BEER'N'BONES

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FLINDERS UNIVERSITY PALAEONTOLOGY SOCIETY

MESSAGE FROM THE PRESIDENT

Hi All.
I hope this edition of our publication finds you well, and not too strung out on that ever-faithful study aid, Red Bull. As you may have noticed, this issue of Beer'n'Bones has been somewhat delayed – this is because your president has been a little bit of a slack tart in regards to anything not honours-related, and has held up a very tolerant Sam by not providing him with this Letter From The President.

Thankyou to everyone who has participated in events that have been organised, such as the Naracoorte field trip – special mention to Bessie the termite-ridden cow. Also a very big thankyou to Jeremy Austin for taking time to travel out to our neck of the woods for his talk on ancient DNA.

We are in the process of organising another Naracoorte field trip for the December holidays, and we will update everyone on dates and cost. Another field trip that we might organise is a venture to discover evidence of the reportedly extinct species, the FUPS pub crawl. There are hopes that our social coordinator may help with this.

This has been a short message, as I'm sure everyone is busy with end-of-year study. Good luck with exams, and I hope to see you at the field trip.

The Grand Poombah
Lesley Moore

IN SITU

NARACOORTE FIELD TRIP

In the mid-semester break, members of the palaeontology society travelled to Naracoorte to help out at the caves. The usual sorting of bones was done, but there were also more exciting activities for the volunteers. The paleo members on the trip started by helping clean up pit A in Victorian Fossil Cave. This was the first overhaul of the chamber since 1970, with a general clean up and the installation of a new viewing platform and staircase to allow visitors to the cave to come closer to the fossils than ever before. The cleaning of pit A was the first major clean up for the site since it was dug up in 1984. While the palaeo members were busy doing this they also had time to dig up the remains of a cow which died around 2 years ago. The whole effort of digging this cow up was to see the effects of surface weathering and also to see how termites affect the pattern of bone degradation and what parts are mainly affected by the termites. It also allowed members the opportunity to manage all of the processes necessary in undertaking a dug, from organising the grid, managing controlled excavation and documenting the finds. Overall the trip was very successful with the overhaul of the Victorian Fossil Cave and digging of Bessie the cow.

Ben Kha

'Bessie' in situ.

The FUPS team at work

OLD NEWS

FOSSIL FISH LIKE TO _ _ _ _

The fishes of the Devonian period have for a long time been recognised for their importance in reconstructing the origins of true vertebrates. Recent publication has detailed a find which encapsulates a hugely important evolutionary step, viviparous (live) birth, in its earliest manifestation to date. The find concerns a placoderm fish found in the Gogo formation in northern Western Australia. The specimen, preserved in three dimensions in rock, was exposed by acid etching over a two month period to reveal smaller placoderm within it. Originally thought to have been the remnants of a final meal for the placoderm, subsequent studies led researchers to believe otherwise. The skeleton within was determined to be of the same species as the larger one based on dental characteristics. The inner specimen also did not show acid wear as would be expected within a stomach, especially on such a small individual. This led researchers to conclude the smaller individual to be a developing embryo, a theory which enabled them to reconsider a previously confounding element, which turned out through electron microscopy to be a fossilised umbilical cord.

The placoderm also is a new species, and has been named *Masterpiscis attenboroughi*. The genus name is Latin for 'mother fish', while the species name is in honour of Sir David Attenborough, who bought the Gogo site to world attention in his series 'Life on Earth' in 1979. Furthermore, the find allowed researchers to reassess previous finds, and through them were able to attribute another specimen *Austroptyctodus gardineri* as being in a comparable state, with three embryos within it. Both the *Masterpicies* and *Austroptyctodus* embryos were shown to be approximately 25% smaller than their parents.

The finds have reset the earliest known live birth by 200 million years. They have been dated to approximately 380 million years old, while the previously known live births could only be attributed to a holocephalan cartilaginous fish from the lower carboniferous. The find also highlights issues of ontogeny, as the supragnathals (upper dental plates) meet at a fused symphysis, signifying the young would likely have structural support for biting immediately after birth. The significance of the presence of the umbilical cord is also paramount. This signifies that the fish have evolved beyond the first stages of evolution of live birth, where the mother simply provides protection for eggs within her.

Upon announcing the discovery palaeontologist John Long pronounced, 'It's not the first time animals had sex, but it's the first time it was fun.' At this stage we are unsure about exactly how this statement has been quantified.

