Batis (@miss_luckypony) and Shane Durrant (@shaneandsons). The evening talks all fell under the theme “This could be better” and I spoke about my personal experience getting into the field of Palaeontology, and why it is so important to communicate the story of South Africa’s amazing fossil heritage to the public. You can watch me tell my story at www.nakedthoughts.co.za.

In the second week of October Jonah Choiniere lead our last lab field trip for the year. The trip involved collecting a fossil found by Kimi Chapelle a few years back on Heelbo farm

near Rosendal (Free State Province). Other ESI attendees were Wilfred Bilankulu, Rick Tolchard, Cebisa Mdekazi, and Gavin Dollman. Postdoctorate fellow from UJ Lara Sciscio also joined us along with a group of History of Art students lead by Joni Brenner and Justine Wintjes. Their students were conducting researching projects that marry science and art, which was a recipe for very stimulating evening conversations.

The fossil we collected is of great importance because it may be one of only two known poposauroid non-crocodylian crurotarsan fossils found in South Africa. Research conducted by Rick on this and other crurotarsan material from the Karoo Basin for his Masters degree will ultimately provide important findings concerning what crurotarsan species were present in the Karoo Basin in the late Triassic, and how these taxa can help correlate to other Karoo-

aged basins globally. Also, in conjunction with the biostratigraphic revisions conducted during my postdoc in collaboration with Lara Sciscio this new fossil will shed light on how crurotarsans were affected by the extinction event, and where the inferred Triassic-Jurassic boundary may lie in the upper Karoo stratigraphy. It was a very productive trip, but also a bitter-sweet one as it was my last field trip as an ESI member for the foreseeable future. This is because I have accepted a two-year postdoctoral fellowship hosted by Ken Angielczyk at the Field Museum in Chicago.

I can’t believe how quickly my 6 years at the Evolutionary Studies Institute have passed by. I first met members of the then Bernard Price Institute at the very first PSSA meeting I attended in Howick back in 2010. I had just begun a Masters degree earlier that year supervised by Roger Smith and John Compton, but I

Goodbye for now

Pia Viglietti (Field Museum, Chicago)



knew based on the kind reception of many (*then*) BPI staff and students where I wanted to move for my PhD. I have made so many long-term colleagues and friends, and really got to know South Africa's palaeontological community by being based at the ESI.

Therefore, I cannot go any further without thanking all at the ESI for your guidance and friendship, it has been pivotal in helping me make the most of my career opportunities. My research would have also been impossible if it wasn't for the ESI technical staff who painstakingly prepared fossils collected during my PhD and postdoc and making sure the field work vehicles were in working order. Many of you have become lifelong friends, and I am indebted to all of you for your help, company, discussions, and sense of humour.

Given that my research will remain focused on the Karoo and the Karoo-aged fossil record in

Southern Africa this is not a farewell, just goodbye for now. I look forward to many more years of research collaboration and friendship, and I wish everyone at the ESI all the best.

Finally, thank you to the National Research Foundation (DST-NRF), DST-Centre for Excellence in Palaeoscience (CoE-Pal), and the Palaeontological Scientific Trust (PaST) for funding my research for all these years. Your support has no doubt helped me in my early career as a researcher.

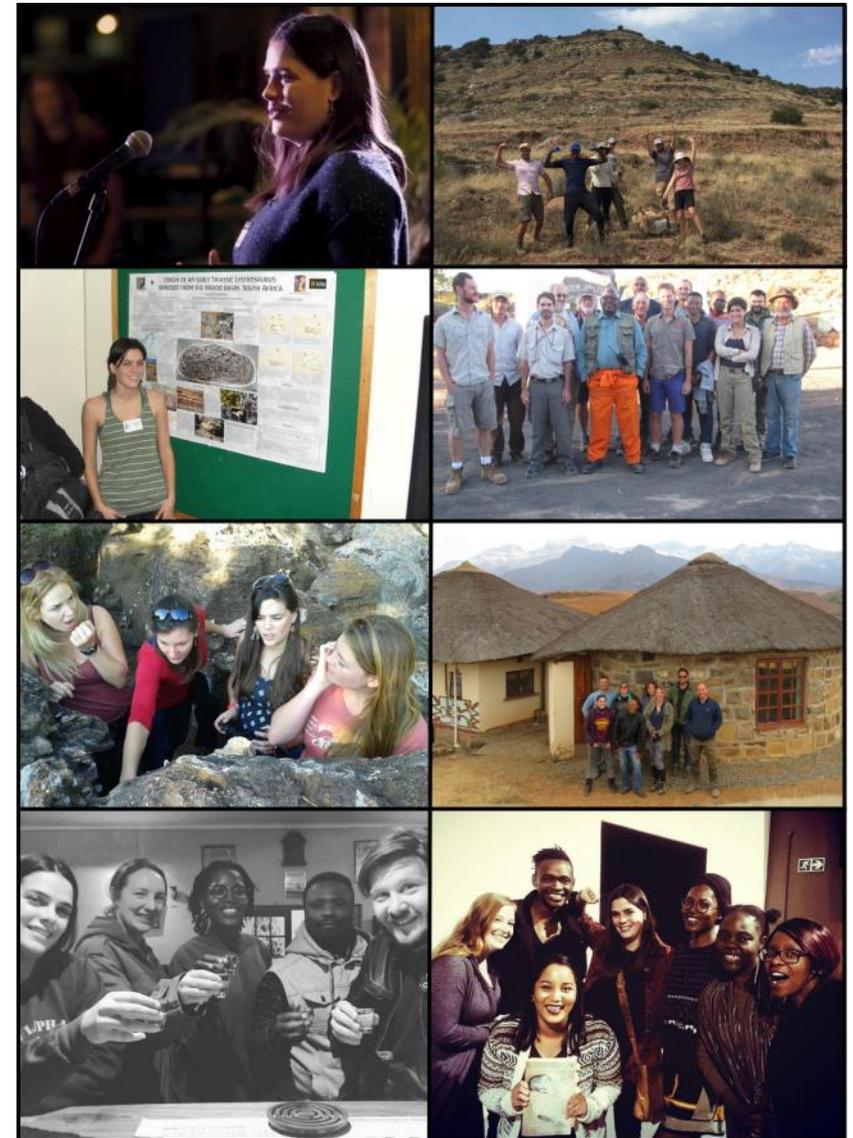
Goodbye for now

Pia Viglietti (Field Museum, Chicago)



Figure caption

Goodbye for now ESI: (top to bottom) Giving my storytelling talk sponsored by Naked Insurance. (left to right) Jonah Choiniere, Wilfred Bilankulu, Justine Wintjes, Gavin Dollman, Rick Tolchard, and Lara Sciscio flexing their muscles victoriously after a gruelling effort to carry a 100 kg + poposaurid fossil jacket down Spioenkop hill on Heelbo farm. My first PSSA conference back in 2010 where I first met many ESI staff and students who inspired me to come study at Wits for my PhD. Working with Bruce Rubidge and Michael Day on their End-Guadalupian extinction project during my PhD. Aurore Val (far right) giving Katja Douze, Stephanie Day, and myself a tour of fossil sites near Sterkfontein Caves. In the field during my postdoc with (from left to right) Jonah Choiniere, yours truly, Kimi Chapelle, Puseletso, Cory Dinter, Kathleen Dollman, Blair McPhee, and Stephan Spiekman. Kathleen Dollman and I (left) leading a Choiniere lab fieldtrip with Cebisa Mdekazi, Gilbert Mokgethoa, and James Neenan. (from left to right) Rosa Moll, Silindokuhle Mavuso, Kim Tommy, yours truly, Cebisa Mdekazi, Pamela Akuku Achieng, and Keneiloe Molo-pyane at Christa Kuljian's Darwin's Hunch talk in the Origins Centre. There are many others not shown in the photos here, but I appreciate you all and thank you for making my time at the ESI so memorable.



Why I don't like dinosaurs

Chris Harris (ESI)



After completing my Honours at the Evolutionary Studies Institute (ESI), I spent a year working at the Albany Museum's Devonian lab assisting Dr. Rob Gess with research and other such things. I thought I was a lucky guy to be working in a world class laboratory; some of the world's experts on various groups of Devonian vertebrates made visits to our little Eastern Cape village (known as Grahamstown, eRhini, or more recently Makhanda), and it was fantastic to meet Professor Per Ahlberg and Dr Alice Clement when they were in town.

But not all was sunny at the lab. Dark forces inhabited the transom above the front door facing the street. At first they would leer from their perch with their beady reptilian eyes. Soon they began to swoop down aggressively. It wasn't long before they went into full attack with claws and wings, first one then the other,

aimed at the head of any researcher who tried to enter. Bird attacks came in twos. This pair of red winged starlings was terrorizing our lab. Consult figure 1 for mugshot.

I tried various methods of defence. I figured that ignoring them would show them I wasn't afraid. I would stare back at the birds as they contemplated their dive. But watching a bird stare intently into your eyes and then swoop down at your face is quite unsettling. Truth was, each time I went through that door I was becoming more and more traumatized. I would raise my jacket over my head protectively, and this helped tremendously to protect me from the attack. People on the street would look at me curiously as I prepared my armour on returning from a lunch break.

It's not good to take things personally, but... it was personal.

A few times, I observed people walking along

the pathway right in front of the lab, ignored by the minions. But when I emerged from my car on the street, I was immediately beset upon. They had identified me as their enemy.

A few months later, I was telling this tale to Viktor Radermacher at ESI, and he was fascinated by it. He suggested I should contact an ornithologist and/or ethologist. It was a clear example of learning behaviour and subject identification in birds. Starlings along with crows and mynahs are some of the most intelligent birds.

Instead of self-preservation, I could have recorded some better notes. As I had been day-dreaming about defending myself with a tennis racket, Viktor was now dreaming about evolutionary biology. But I wonder if he had been in my shoes, would he have been so philosophical?

Why I don't like dinosaurs

Chris Harris (ESI)



Gess, on the other hand, began to regard these aggressive birds as part of our security forces. He didn't support my suggestions of full scale war. He thought that the birds might discourage intruders, especially after a window had mysteriously broken one night, with nothing of value taken.

One day suddenly the attacks relented. The chick had flown the nest. For weeks afterwards, I would flinch at the slightest flutter from above, half expecting to be swooped upon as I came in to work. Once I recovered from my insecurity, come to think of it, there was something charming about the way a pair of starlings were such stern defenders of their infant. I'm only glad that these flying dinosaurs are a shade of their ancestors, or I wouldn't be around to tell the tale.



A pair of red winged starlings. Photograph by Alan Hill.

A quick update from Christophe

Unidad Ejecutora Lillo, Tucumán, Argentina



Dr. Christophe Hendrickx, who worked as a postdoctoral fellow at the ESI for three years under the supervision of Profs. Jonah Choiniere and Fernando Abdala, was recently awarded a two-year postdoctoral fellowship in Argentina.

Provided by the Conicet, this funding will enable Christophe to continue his work on the evolution of the dentition in non-mammaliaform cynodonts using disparity, evolutionary rate and dental complexity analyses. Christophe will be working under the supervision of Profs. Fernando Abdala (yes, again! It's like a small ESI franchise) and Diego Pol in San Miguel de Tucumán, where his Argentine wife Graciela comes from. And to follow up with good news, Christophe and Graciela are expecting



UJ Paleomag Lab up and running!