Artists reconstruction of Masterpicies *giving birth*

Sam Arman

Long, J. A., Trinajstic, K., Young, G. C., Senden, T., (2008), Live birth in the Devonian period, *Nature*, Vol. 453, 29 May 2008, pp650-653

SBS World News Australia, (2008), television program, SBS Television 25/5/08

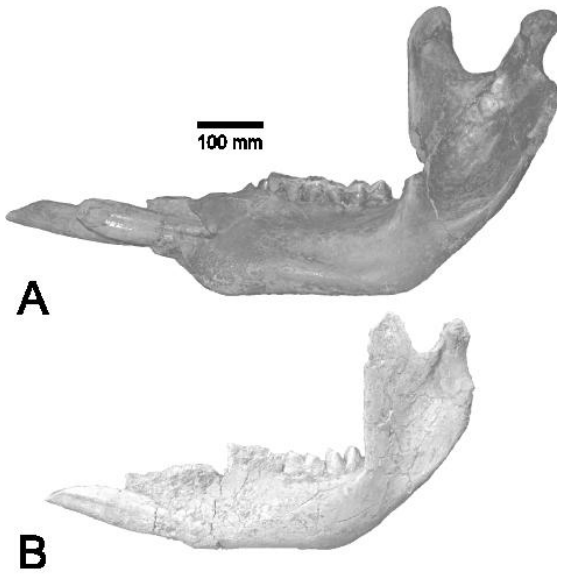
DIRPROTODON REVIEWED.

Last issue, BEER'N'BONES, in its feature fossil bought you *Diprotodon opatum*, noting, 'The taxonomic status of Diprotodons is not entirely clear, but there are at least two species recognised; *Diprotodon opatum*, and *Diprotodon minor*.'. This status can now be cleared up thanks to a recent review of material. The review, of over 1000 teeth from Australia-wide fossil localities has come to the startling conclusion that while two distinct morphological varieties exist, there is no grounds to propose that more than one species of Diprotodon actually existed. This is in startling contrast to the multiple (up to eight) varieties that have been supposed by various authors. What the review instead supposes is that extreme sexual dimorphism existed, with the smaller variety being approximately one-third the size of the larger variety. Without the significant pelvic differences between sexes as shown in placental mammals, which sex is the larger variety is hard to determine as yet, but it is proposed that by analogue to other megaherbivores, and sexual dimorphism seen in extant kangaroos, that the male is the larger variety.
This dimorphism also allows extrapolation on other features of Diprotodons, with postulations that Diprotodon was polygynous and a generalist feeder. Furthermore, one site at Bacchus Marsh in Victoria featured a congregation of only the smaller morph in what appeared to be a drying marsh during a prolonged drought. This 'mass mortality event' (Price, 208, p385) has been supposed to be a congregation of a single gender segregated herd, signifying a gender based separation of social groups.

Sam Arman

Arman, S., (2008), Feature fossil: *Diprotodon opatum*, *BEER'N'BONES*, vol.3, no.1, p9

Price, G. J., (2008), Taxonomy and palaeobiology of the largest-ever marsupial, *Diprotodon* Owen, 1838 (Diprotodontidae, Marsupialia), *Zoological Journal of the Linnean Society*, Vol. 153, pp369-397



Dentaries of the large (A) and small (B) variants of Diprotodon opatum.

MORE DIPROTODON (SORTA).

Road works on a Papua New Guinea hillside have revealed an incomplete lower jaw, and a few isolated teeth of a Diprotodontid. It has been determined to be comparable to *'Kolopsis' watutense,* a medium sized Zygomaturine browser.
It has been interpreted as being deposited in a lake deposit dated to be of Miocene age. This is on the basis of potassium-argon dating on the surrounding breccia. While this is an indirect measurement, since the breccia completely encased and infused into the specimen, it is thought that the fossil could not have been deposited earlier than 13.2 Ma. Accepting possible igneous reworking however, the researchers have also placed a second date of 7.4 Ma, which corresponds to the last volcanic activity in the region.
The discovery of such an age is important as the only comparable *Kolopsis* is *K. torus* from the late Miocene deposits at Alcoota in the northern territory. This does not create any phylogenetic issues however; as there is a 2 million year gap connecting *Kolopsis* with its precursor *Neohelos.* Further complicating this though is exactly how the species made its way to PNG. This is because a continuous land bridge has only previously been attributed between Australia and New Guinea between 8 and 12.5 Ma on molecular evidence of extant marsupials, and 11-7 Ma on geological grounds.
Papua New Guinea has had a scattered history of fossil marsupials, with discovery of 14 megafaunal species at two Pliocene and eight

Pleistocene sites. The discovery of Miocene strata, and indeed possible future megafauna sites is not unexpected though, due to the greater tectonic in the region compared to that of Australia revealing more underlying strata.