Lara Sciscio (UJ)



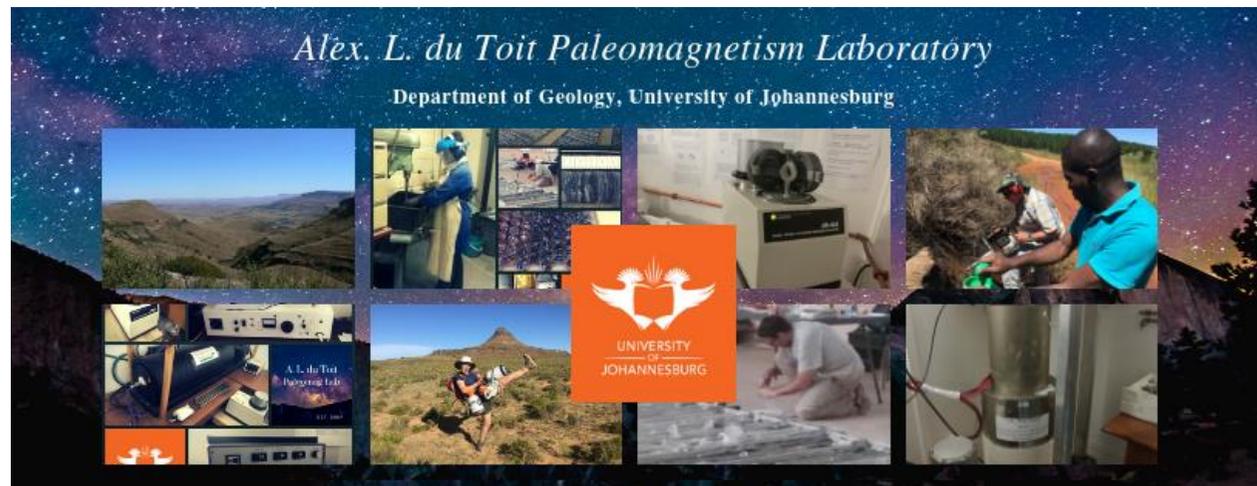
The Paleomagnetism Laboratory at the University of Johannesburg is now fully functional once again.

The Paleomag Lab is part of the Rock and Paleomagnetism Instrument Development Consortium. This functions as a multi-campus virtual institute based out of Caltech (USA). The UJ Paleomag Lab is dedicated to acquiring igneous and sedimentary rock magnetism data. In more recent years, with the available equipment in the lab, it has focused on Archean-Proterozoic rocks.

Over the last ~3 years, the lab has had several issues with the highly sensitive 2G Enterprises SQUID magnetometer. This magnetometer is a 2G Enterprises vertically-oriented Super-Conducting Quantum Inter-

ference Device “SQUID”. It is ideal for measuring small magnetic fields. This system is highly precise and sensitive, which is necessary when measuring rocks with very low magnetic intensities (e.g. flowstones, sandstones). The past few years has seen the lab solely using an AGICO JR-6A Dual Speed “Spinner” Magnetometer. This is useful when measuring rocks with high magnetic intensities (i.e. lavas and dykes), but less so for sedimentary rocks.

Given the repair of the SQUID and after some troubleshooting, the lab can now process low intensity rocks once more! Good news for all those wanting to do magnetostratigraphy. As such, we are now fully operational again!



South Africa's first fossil hunters lecture Series : What we learnt

Julien Benoit et al. (ESI)



“In a gradual process of creation, [The animal world] finally leads to man, who is able to think and to reflect. The higher stage of man is reached from the world of the monkeys, in which both sagacity and perception are found, but which has not reached the stage of actual reflection and thinking.”

These words are not from Charles Darwin, but from an African scholar, the Tunisian Ibn Khaldun, who lived some 500 years before Darwin was even born. Surely Darwin did not know about this Muslim author from Africa when he coined the modern Theory of Evolution, but the very fact that scholars like Ibn Khaldun existed illustrate that evolutionary studies are, and have always been, free from geographical and cultural barriers.

A question then arises: was there African palaeontology before the word “palaeontology” was invented? Palaeontology is the science of

the evolution of species. Often when it comes to South African palaeontology, famous names such as Raymond Dart, Robert Broom or James Kitching come to mind. But what about fossil discoveries made before them? Little is known about the fossil discoveries that took place before the scientific era, particularly in pre-colonial times. Early European settlers as well as indigenous people were finding fossils well before science could account for the existence of the petrified remains of long extinct creatures. They were often considered curiosities, with legends created to account for their existence (called geomythologies), or included in traditional medicine, rock art and religious beliefs.

To celebrate Heritage Day 2018, the Evolutionary Studies Institute organized a lecture series entitled ‘The First Fossil Hunters of South Africa’. The invited speakers were Prof. Anusya

Chimsany-Turan (University of Cape Town), Dr. Sharad Master (Wits University, Geosciences), Dr. Cameron Penn-Clark (Wits University, Evolutionary Studies Institute), Dr. Charles Helm (Peace Region Palaeontology Research Centre, Canada), and students Aviwe Matiwane (PhD candidate, Rhodes University), Kimberleigh Tommy (PhD candidate, School of Anatomical Sciences, Wits), and Cebisa Mdekazi (Masters candidate, Evolutionary Studies Institute). The event was kindly sponsored by the DST-NRF Centre of Excellence in Palaeosciences (CoE-Pal) and the Palaeontological Scientific Trust (PaST). The objective of this conference was to raise awareness about the earliest fossil hunters of Southern Africa among both academics and students by presenting evidence of early fossil findings made by early European settlers and indigenous people between 300 000 and 200 years ago,

South Africa's first fossil hunters lecture Series : What we learnt

Julien Benoit et al. (ESI)



and how they interpreted them in a pre-scientific and pre-Darwinian context. It was also the opportunity to give back some credit to the often forgotten first fossil finders and to inspire a new generation of young South African scientists by introducing new role models.

In the first talk, Prof. Chimsany-Turan reminded us that the scientific relevance of the wealth of fossils from South Africa is internationally renowned. When international media outlets talk about South Africa, it is not to talk about political insecurity or corruption, as most people might think, but to talk about the amazing fossil discoveries.

In the second talk, Dr. Master demonstrated that the oldest report of fossil finding in South Africa is as old as the Cape colony itself. In 1652, Hondius wrote that the survivors of a shipwreck of the Dutch company's Haarlem found fossil seashells while looking for fresh-

water in, what is now known as, Table Bay.

In the third and fourth talks, Dr. Penn-Clarke and Dr. Helm pointed out that given the oldest *Homo sapiens* fossils in Africa are 300 000 years old and, given that the South African soil has always been packed with fossils, humans must have found fossils well before colonization, and even during prehistoric times.

The first evidence of a fossil intentionally transported by a human in Africa (and in the World) is an orthocere shell from Erfoud in Morocco. It was 300 000 years ago. Intentionally transported fossils are termed "manuports", and the earliest evidence of manuported fossils in South Africa are trilobite fossils that were transported kilometres from their source during the Middle Stone Age.

The first discovery of a Karoo reptile was likely made by a Griqua person in the 1820s who

found a slab of rock bearing a *Mesosaurus* skeleton and used it as a pot lid. This fossil has now become the holotype of *Mesosaurus tenuidens*, and is housed in Paris. Nobody knows who the original collector was.

Dr. Helm presented the fascinating and controversial case of the cave paintings at Mokhali Cave in Lesotho. The Mokhali Cave is located very close to a site where dinosaur footprints are exposed. These dinosaur footprints are about 200 million years old and have probably been exposed for decades. One of the cave paintings bears striking resemblances to tri-dactyl footprints. This would suggest that the Khoisan were aware of those dinosaur footprints. Even more intriguing was the presence of (now faded) bird-like characters painted next to this alleged dinosaur footprint. Today, only walking birds make footprints with three large digits like this and it is, thus, possible that

South Africa's first fossil hunters lecture Series : What we learnt

Julien Benoit et al. (ESI)



these bird-like figures represented the track makers. This is a matter of debate, and scepticism is warranted. However, if these are indeed the trackmakers, they would look surprisingly like actual theropod dinosaurs as we interpret them today (exceptionally *birdish* – Ed), and as such are far more accurate than the sluggish brutes reconstructed by Sir. Richard Owen's famous Crystal Palace exhibition.

Why would people collect fossils if not for science? The reasons are numerous, for instance, by accident (e.g. the nummulites in the building blocks of the pyramids of Giza), for medicinal purposes (as people in Asia still do today), for aesthetic purposes (e.g. jewellery), or for religious reasons.

To conclude, why is it important to know that indigenous people have been finding fossils in Africa for a long time? Firstly, it appears that fossils have been collected by *Homo sapiens*

as early as their inception, and this has implications for the origin of our cognitive capacities and intelligence. Secondly, this knowledge may shed new light on difficult to interpret pieces of rock art. For example, some pieces of rock art are found in shelters that also have conspicuous dinosaur footprints exposed in the vicinity. This also opens up questions surrounding how often such an associations occur, and if any correlation can be found?

Finally, and more importantly, the acknowledgement of indigenous knowledge is an opportunity for us to credit communities that are overlooked holders of this knowledge. This could lead to the (re)discovery of sites that have been known by local people for ages, but previously disregarded by science. Who knows what wonderful new fossil bearing localities will become available? Even more rewarding is the idea that if new fossils sites are discovered this

way, this would finally bring some credit to the communities who discovered them, and engage a crucial turnover for cultural re-appropriation of the South African fossil heritage. This would be a first step into make our science more popular and more integrated in traditional African cultures.

Source : Helm C.W., Benoit J., Mayor A., Cawthra H.C. Penn-Clarke C., Rust R. (in press) Interest in geological and palaeontological curiosities by southern African non-western societies: A review and perspectives for future study. Proceedings of the Geologists' Association. DOI: 10.1016/j.pgeola.2019.01.001

South Africa's first fossil hunters lecture Series : What we learnt

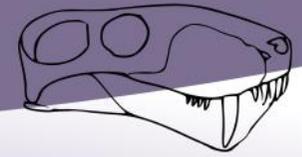
Julien Benoit et al. (ESI)



Background (Left to Right): Dr Sharad Master, Ms. Kimberleigh Tommy, Ms. Aviwe Matiwane, Ms. Cebisa Mdekazi, Dr. Charles Helm, Prof. Anusya Chimsany-Turan.
Foreground: Dr Julien Benoit
Absent: Dr Cameron Penn-Clarke

National Geographic expedition to Mozambique

Steve Tolan and Ricardo Araújo



Following on from previous successes over recent years, a team from the PaleoMoz Project (see www.paleomoz.org) carried out another expedition to various sites in Mozambique, many of them never having been visited by palaeontologists before, and the fossil potential unknown.

The team started off in Maputo, the capital, and initially consisted of Ricardo Araújo from Universidade de Lisboa, Portugal, Nelson Nhamutole (head of the Laboratory of Paleontology of the National Geology Museum), Zanildo Macungo (lead preparator at the Paleontology Laboratory of Mozambique), and Issaia Macaneta (the museum's driver). Both Nelson and Zanildo have just been accepted for MSc courses at Wits University this year. The team drove to Tete, where they were joined by Steve Tolan, a fossil enthusiast from the Luangwa Valley, Zambia.



Permian tree and associated broken roots

First stop from Tete was an area where the team found a new extensive outcrop of fossil trees. The team was joined for a few days by

Dino Milisse, the Director of the National Geology Museum of Mozambique, situated in Maputo. Some of the team concentrated on studying the incredible fossil trees in Tete Province, which they had discovered at various sites in previous visits. The fossil trees are part of a

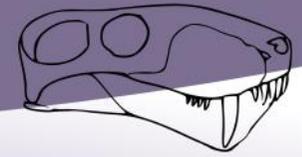


Loaned transport

Permian fossil forest which runs for many kilometres, creating what is thought to be Africa's largest fossil forest, and which may even be the largest in the world. After digging down

National Geographic expedition to Mozambique

Steve Tolan and Ricardo Araújo



around the tree stump to a depth of about 2 metres over several days, our hoped-for wide buttress roots seem to have rotted away, maybe before fossilisation, and it tapered inwards towards the base, and actually fell over in the night. If it was still being excavated at the time, it could have killed someone, as it weighed a couple of tons! What was annoying is that there was a large village a few hundred metres from the excavation, and each night the locals would break off a piece of root, or part of the stump, to find out what made it so 'valuable' to us!

The remainder of the team explored new areas with Triassic up to Cretaceous outcrops. Many of these previously unexplored sites contained fragmentary bones of large and small vertebrates, though nothing identifiable was found, but the potential for better finds is certainly good.

Some of the team then crossed the Zambezi by a small ferry boat, where they explored possible new sites on two motorcycles, lent by the local district administration.

The whole team then returned to Tete, where they restocked with supplies, then drove to the Dôa area, south-east of Tete. There they took many samples of fossil wood and also explored areas further south, where the British geologist Frank Dixey found dinosaur fossils in the 1920's.

The team then crossed the border into Malawi to save time and mileage, and re-entered northern Mozambique. They drove to Metangula, on the shores of Lake Niassa, then drove inland to the heart of Metangula Graben, where the team camped in the back garden of the local headman's house. They were joined by four local men, Buanar, Gemusse Imed and Paulo, who had been working with the Paleo-

Moz team for some years, and they have become expert fossil-finders, and are very useful



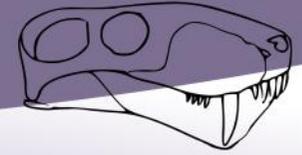
Team and local helpers, Metangula graben



Roadside snack time!

National Geographic expedition to Mozambique

Steve Tolan and Ricardo Araújo



when excavating fossils, as well as wrapping them safely for carrying back to camp, and from there to Maputo.

Some of the team worked on an area which produced a lot *Glossopteris* fossils, and several large slabs were collected. The rest of the team explored both new and known Permian sites in the area, collecting many vertebrate fossils, including several new creatures never found in the area before, and which are currently being prepared and worked on.

The area, which has been (lightly) explored for fossils since 1949, although it was only in 2009 that Ricardo Araújo started carrying out regular and extensive fossil expeditions to the area. However, it is thought that the team may have tripled the known vertebrate fauna of Metangula Graben during the latest expedition. Up to now, the fossils have been overwhelmingly *Endothiodon*-dominated, but that appears to be changing.

At the end of the fieldwork, the team crossed back through Malawi to Tete, then onto Maputo, covering over 6,000 kms in a month.

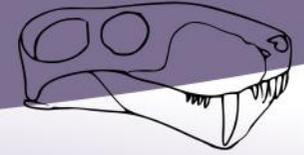
Exciting plans are in place for a much more comprehensive expedition of the Metangula area in 2019.



Dino Milisse,
Director of the National Geology Museum of Mozambique,
helping to excavate a large fossil tree root.

Titanic travels

Sifelani Jirah (ESI)



From January - February 2018 the ESI Fossil collections manager Mr Sifelani Jirah concluded his data collecting trips for his PhD with a visit to the Natural History Museum, London and Berlin Museum für Naturekunde.

2018 was a pretty busy year. I inspected, measured and photographed multiple titanosuchid specimens, and also shared some tentative results of my research with the Palaeontology community at PSSA in Bloem. Sorry to keep you all waiting for the final product, but all good things require diligence. Apart from the cold, I had a blast in Europe! I fortunately escaped the icy European winter and back to some scorching Karoo heat during our annual Middle Permian Fieldtrip in Laingsburg and Victoria West where I had fun with fossils!



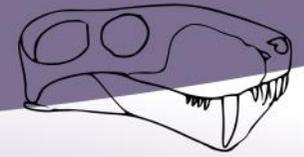
Working on a *Jonkeria* specimen at the Berlin Museum für Naturekunde.



Excavating *Rhachiocephalus* in Victoria West, South Africa.

Titanic travels

Sifelani Jirah (ESI)



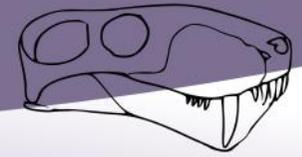
Working on a *Titanosuchus ferox* specimen.



Plastering the *Rhachiocephalus* specimen with Dr Marco Romano.

Fossil rescue missions and PhD work

David Groenewald (ESI)



Well, 2018 was a busy year, and 2019 looks to be much the same as I sit down to write up my PhD, spend some time in the lab dabbling with detrital zircon and petrographic analysis, and maybe venture out for the occasional foray in the field to stretch my legs and gather some last-minute data.

During 2018 I spent a good amount of time doing fieldwork towards my PhD (read: “traipsing about the veld looking for fossils, looking at all those lovely rocks, and having coffee and food at farmhouses”). I measured several stratigraphic sections crossing the Ecca-Beaufort contact in the Free State and KZN and have had some success on the vertebrate fossil front, making a few exciting finds with several specimens that have been, or are currently being prepared downstairs at the ESI.

In July 2018, a farmer near Mooi River, KZN,

contacted the ESI after finding some fossils in an old road-gravel quarry on their farm. A rescue mission was launched, with the team comprising of Irene Esteban Marco Romano, Viktor Radermacher and myself racing down to excavate the specimens (Figures 1 and 2). After a busy two days of excavating and enduring bitter cold (we had to break the ice off the plaster jackets in the morning), we brought back seven specimens: mostly *Lystrosaurus maccaigi*, but also an isolated canine (likely belonging to a gorgon) and some interesting ribs. The ribs, which are expanded proximally, bear resemblance to those of *Thrinaxodon*. However, they are larger than the range seen in *Thrinaxodon* and we are therefore still puzzling over its identification.

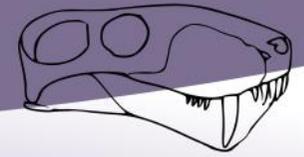
In keeping with interesting (albeit problematic) finds, I recovered a pelvis and left hind limb of an as of yet unidentified cynodont from *Dap-*

tocephalus Assemblage Zone strata in the northeastern Free State (Figure 3). Why is it that, with the exception of *Procynosuchus*, we only have skulls of Permian cynodonts and have no idea what the rest of their skeleton looks like? Now that the specimen is prepared by the volunteer Pam, we eagerly await Fernando’s visit later this year so we can try narrow down which cynodont the pelvis belongs to, as it has an interesting blend of characters from Permian and Triassic forms.

In July, I also went down to visit the collections of the KwaZulu-Natal Museum in Pietermaritzburg to look at their therapsid collection in order to add it to the Karoo Vertebrate database. The collection is small, and most of the material is fragmentary or unprepared, but the visit still added dots on the map which will be important for refining the biostratigraphy in KZN. There are three holotypes in the collection, alt-

Fossil rescue missions and PhD work

David Groenewald (ESI)



though two of them have been reidentified: NM0188 - *Scymnosaurus warreni* (reclassified as *Moschorhinus*), NM175, NM178 and NM180 - *Dicynodon ingens* and NM0498 - *Lystrosaurus andersoni* (synonymized with *L. curvatus*). Another specimen in the collection that caught my eye is a jaw fragment (MM0505) identified as belonging to the mosasaur *Liodon* in the catalogue. While its provenance data is dubious, as it definitely does not come from the “Beaufort Beds” near Estcourt, South Africa does not have many mosasaur remains, and I thought I would mention the specimen here for interest.

My last intriguing find for 2018 was made near Brandfort in the Free State. In this area, we think the *Daptocephalus* Assemblage Zone is present but, as there have not been any fossils recovered from the lower Beaufort Group rocks in this area, this is really more of an educated

guess waiting to be tested. After spending time in the area hunting for outcrop, I began to understand why no fossils had previously been recovered. Luckily I stumbled across something just as I was about to call it quits and head home empty handed. What started off as an uninteresting piece of weathered bone which, in my despondency, I was going to excavate and bring back (more as proof that there are fossils in the area and that I was actually out looking rather than finding anything actually useful) soon turned into a much larger job after I exposed the tip of a large canine! This specimen is currently being prepared by Thilivhali Nemavhundi at the ESI and I am looking forward to finally seeing what it is (Figure 4). Hopefully, whatever it turns out to be, it will be useful from a biostratigraphic standpoint.



Figure 1 Vik and I excavating a *Lystrosaurus* skull under the watchful eye of Irene. Photo: Marco Romano



Figure 2 The team, from left to right: Vik, Marco, Irene and David, pose with the excavated fossils in jackets.

Fossil rescue missions and PhD work

David Groenewald (ESI)

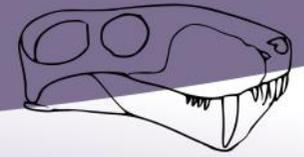


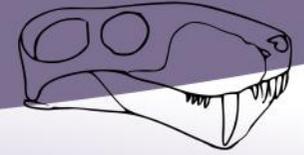
Figure 3 Unidentified cynodont pelvis and left limb.



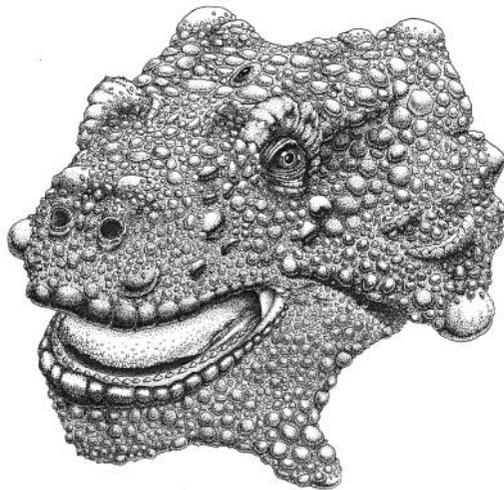
Figure 4 Excavation of the specimen, starting from just a small bit of weathered

Pareiasaurian travels

Marc Van den Brandt (ESI)



With the current paucity of willing researchers in the field, pareiasaurs can certainly take one places! Their abundant fossil remains fill some of the world's most famous Natural History collections. Recently, during the second half of my pareiasaurian taxonomic PhD, I have been fortunate enough to study historic South African material, collected by Broom, Seeley and Romer, now housed in New York, London and Chicago respectively.