Sam Arman

Menzies, J., Davies, H. L., Dunlap, W. J., Golding, S. D., (2008), A possible early age for a diprotodon (Marsupialia: Diprotodontidae) fossil from the Papua New Guinea highlands, *Alcheringa: An Australasian Journal of Palaeontology*, Vol. 32, pp129-147

ARGENTINEAN MEGARAPTOR IN VICTORIA WHEN IT SHOULDN'T BE

A single bone found in 1989 has been used to provide evidence of faunal exchange between South America and Australia at a time which challenges some models of Gondwanan divergence. The specimen has received much attention as Australia's sparse Dinosaur fauna has made it difficult to study the divergence. The fossil is only the second Australian dinosaur to be attributable to a genus from another continent, the others being Allosaurids. This specimen too was originally described as an *Allosaurus*, but subsequent study has seen it being reinterpreted as an Abelisaurid, a Gondwanan clade of carnivorous bipedal dinosaurs.
The specimen consists of a left ulna found at 'Dinosaur Cove', near Cape Otway in Victoria.
The specimen had been deemed comparable to the Argentinean *Megaraptor namunhuaiquii* on the basis of two processes found in *Megaraptor* but no other theropods. It differs from *M. namunhuaiquii* by the distal articular surface being circular as opposed to triangular, and a smaller overall size. These differences were not deemed as yet sufficient to warrant a new taxon.
Due to the similarity between these two specimens, it is proposed that their must have been a recent common

A Megaraptor *claw from South America*

ancestor which was able to traverse the two continents, implicating a terrestrial connection between South America and Australia during the Early cretaceous. This goes against the 'traditional model' of Gondwanan separation, which suggests that Gondwana initially split into eastern (Antarctica, India, Madagascar and Australia) and western (Africa and South America) before the continents finally separated. It also does not allow any significant climatic barrier to separate the regions. It instead provides support for either an 'Africa-first' model, where Africa splits first, and the others follow, or a model proposing a number of land bridges allowing faunal interchange over the regions. There is also geological and plant fossil evidence that also supports these Gondwanan interchange models.

Sam Arman

Smith, N. D., Makovicky, P. J., Agnolin, F. L., Ezcurra, M. D., Pais, D. F., Salisbury, S. W., (2008), A *Megaraptor*-like theropods (Dinosauria: Tetanurae) in Australia: support for faunal exchange across eastern and western Gondwana in the Mid-Cretaceous, *Proceedings of the Royal Society B.*, published online doi:1098/rspb.2008.0504

TASMAINA: NOT THAT DIFFERENT

The megafauna debate rages on, with the latest battleground being Tasmania, with recent reanalysis of data from the isle. Tasmania previously has been a quandary for 'bleitzkreig' proponents due to geological dispersion disrupting previous understandings. Central in the debate is the land-bridge, previously connecting Tasmania to mainland Australia. As faunal exchange in the late quaternary was limited to the 43 to 37 ka period, previous analysis of fossils proved disruptive to human-based megafauna extinction theories, as dated fossils showed extinction to have occurred prior to and independent of human occupation.
Reanalysis of collagen within bone via C14 dating and OSL

dating of surrounding sediment has revealed a date more applicable to human-based extinction models. The refined date of 39,980±610bp, provides possible evidence for human-megafaunal interaction on the apple isle, strengthening the case for human based extinction.
This has been furthered by radiocarbon dates of analogue sites revealing dates indicating megafaunal survival in Tasmania until at least 42.9-40.9ka.
Compiled with climatological data, Tasmanian extinctions show no apparent trend towards faunal loss or any change in faunal diversity by climatic means. The change in fauna upon the establishment of land connections between Tasmania and mainland Australia remain to be settled however, as landscape alteration by burning regimes, as have been the case in mainland Australia, have not been found in Tasmania.

Turney, C. M., Flannery, T. F., Roberts, R. G., Reid, C., Fifield, K. L., Highham, T. F.G., Jacobs, Z., Kemp, N., Colhoun, E. A., Kalin, R. M., Ogle, N., (2008), Late-surviving megafauna in Tasmania, Australia, implicate human involvement in their extinction, *Proceedings of the National Academy of Sciences*, Vol. 105, No. 34, pp12150-12153

INTERVIEW

LIZ REED

What is Taphonomy?
By definition, the field refers to the laws of burial. It comes from 'taphos', and 'nomos' literally meaning the laws of burial. Since that original definition it's really taken to encompass the whole range of the processes that basically lead to the accumulation and deposition of a fossil deposit.

Why is it important?
Often taphonomy is seen as a bit of a wet blanket to a lot of highly imaginative palaeontological conclusions. Taphonomy is a good way to check the reliability of the fossil deposits we're working on. If we're trying to reconstruct past communities we need to know that what we're looking at is a good representation of the past community or if it is biased, and the only way we can find that out is through taphonomy. So it really is a critical and essential part of all fossil site studies.