Created with extraordinary aplomb and accuracy by Viktor Rademacher (ESI), this exquisite artistic interpretation of the pareiasaur *Embrithosaurus schwarzi*, leads us to reconsider the common view of pareiasaurs as uninteresting, ugly, boring, languid animals.

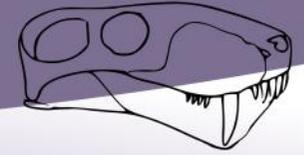
Following the SVP Conference in Albuquerque, USA, in October 2018, myself and fellow ESI MSc student Viktor Rademacher spent a week at the American Museum of Natural History (AMNH), studying pareiasaurs and Viktor, archosaurs.



Instinctively repeating "What species is this?" an apt and famous line from Jurassic Park (1993), one of the 18 partial South African pareiasaurs at the AMNH.

Pareiasaurian travels

Marc Van den Brandt (ESI)



Taking full advantage of our first trip to the big apple, evenings were spent at tourist hot spots, such as Times Square, the New York Public library, Grand Central station, the Empire State building and getting lost on the New York subway.



A typical New Yorker in the NY Subway.

Former ESI PhD and Postdoc, Mike Day, now curator of Fossil Reptiles at the Natural History Museum, London, arranged for special access to

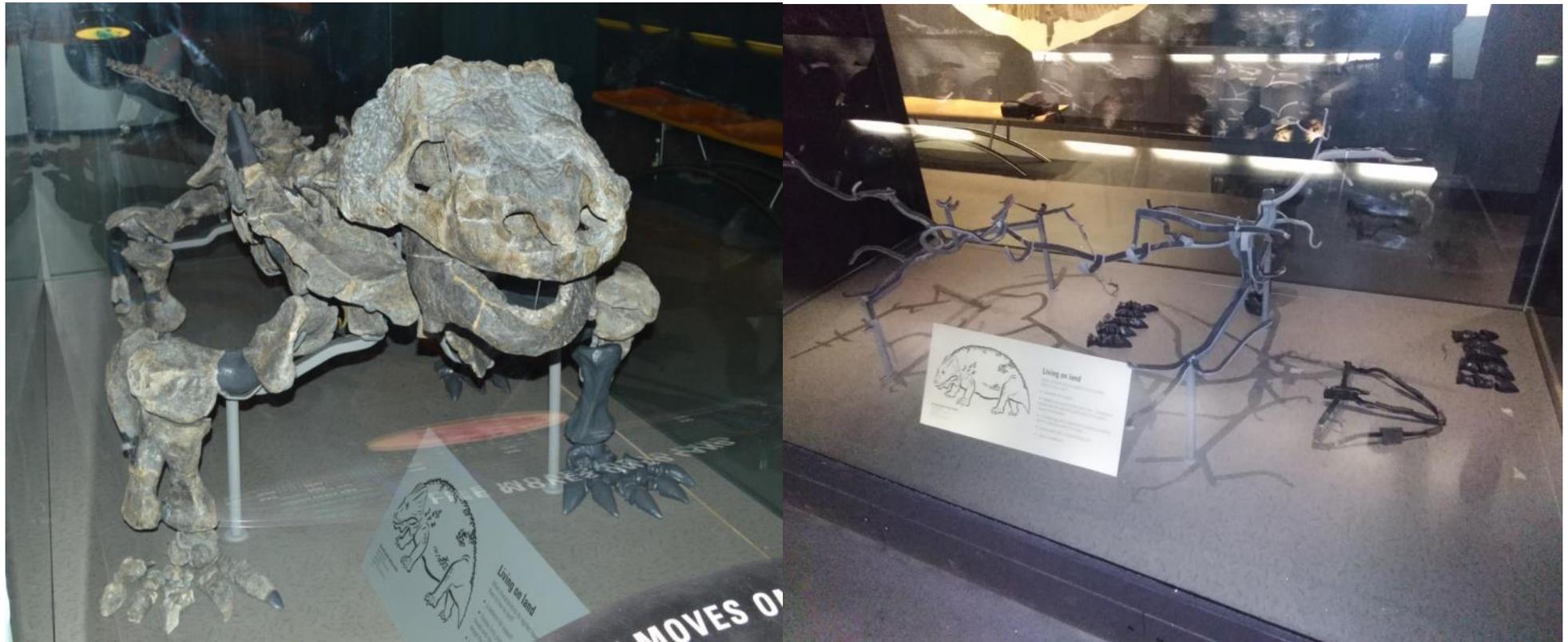
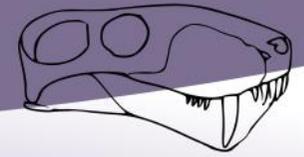


After a busy day of fossil analysis, checking out Times Square, New York, with Viktor Rademacher.

the mounted holotype of *Bradysaurus baini*, leaving this unusually sad wire frame on display to the public.

Pareiasaurian travels

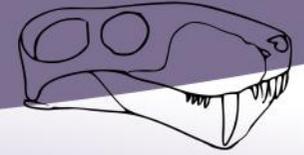
Marc Van den Brandt (ESI)



NHMUK R1971 or "Fred/Livingston", the holotype of *Bradysaurus baini* (left) before and (right) after being removed from display for study, for the first time since 1993. Fred's body parts and skull were also surface scanned by the NHMUK staff, and the data will be available for future scientists soon.

Pareiasaurian travels

Marc Van den Brandt (ESI)



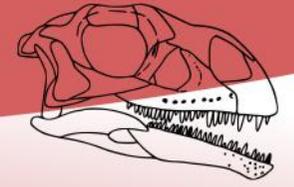
In Chicago I managed to just miss the “polar vortex” when extreme weather pushed Chicago temperatures below that of Antarctica. Putting myself on temporary exhibit to the public, along with UC 1533 *Bradysaurus baini*?, Field Museum, Chicago, part of a surprisingly large collection of 22 partial South African pareiasaurs collected on a 1929 Karoo field trip by A.S Romer and friends.

Now the challenge of assimilating all the data gathered into a succinct and robust taxonomy is well underway, along with several new descriptions. Only possible through the generous funding provided by my primary supervisor Bruce Rubidge and the African Origins Platform (AOP) grant, the National Research Foundation (NRF), the Centre of Excellence in Palaeosciences (COE-Pal) and the Palaeontological Scientific Trust (PAST). And an extra special thanks to Ken Angielczyk for hosting my stay.

The End.

Lightning review of the 78th Annual SVP Meeting

Kimi Chapelle (ESI)



In October 2018, several of us from the ESI attended the 78th Annual Meeting of the Society of Vertebrate Paleontology (SVP). Five of us submitted abstracts, and all five of us were awarded oral presentations! So, PhD candidates Kathleen Dollman, Marc Van Den Brandt, and myself, together with MSc candidate Viktor Radermacher, and postdoctoral research fellow Dr Christophe Hendrickx set off to Albuquerque to present our research at one of the largest palaeontological meetings in the world. It was one of the largest recorded SVP meetings with over 1400 attendees.

Before the meeting, Dr Blair McPhee (now at Universidade de São Paulo, Ribeirão Preto, Brazil), Kathleen Dollman, Dr Christian Kammerer (North Carolina Museum of Natural Sciences) and myself went on a three day road trip to the South of New Mexico. Along the

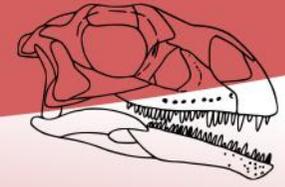
way, we stopped at White Sands National Monument in the Chihuahuan desert. These white gypsum dunes are home to a variety of wildlife, including the endemic bleached earless lizard. We visited the Carlsbad Caverns National Park which comprises of over 100 limestone caves as well as an enormous colony of 500 000 Mexican free tailed bats. What an amazing place to visit! The caves are gigantic and filled with breath-taking speleothems. Unfortunately, due to a cold snap, the bats had already migrated South and we didn't get to see one (not for lack of trying). Finally, we spent a night in Roswell and got acquainted with the famous Roswell Extra Terrestrial beings and visited the UFO Museum.

Once the road trip fun was over, we headed back to Albuquerque for SVP. As a group, the ESI presented on a wide variety of research including pareiasaurs, Ornithischian breathing,

locomotory ontogeny in dinosaurs, extinct crocodiles and gomphodont dentition. It was humbling to present in front so many international professionals. We met up with other fellow South African colleagues including Prof Roger Smith (who delivered the kind of talk that inspires immediate desire for fieldwork – Ed), Dr John Hancox and Dr Eva Hancox, as well as colleagues from around the world. It was also a pleasure to spend time with Cory Dinter, a former ESI MSc candidate, who recently graduated from the ESI and has moved back to New Mexico. We visited the New Mexico Museum of Natural History and Science, had delicious Mexican food and Margaritas and danced our feet off at the banquet dinner! Altogether, a very memorable conference and trip with great company!

Lightning review of the 78th Annual SVP Meeting

Kimi Chapelle (ESI)



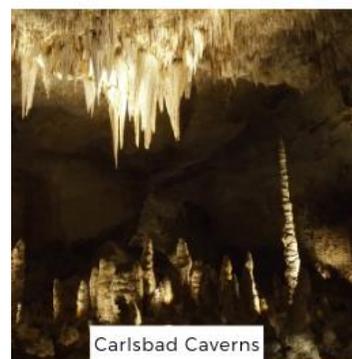
Abstract references:

- K. E. Chapelle, J. N. Choiniere, R. B. Benson, A. Otero** LOCOMOTORY SHIFTS IN DINOSAURS DURING ONTOGENY
- V. Radermacher, J. Choiniere, K. Chapelle, W. De Klerk, V. Fernandez, R. Butler, E. Bordy** NOVEL POSTCRANIAL FEATURES IN A NEW SPECIMEN OF *HETERODONTOSAURUS* (DINOSAURIA, ORNITHISCHIA) REVEALED BY SYNCHROTRON X-RAY COMPUTED TOMOGRAPHY: IMPLICATIONS FOR ORNITHISCHIAN PHYSIOLOGY, EVOLUTION, AND SYSTEMATICS
- M. J. Van Den Brandt, B. S. Rubidge, J. Benoit, F. Abdala** UNDERSTANDING MIDDLE PERMIAN PAREIASAUR DIVERSITY: THE CRANIAL MORPHOLOGY OF *NOCHELESAURUS ALEXANDERI* AND
- EMBRITHOSAURUS SCHWARZI**
- K. N. Dollman, J. Choiniere, J. M. Clark, P. Viglietti, M. Norell, X. Xu** SECONDARY PALATE EVOLUTION IN EARLY CROCODYLOMORPHS: FUNCTIONAL AND PHYLOGENETIC IMPLICATIONS
- C. Hendrickx, F. Abdala, J. Choiniere, R. Benson** THE DENTITION IN GOMPHODONTIA (CYNODONTIA, CYNOGNATHIA): DISPARITY, RATE OF EVOLUTION, AND DENTAL COMPLEXITY THROUGH TIME
- R. M. Smith, J. Botha-Brink, C. A. Sidor, N. J. Tabor** END-PERMIAN ECOSYSTEM COLLAPSE IN SOUTHERN GONDWANA: EVIDENCE FROM SOUTH AFRICA AND ANTARCTICA



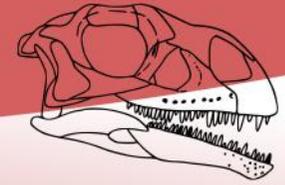
SA reunion!
From left to right: Kathleen Dollman, Prof. Paul Barrett, Dr John Hancox, Prof. Roger Smith and Dr Eva Hancox

White Sands National Monument



Acres of Bone; Welcome to the Team

Jonah Choiniere (ESI)



The second half of 2018 was a flurry of field activity for the Choiniere lab. In September, Prof Roger Benson, Dr James Neenan, and PhD student Marie-Claire Koschowitz of the University of Oxford, PhD students Daniel Cashmore and Emma Dunne of the University of Birmingham and PhD student Stefan Spiekman of the University of Zurich joined us from overseas. They met our field crew of Kimi Chapelle, Gavin Dollman, Cebisa Mdekazi, and Drs Pia Viglietti and Lara Sciscio for ten days of excavation near the village of Qhemegha, Eastern Cape. I assembled this team to start the first phases of excavation of a bone bed discovered by local shepherd Dumangwe Thyobeka and brought to my attention by three local educators, Sginyane Ralane, Themba Jika-Jika, and David Mei.

As we began to dig, we found that what we

thought was a bone bed was in fact a series of at least a dozen individual dinosaur and other vertebrate skeletons, stretching out along a donga system covering more than 30 acres. Our initial excavations yielded a huge new specimen of the cynodont *Scalenodontoides*, a



Figure 1: The “bone bed” area near Qhemegha, Eastern Cape is stunningly beautiful. This donga system has more than 12 dinosaur skeletons in it.

huge, articulated skeleton of a sauropodomorph dinosaur, and an unidentified specimen of what might be a pseudosuchian archo-

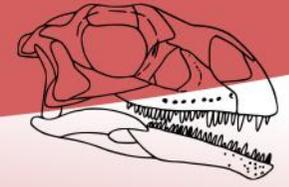
saur. Pia and Lara were able to put the area into stratigraphic context, and in doing so found several other important specimens nearby. Indeed, the entire area seems to be incredibly rich in fossils, and probably represents the



Figure 2: The late Sandile Eland showing us his technique for carrying heavy fossils down the hills near Qhemegha. It was certainly a learning experience for everyone!

Acres of Bone; Welcome to the Team

Jonah Choiniere (ESI)



best lower Elliot Formation locality found since the Ellenbergers excavated Maphutseng.

The village community was tremendously supportive of the work, and we were joined in the field each day by Mr Ralane, local businessman **Mac Shai**, and the late Chief **Sandile Eland**, who all received on-the-job training and became hugely productive members of the team. Local caterer **Yoliswa Mei** provided outstanding local food. **Professors Marius Vermaak** and **Goonie Marsh** of Rhodes University joined us later in the trip, bringing good cheer and good wine. Goonie's stoep-side lecture on the igneous history of the Drakensberg, delivered to a crowd of about 50 townspeople in the waning light of spring, was a particular highlight. Despite 10 days of hard work, we couldn't quite finish our quarries in 2018. We left two enormous jackets in the ground with our new friends and will return in March with a hoist truck to remove

them. Quarrying at the site will continue intensively for at least the next three years, but I imagine the area will require a decade of careful research to fully understand what it has to offer. In the meantime, we will be assisting in curriculum development in the local school system, and helping to develop palaeotourism opportunities to take advantage of the natural beauty and deep-time heritage of the region.

Finally, I'd like to extend a huge welcome to my new students! At the Honours level, the lab is joined by **Mike Zondo**, Curatorial Assistant at the Natural History Museum in Bulawayo, and by **Thabile Seerane** and **Nothemba Belle**, two participants from 2018's Palaeosciences Accelerator Programme. At the MSc level, **Mathew Robinson** has returned after his Honours year to study *Aardonyx*, and I will be co-advising **Zichuan Qin** of the IVPP in Beijing in his work on early alvarezsaur evolution.



Figure 3: Members of the Qhemegha community turned out in great numbers to sing our praises on our final day of excavation.

Acres of Bone; Welcome to the Team

Jonah Choiniere (ESI)

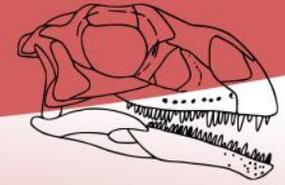


Figure 4: From left to right, Cebisa Mdekazi, Kimi Chapelle, Emma Dunne, and Lara Sciscio are getting the leg of a huge dinosaur wrapped in plaster for the trip back to the lab.



Figure 5: The media coverage of the discovery was intense, with articles appearing in local newspapers and on the BBC.



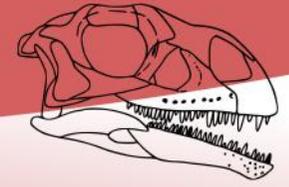
Figure 6: Gavin Dollman using his drone to make 3D models of outcrop.



Figure 7: One of our enormous jackets being pedastaled. We will return to pick this up with a crane in March, 2019. Clockwise from top left: James Neenan, Cebisa Mdekazi, Kimi Chapelle, Roger Benson, Sginyane Ralane.

Heelbo 2018 - Aaarrggghht (art) & Palaeo

Rick Tolchard (ESI)



In October of last year, I had the privilege of joining my supervisor; Prof. Jonah N. Choiniere, and colleagues Cebisa Mdekazi, Wilfred Bilankulu, Dr Pia Viglietti and Dr Lara Sciscio in the field.

Our destination: Heelbo farm, Free State.

Our mission: recover the remains of a giant predator from South Africa's Late Triassic lower Elliot Formation.

We were also joined by some academics and students from Wits School of Arts (WSOA) who were studying the interaction between the arts and sciences. It was refreshing to engage with different views on the world and how to interpret it.

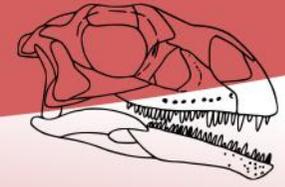
We journeyed each day to a quarry atop a hill side. It was strenuous work and the sun's heat was intense but a sense of accomplishment befell us at the end of each day. The spoils of which were several large jackets that are now under preparation. All in all, we recovered a handsome sample of new material adding to what had already been extracted from the site (an ilium) some years before. The new material looks to yield exciting research in the near future.



Hard at work on the quarry

Heelbo 2018 - Aaarrggghht (art) & Palaeo

Rick Tolchard (ESI)



The team in all our glory



A sculpture of the famous 'Odd Couple' fossil as presented by the WSoA students



Victory after lugging a fresh discovery down the hill

Hominin Palaeo-spectroscopy and Sigma Taxonomy

Francis Thackeray (ESI)



One of the greatest challenges in palaeoanthropology is the establishment of a phylogeny of more than 20 hominin species within a period of seven million years.

Well, it was Shakespeare who wrote about “The Seven Ages of Man”, but in that instance it was an ontogenetic sequence:

“At first the infant mewling and puking in the nurse’s arms...”

And “then the whining schoolboy creeping like snail, unwillingly to school...”

And then the young lover...

Then an older soldier...

And yet older to a venerable judge...

And pen-ultimately to the old man whose voice has changed to “childish treble, pipes and whistles in his sound...”

Ultimately to a skeleton that ends this “strange eventful history”, without teeth,

without eyes, without taste, without everything. One might consider that the skeleton is fossilised, with heavy calcified “ponderous marble jaws” (to quote *Hamlet*, Act 1, Scene Four).

Those are the seven ages of man in terms of Shakespeare’s sequence in *As You Like It* (Act 2, Scene Seven).

So what about “The Seven Ages of Man” in an evolutionary sequence of seven million years?

Let us consider a thought experiment, using the attached Figure 1. It shows a hypothesised lineage, from *Sahelanthropus* to *Homo sapiens*, in a spectrum of colour.

Perhaps seven taxa could be considered as being close to (if not directly on) a hominin lineage of this kind, without distinct boundaries, from *Sahelanthropus tchadensis* through to *Orrorin tugenensis*, *Ardipithecus ramidus*,

Australopithecus afarensis and *A. africanus*, extending to *Homo ergaster* and (seventhly) to *Homo sapiens*, in a spectrum of variation.

The term “Palaeo-spectroscopy” was coined by Thackeray and Odes (2013). We state the following in the context of a morphometric study using “log se_m ” statistics:

“It is pertinent to quote Buffon (1749) who noted that variation may occur ‘from one species to another, and often from one genus to another, with imperceptible nuances’ (from the first English translation of *Premier Discours of Histoire Naturelle*). Further, one may assess the results of this study in the context of the statement by Locke in 1689 (Book III, Part vi): ‘the boundaries of the species, whereby men sort them, are made by men’ (see also Cain 1997)”.

Thackeray and Odes (2013) went on to say that their morphometric study was an “attempt

Hominin Palaeo-spectroscopy and Sigma Taxonomy

Francis Thackeray (ESI)



to address the concept of a chronospecies using se_m values, recognising that there are no clear boundaries between [hominin] taxa. We refer to this approach as **palaeo-spectroscopy**, and appeal for its application to address the problem of morphological changes through evolutionary time, associated with anagenesis, without relying on the Linnaean binomial system of nomenclature". Related to this is the concept of "Sigma Taxonomy", where Sigma is the Greek letter Σ , i.e. S for *spectrum* of variation through evolutionary time (Thackeray and Schrein, 2017), without assuming distinct boundaries between species (an assumption of alpha taxonomy).

Sigma taxonomy relates to a probabilistic definition of a species (Thackeray, 2007; Thackeray and Schrein, 2017), without assuming that species can be distinguished as if they were black or white, distinguishable as distinct enti-

ties, "pigeonholed" into discrete taxa.

Figure 1, showing a possible hominin lineage, does not have clear boundaries between taxa within that hypothesised lineage in a spectrum of time.

Mayr et al (1953) provided a definition of alpha taxonomy. Thackeray (2018) defined sigma taxonomy as "The classification of taxa in terms of probabilities of conspecificity, without assuming distinct boundaries between species".