Does it apply equally to other associated fields such as archaeology and forensics?
A lot of taphonomy has seen its birth in archaeology. And it has certainly seen more of its sophisticated development in archaeology than palaeontology. Forensics is an interesting one too; a lot of people who are actively working as forensic technicians within the law enforcement agencies have had backgrounds as taphonomists.

What sorts of biases are taphonomists interested in?
I will just backtrack a bit. When we are working on taphonomic problems, there are really two aspects to it. One is using modern analogues, what's called actualistic taphonomy, as some sort of analogue for the past. For example, we are assuming uniformitarian principles, i.e. if a termite is chewing a bone, the termite is chewing the bone in the exact same way as it did 100, 000 years ago. Therefore we can look at modern termites and how they influence bone and use that to assess the fossil deposit. The second part of what we do as taphonomists is use the information that we have gained from the modern assemblages, then apply that to the fossil examples.

Are these site-specific or more general across the field?
Now that's really an interesting question because they can be very site specific and they can also be very general, and in ways that you would not expect. I will just use caves as an example because I have worked in caves so much. I did a study on decomposition rates and disarticulation rates of kangaroos both in and out of caves. The interesting thing was that the actual disarticulation was pretty much identical in caves and surface sites, because it's controlled by anatomy. So in

that case some processes are going to work in the same way regardless of where they are. Other things are more site specific, like for example in caves you get drip-water corrosion and the high incidence of fungi within the caves that are master decomposers. So you do get some specific and general aspects, and often it can be a bit of each. It's our job to try and recognise them.

Do you believe that taphonomic processes are adequately taken account for by palaeontologists at large?

Is any of this going to be libellous? That's a tricky one, because in some cases I would say no, but I think that tendency is more one that was in the past. I think certainly in the 'glory days' when palaeontology was seen as a grab mission to get the best cranial material for the museum collections, certainly taphonomy was not given any consideration. I think now people are a lot more aware that there is some sort of taphonomic aspect. I would probably like to see more rigorous taphonomy, particularly in Australian palaeontology, but at least it's on the board now. It used to be that simply people would say 'lets not worry about that, it might stuff up our conclusions'.

You have long been associated with the fossil sites at the Naracoorte Caves World Heritage Area, how did this association arise?

Well basically as an undergraduate student, I came here doing the course that I now coordinate, that Rod Wells did. I honestly can't say that ever since I was a little girl I used to play with dinosaurs and wanted to be a palaeontologist. It wasn't the case at all. I was always interested in archaeological stuff; old stuff, but I never really gave it a lot of thought as a career. I came here and I was really just blown away by the site and everything about it. I must say too, that Rod is a very inspirational lecturer and he really motivated me to continue. I did honours with him and I've really been here ever since. Since the late Pleistocene it feels like.

What taphonomic bises have been most prevalent here?

Well it varies between sites. We have three distinct types of caves here as far as how they accumulate bones. The first type is like Victoria fossil cave, where the caves are deep; around 18-20 metres deep. In those caves they tend to form solution pipes, which are narrow pipes down into the cave. Because of this, the caves are humid, they are pretty well climate controlled, they are dark and tend to be more or less purely pitfall traps.

Biases that we would see in pitfall traps would be a strong tendency towards things that are easily trappable, and kangaroos are the world champions at that, as are any active mammals running around on the ground. However that said, they still do collect very good representation of the ancient community, I would say just off the top of my head that they are collecting about 70% of what's there. Because one of the beauties of them is they are open for a very long time, so they are just sitting there waiting, and sooner or later they are going to catch one of everything, or in some cases lots of everything.

The second sort is the caves that are very open, large openings like Blanche cave. They have a lot of light coming in and they have vegetation growing in them. They don't ever block up from sediment cones like the pitfall caves do. They do have a pitfall aspect to them, but nowhere near as prevalent as the solution pipes which have small, sort of sneaky holes. But what they do do is allow animals to use those caves quite regularly, and so in these caves we see large deposits derived from Owls that have used the caves as roosts and bought their food back. The bias you get from them is basically they are collecting within their prey range; they're not going to be bringing in large mammals so you do get a bias towards what is their prey range, and that's generally small vertebrates.

The last kind is basically caves that are modified roof windows, where animals can just walk in. In those caves we tend to see that there's no vertical component, nothing can fall in. So we don't see the big deposits of large mammals that have fallen into the cave. We see these being used by things like burrowing mammals, by mammalian predators, things that can easily access the cave and use it as a den. So again the bias there is going to be towards the prey range. And even in the case of large mammalian predators, a bias may even be may be what they're actually bringing

Liz inflicts some bias

back to the cave, they're only going to be bringing the meaty bits of the carcasses not the bony bits that aren't very profitable.