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Hominin Palaeo-spectroscopy and Sigma Taxonomy

Francis Thackeray (ESI)

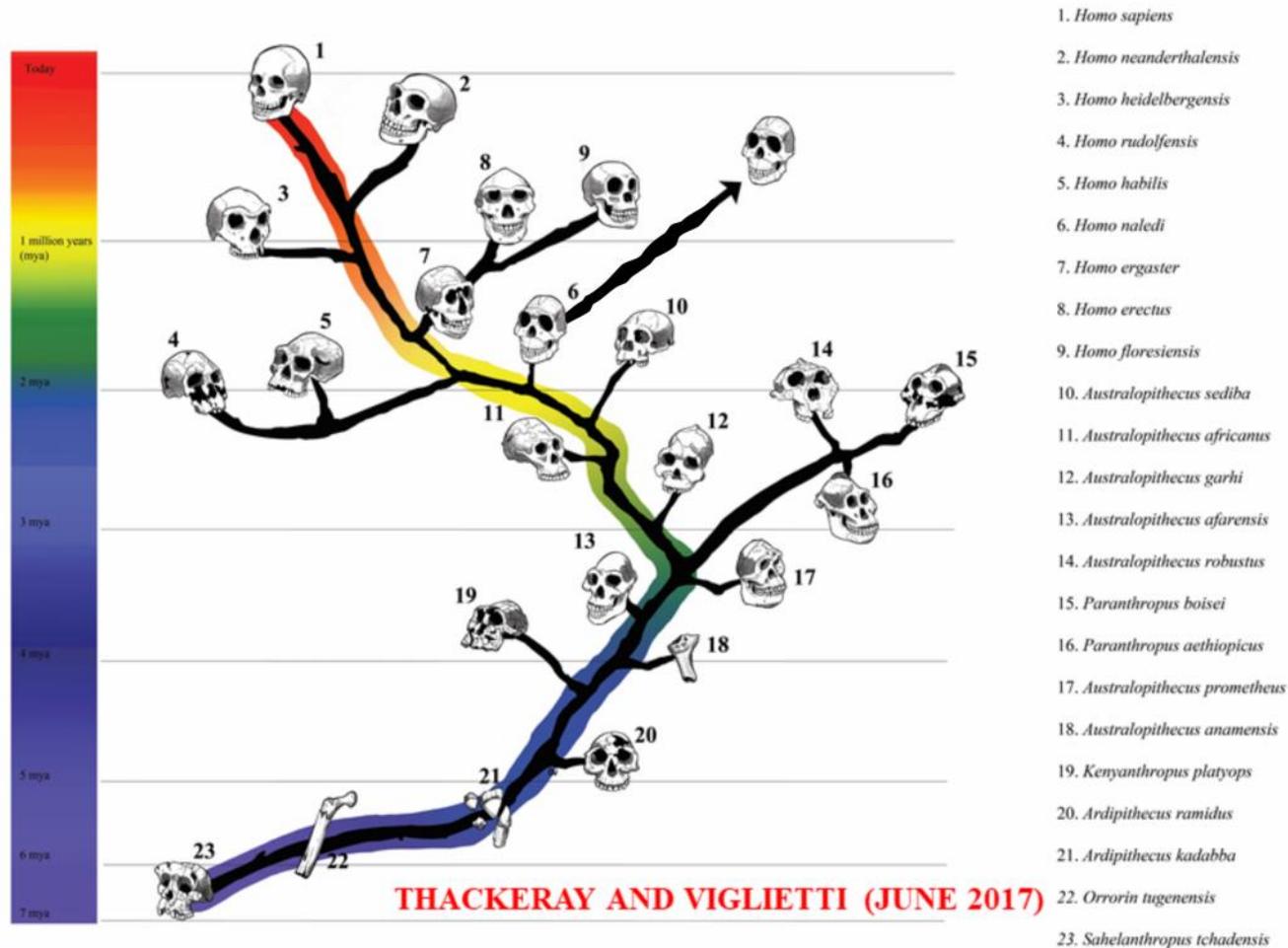


Fig. 1. A hypothesised phylogenetic tree for hominins within the last seven million years. Drawing after B.A. Wood, updated by Francis Thackeray and Gina Viglietti in 2017 to show a “palaeo-spectroscopic” hominin lineage, without clear boundaries between species in that lineage.

Species, Fuzzy Set Theory and Probabilistic Definitions

Francis Thackeray (ESI)



Lofti Zadeh (1921-2017) was a mathematician who was born in Azerbaijan and educated in Tehran in Iran. He emigrated to the United States in 1943 and obtained his PhD at Columbia University in New York in 1949, before moving to the University of California (Berkeley). He published an important paper simply called *Fuzzy Sets* in 1965 in the journal *Information and Control*. This was an extension of “Set Theory” as defined by a German mathematician, Georg Cantor (1845-1918).

In Set Theory any object is a member of a set, or it is not. In answer to the question as to whether object q belongs to set A, the answer can be either yes or no. But in Fuzzy Set Theory, an object can have a *degree* of membership. An example can be given in terms of “the set of all high skyscrapers”. The description of

this set is not expressed by the answer yes or no, but can instead be expressed by a particular number (eg. -1.61) within a degree of variation (eg. ± 0.2).

In his highly-cited paper, Zadeh (1965) uses the word “homomorphism”, which in algebra can be defined as a “structure preserving map” between two structures that have the same type. The term is derived from two Greek words, *ὁμός* (*homos*) meaning “same” and *μορφή* (*morphe*) meaning form or shape.

How does this relate to the concept of a biological species? In terms of alpha taxonomy, if specimens ‘ p ’ and ‘ q ’ have almost identical, if not exactly the same, shape as a result of interbreeding, they could be considered “homomorphic” within a set A – the representation of what is perceived as a distinct species.

But in the context of genetic variation, a mem-

ber ‘ a ’ of set A might perhaps (in probabilistic terms) be capable of interbreeding (through hybridisation) with member ‘ b ’ of another set, Set B, depending in part on the amount of time since divergence of species A and B.

So how does one classify the two? This situation relates well to the concept of Fuzzy Set Theory and Sigma Taxonomy (*see prev. article – Ed*), the latter being defined as “the classification of taxa in terms of probabilities of conspecificity, without assuming distinct boundaries between species” (Thackeray, 2018). This itself relates well to the concept of “fuzzy boundaries” between species, as perceived by Alfred Russel Wallace (1870).

In algebra, homomorphisms of vector spaces are linear maps, which are the subject of linear algebra and mathematics of the kind explored by the German mathematician Carl Friedrich

Species, Fuzzy Set Theory and Probabilistic Definitions

Francis Thackeray (ESI)



Gauss (1777-1855).

When measurements of “Specimen p ” (perceived to belong to Species A) are compared to homologous measurements of “Specimen q ” (also perceived to belong to Species A), one can express the relationship between the two in terms of the equation $y = mx + c$, where m is the slope in a Cartesian plane (“Cartesian” being the term derived from René Descartes, the French mathematician and philosopher whose cranium is curated in the Musée de l’Homme in Paris).

In the context of pairwise comparisons of measurements of many crania of specimens within Species A, the degree of variation of the log-transformed standard error of the slope m ($\log se_m$) is a measure of the degree of morphological variation typically expressed within that Species A. Thackeray (2007) demonstrated that within many modern biological species

(A, B, C...n), the typical amount of morphological variation within a species (expressed by the log of the standard error of slope m) has a Normal (Gaussian) distribution with a mean value of -1.61 (T), and an associated standard deviation ($\sigma = 0.2$), constituting a probabilistic definition of a species.

In palaeontology it is commonplace to obtain measurements of any two specimens ‘ p ’ and ‘ q ’, without knowing whether they do or do not belong to a single species. A probabilistic definition of a species may be invoked. The fact that it is probabilistic and not discrete relates well to the concept of being “fuzzy” when it comes to comparing specimens ‘ p ’ and ‘ q ’.

Recognising that hybridisation between biological species is more common than previously thought (Thackeray and Schrein, 2017), there is a need for a probabilistic definition of a bio-

logical species, using “sigma taxonomy” (Thackeray, 2018) as opposed to alpha taxonomy (Mayr *et al*, 1953) which assumes distinct boundaries between species.

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- Thackeray, J.F. 2018. Alpha and sigma taxonomy of *Pan* (chimpanzees) and Plio-Pleistocene hominin species. *South African Journal of Science* 114 (11/12): 1-2.
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A Botanist's delight!

Marion Bamford (ESI)



In August 2018 I joined the PPP-G team (Paleo Primate Project – Gorongosa) for our third field season in Gorongosa National Park, central Mozambique to continue surveying for fossil sites. We have twelve sites with fossils, some very scrappy but some very productive – watch this space!

As a continuation of this project, a few of us were invited to Chile to present talks on the research. So in December I joined Dr Felipe Martínez (team member and our host at the Pontificia Universidad Católica de Chile, Santiago), Prof René Bobe, Prof Susana Carvahlo, Dr Tina Lüdecke and Mr Tongai Castigo in Santiago. We held a workshop. We gave talks and discussions with postgraduate students on the project at the first workshop at the Universidad de Chile, hosted by Prof Teresa Torres. The second and more formal symposium was in the Salón de Honor San Alberto Hurtado, Av. Libertador Bernardo O'Higgins 340, Santiago, Casa Central. This was hosted by the Dean of Humanities and about 100 delegates attended.

A separate purpose of the trip was to visit the Darwin Fossil Forest at Copiapo in the Atacama Desert, northern Chile. This is on private land

and in a remote part, so not many people visit the site. The owner of the land hosted us all and drove us to his farmhouse on the property. Massive mudslides in the mountains in 2013 had wiped out much of the infrastructure but we could still see the evidence of the mud. We walked along a disused track that had been washed away in parts, to an abandoned copper mine and from there on along paths, up to 3600 metres above sea-level, then down to the fossil forest. The views of the geology and fossils were spectacular because there was very little vegetation, only scruffy Ephedra bushes. The woods are thought to be Triassic or Jurassic but the stratigraphy has been inverted and there are no vertebrate or pollen remains to help with dating. The tree trunks are almost 1m in diameter and the broken sections would add up to be over 25 m long. Prof Torres and I will be describing and publishing the woods.

Then we flew to the south of Chile to the lake district to see the equivalent living forests. This area has volcanoes and meltwater lakes with glaciers. Even the active volcano that we could see puffing out smoke from our hotel windows, at Villarrica, had a glacier. The forests of huge *Nothofagus* species and *Araucaria araucana* (southern beech and

A Botanist's delight!

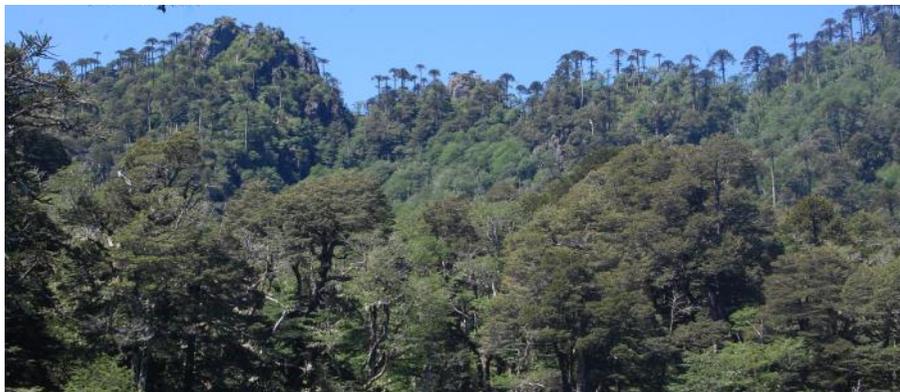
Marion Bamford (ESI)



monkey puzzles, respectively) were a stark contrast with the Atacama desert vegetation. We spent a day walking up to the forest along very steep paths and could hardly walk the next day because of stiff thighs and calves. A visit to one of the many geothermal springs was a welcome relief. The particular one we visited was in a Japanese style with the hot and cold water rushing down the narrow gorge being trapped in a series of nineteen pools, ranging in temperature from 36° to 43° C. Many ferns grow on the walls of the gorge and in the water were the enormous leaves of *Gunnera* sp. It was a botanist's delight!



Teresa Torres and Marion Bamford standing next to one of the fossil trunks, Darwin Fossil Forest



Nothofagus in the foreground and Araucaria on the high ridges



Marion Bamford and Felipe Martinez at the thermal springs

A Botanist's delight!

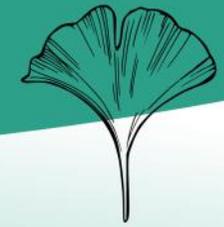
Marion Bamford (ESI)



Villarrica volcano, still active and lake in the foreground.

Kannaskoppia/Kannaskoppifolia/Kannaskoppianthus

John Anderson & Heidi Anderson/Holmes (ESI, Wits)



Having finally published our Molteno Sphenophyte volume just prior to the PSSA conference in Bloemfontein last year; our aim before the end of the current year is to complete our *Kannaskoppia* volume. With much of the research and compilation completed over previous years, it already exists in fairly complete draft form. This distinctive gymnospermous genus with its well-defined foliage and fruiting structures, provides the perfect opportunity to delve in some depth into the spread of topics elaborated below: taxonomy, diversity, habit/habitat and colour.

Taxonomy (& the recognition of species)

This is a tricky topic across all fields in palaeontology. Sample size being at the core of it. The larger the sample—specimens, populations (palaeodemes) and localities--the more

readily one can distinguish variation within species from a particular location and between locations. *Kannaskoppifolia* and its affiliated microsporangiate (male) and ovulate (female) organs is plentiful and diverse, though not too copiously so, offering great scope for taxonomic exploration. A critical consideration in palaeobotanical studies is the affiliation of dispersed organs, so finding at least some attached specimens can be of great help.

The available sample in our Molteno collection (from a total of 100 assemblages/taphocoenoses(TCs), from around the outcrop and through the stratigraphic sequence), in succinct terms:

Kannaskoppifolia (foliage): 26 assemblages, c1000 specimens, found attached in 4 TCs

Kannaskoppianthus (male): 12 assemblages, c200 specimens, found attached in 3 TCs (with

foliage in 2 TCs)

Kannaskoppia (female): 1 assemblage, c50 specimens, found attached with foliage.

Diversity (thinking of today's world)

Kannaskoppifolia & affiliates: From within the sample outlined, we recognize 10 whole-plant species (based on 10 foliage, 1 female and 4 male species).

Molteno gymnosperms overall: 143 whole-plant species (38 genera, 32 families, 10 classes).

Molteno flora overall (vegetative): 211 species (61 genera).

Based on our 1999 statistical study of the Molteno sample of some 250,000 vegetative specimens from the 100 assemblages; we projected from the 204 observed species then recognized a total of 876 preserved species; and from this estimated that ca 2,000 species had

Kannaskoppia/Kannaskoppifolia/Kannaskoppianthus

John Anderson & Heidi Anderson/Holmes (ESI)



actually existed across the biome--a number akin to the diversity in a similar biome today.

Habit & habitat (within the Molteno Biome)

We have recognized a rich tapestry of seven primary habitats across the Molteno floodplain biome—from primary and secondary riverine forest, to woodlands in the open floodplain and bordering lakes, to coniferous thickets and horsetail marshes, to herbaceous meadows on sandbars within the braided-river systems.

Kannaskoppia is interpreted as a herbaceous pioneer to small shrub occupying the sandbar meadows and various situations within the riverine forests and lakeside woodlands. Each species, as in the species within any genus today, will have shown unique habit and habitat characteristics. The aim in the finished volume is to show rendered habit/habitat sketches of each species, portraying the 'life

and times' of this attractive taxon within the diverse flora.

Colour (into the realm of hypothesis)

If one could venture across the Molteno floodplain back then in the Triassic, how much colour would one encounter. At the heyday of the gymnosperms (cone-bearing plants), as expressed in the Molteno, how far had colour touched the natural world, compared to today in the Holocene heyday of the angiosperms (flowering plants), or back in the Carboniferous heyday of the spore-bearing plants?

Whilst the terrestrial world had truly turned green in the Carboniferous, and our current world is filled with colour across the spectrum thanks to the flowering plants, in harmony with the birds and the insects; what then of the later Triassic? Our hypothesis would be that the colour spectrum—red, orange, yellow, green,

blue, indigo, violet—found its first full terrestrial expression during the Triassic Explosion of life in the aftermath of the end-Permian Extinction. The birds had not yet appeared as it was still in the earliest days of the dinosaurs; but the insects had radiated to great diversity in synchrony with the gymnosperms. The Coleoptera (beetles) were at the insect helm, for the first time accounting for around half their total diversity, and surely playing the role of principal pollinators. One can readily imagine them as colourful as they are today. The Hymenoptera (wasps, bees and ants) and the butterflies had not yet appeared, having radiated along with the angiosperms in the Cretaceous. Thus previewing aspects of our forthcoming volume.

Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



The palaeobotany-palynology team at the Evolutionary Studies Institute (ESI) is gearing up for an exciting 2019 academic year. With 4 newbies in the house, our current research profile is expanding with thrilling projects.

Meet the team!

Moteng Moseri

Hello PalNews friends! My name is Moteng Moseri and I have recently joined the ESI family from the School of Geosciences. I did my Honours in Geology (sedimentology) and I am now pursuing an MSc in Palaeopalynology. I will be working with Dr Frank Neumann and we are looking at pollen from Miocene sediments in Langebaanweg, with the aim of interpreting the emergence of the fynbos flora.



Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Chandelé Montgomery, Hons student

Hi, my name is Chandelé Montgomery and my passion stems from a desire to understand how organisms adjusted to life after the Permo-Triassic extinction. To start tackling this subject I am making use of microvertebrate samples collected from the Driefontein 11 farm in the Free State of South Africa. More specifically I am looking at around 7000 coprolite specimens from the site and their inclusions to expand on the morphotypes known from this period. The aim is to link morphotypes with potential producers and to determine what they fed on by studying the inclusions. From a young age I have been intrigued by how palaeoscientists recreate entire vivid depictions of prehistoric ecosystems, teeming with a variety of flora and fauna. I believe that the wealth of information hidden in these coprolites can aid the long term goal of reconstructing the palaeoecology for the period.

Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Nikiwe Ndlovu, Hons student

Nikiwe has just joined the ESI for an Honours degree in Palaeontology. She is currently working closely with Dr Neumann on a Miocene project. Her project is investigating a formation in Knysna. The present vegetation has Fynbos elements and Afrotemperate forest taxa, but deposits from the Miocene formation reveal a history of subtropical forest, including palms. Keep your eyes peeled for future Pal News as Nikiwe will be telling us more cool stuff about her project!

Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Nelson Nhamutole, MSc. candidate



Nelson is a newbie – from Maputo, Mozambique. He has joined the ESI to do his MSc on fossil woods from the Mago± and Matinde Formations in Northern Mozambique (Permian and Triassic). The fossil forests there are very extensive with huge trunks that have remained untouched for decades – Nelson is going to identify the trees and reconstruct past climate using their growth rings.

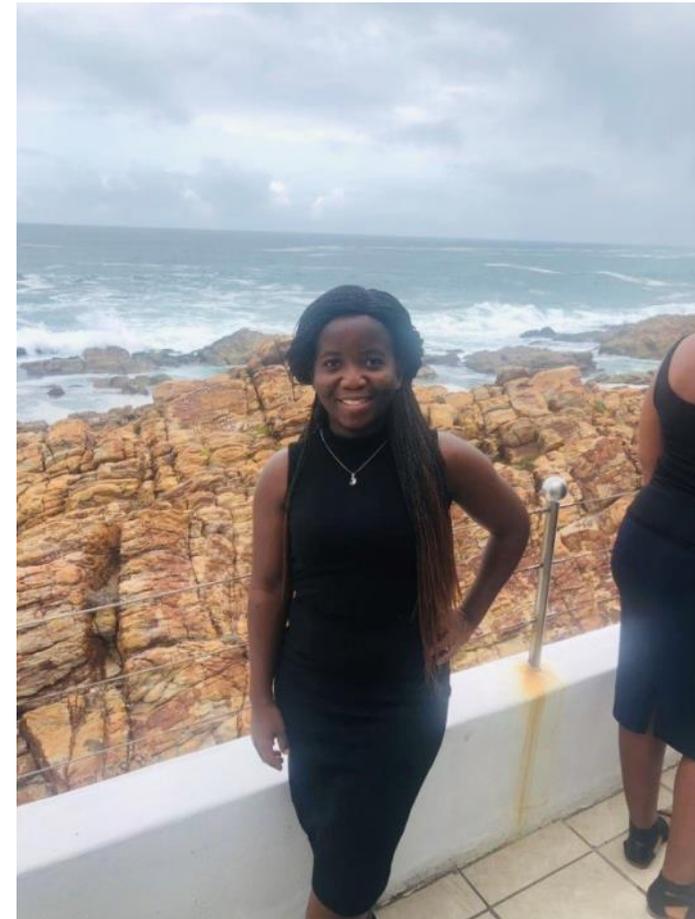
Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Bongekile Zwane, PhD candidate

Bongi is not a newbie!! She's been working closely with the ESI since 2016 from the Archeological department, but this year she's officially registered for a PhD with the ESI and is working on microscopic charcoals (anthracology) and investigating the vegetation from Sibudu and Border Cave at the time of the Tuba eruption and a thousand years later. Is there exciting evidence of a devastating volcanic winter in Kwa-Zulu Natal, South Africa? She is conducting this research under the supervision of Prof Marion Bamford. Welcome to the palynology and palaeobotany team Bongi, we can't wait to hear all about the progress of your exciting project!



Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Kevwe Eweto, Msc. Candidate

Hi PalNews friends! I am the coordinator of our lab's Palaeobotany news for 2019. My research interest, since my Honours degree in 2017, has been in palaeoenvironmental reconstructions. This involves the study of plant pollen and spores in relation to their original depositional environment. My previous project focused on Holocene sediments from the Okavango source river wetland in Angola (see Fig 1, for some of the pollen photos). My MSc project will be a palynological study on a Quaternary wetland deposit from the uMgeni Vlei Nature Reserve from KwaZulu Natal, South Africa, so keep following updates from Pal News for more exciting updates about my project.



Figure 1: Pollen indicators from the Okavango wetland (A) Oleaceae sp; (B) Poaceae sp; (C) Chenopodaceae sp

Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Elysandre Puech

Ely, from France, is doing her PhD on charcoal from Bushman Rock Shelter, Limpopo Province. Here she is with May Murungi (post doc at the ESI too, working with the rest of us, on phytoliths from Sibudu and Mwulu's cave. They are collecting modern wood samples to make into charcoal for the reference collection.



Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Prof. Marion Bamford, Director of the Evolutionary Studies Institute

Despite being extremely busy with the responsibility of being the ESI's Director, and supervising students, Marion still manages to make time for research. Last year she managed to do some fieldwork in both Mozambique and Chile, and still attend two conferences, being a keynote speaker at one of them! She has already presented research at two conferences this year, the SAAB (South African Association of Botanists) conference at UJ, and the SASQUA (Southern African Quaternary Association) in Mossel Bay. Current projects include Permian woods from Zambia and Mozambique, Olduvai Gorge flora, Koobi Fora flora, and charcoals from Wonderwerk Cave, Pondoland, Grassridge Shelter and Amanzi Springs.

Meet the Palynology/Palaeobotany team!

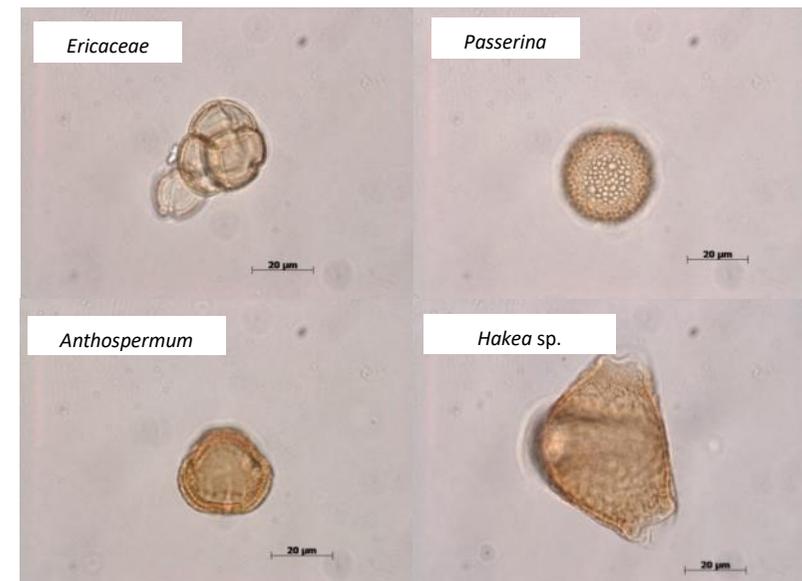
Kevwe Eweto *et al.* (ESI)



Dr Frank Neumann, Researcher

Frank H. Neumann works currently on several Neogene and Quaternary profiles from southern Africa, Israel and Central Europe.

In cooperation with Prof. Kevin Balkwill and Dr James Harrison (AP&ES/Wits University) and partners in the industry, namely the oldest honey brand in South Africa PEELS, the research field melissopalynology was initiated. Here the origin and quality of honey will be tested by looking at the pollen content. In addition, the pollen and nectar foraging behaviour of bees will be investigated in order to learn more about the bee plants of southern Africa. In December 2018 a field trip to Pullen Farm, a nature reserve in Mpumalanga where AP&ES has a research station, was undertaken. Plant material and bee pollen loads from nearby bee hives, owned by Prof. Kevin Balkwill, were collected. Below pollen of a Fynbos honey from the Eastern Cape.



Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Irene Esteban, Postdoctoral Fellow

Hello palaeos! My name is Irene Esteban, I am a postdoctoral fellow at the Evolutionary Studies Institute working on phytolith analyses. I currently work at several Middle Stone Age sites from South Africa, mainly at Mwulu's cave (Limpopo) with Dr Paloma de la Peña; at Border Cave (KwaZulu Natal) with Prof Lyn Wadley; Umhlatuzana (KwaZulu Natal) with Dr Gerrit Dusseldorp, and Elandsfontein (Western Cape) with Dr J. Tyler Faith and Dr David Braun. In the Spanish Levant, I work at Cova de les Cendres (Alicante; Upper Paleolithic) and Cova Negra (Valencia, Middle Paleolithic) in collaboration with Prof Valentín Villaverde, and Holocene terraced fields with Prof Michael Barton.

I am a co-P.I. for the P5 project at Pondoland (Eastern Cape, South Africa) led by Dr Erich Fisher. Here, we have been awarded funds from the US-NSF to continue the project. We are planning to continue our excavations at the Waterfall Bluff site in Pondoland during May/June 2019.

I was recently awarded a grant by the Palaeontological Scientific Trust to continue my previous work on phytoliths from modern plants and soils. In 2018 I conducted vegetation surveys along the Greater Cape

Floristic Region, for expanding the phytolith collection of modern surface soils from pristine vegetation and collecting modern plants.



Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



Alisoun House, Postdoctoral Fellow

I have completed all of my degrees at Wits and my research has consistently had a botanical component. I began in the school of Animal, Plant and Environmental Sciences and am now conducting archaeobotanical research at the ESI. My interests primarily lie in applying microscopy techniques and advancements to various fields of studies where they may provide additional insights, My current postdoctoral research involves using Reflective Light Microscopy to analyse and identify the woody species of archaeological charcoal recovered at an Early Iron Age (EIA) site in KwaZulu-Natal.

Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)



May Murungi, Postdoctoral Fellow

May is currently a post-doc at the ESI and focuses on using fossil phytoliths to reconstruct past South African Stone Age environments that include early human-plant interactions and the vegetation of this ancient environment. May has previously studied the phytoliths from Sibudu cave in KwaZulu Natal and will this year focus on studying phytoliths from deposits from Bushman Rock Shelter in Limpopo, investigating the landscapes early hunter gatherers inhabited and its influence on their behaviour in this region. May will also collaborate with archaeologists to study the preliminary potential of phytoliths at other South African sites i.e. Oliemboospoort in Limpopo and Uhmlatuzana rock shelter in KwaZulu Natal.



Meet the Palynology/Palaeobotany team!

Kevwe Eweto *et al.* (ESI)

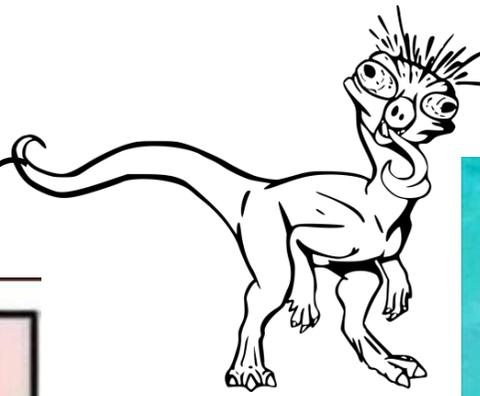


Sandra J Lennox

Sandra J Lennox (PhD 2016, University of the Witwatersrand) is a recent postdoctoral research fellow at the ESI. She specializes in anthracology and has identified woody taxa from charcoal at Border Cave and Sibudu.

Orcid: <http://orcid.org/0000-0003-0078-3685>

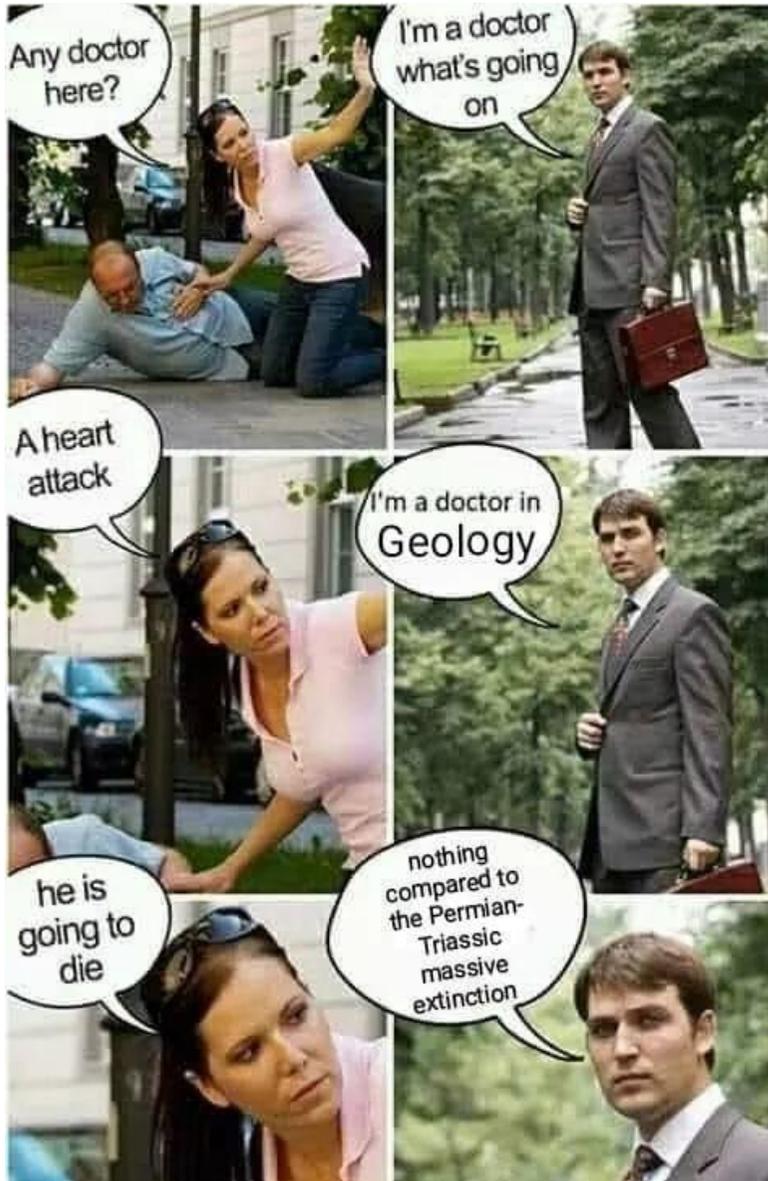
Comic Corner



When I'm a Dimetrodon and someone asks if I'm a dinosaur



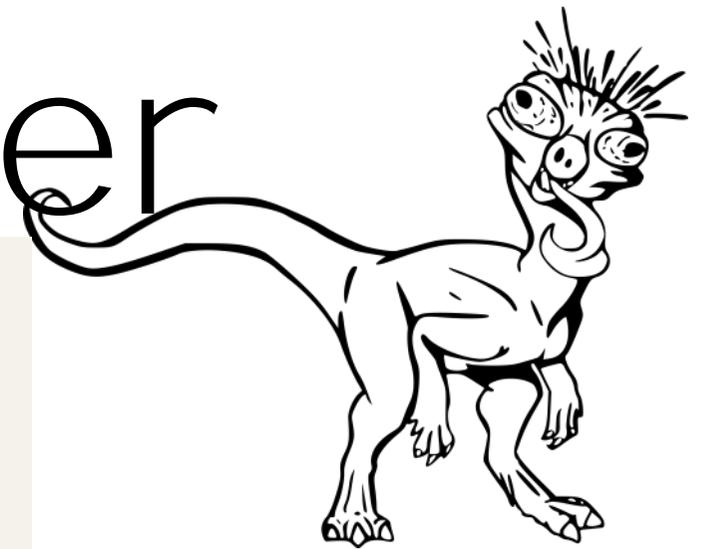
Comic Corner



If *Anomalocaris* wore gloves, would it wear them like this...



... Or this?



Person: you can't explain your day with a palaeontology photo

Me:

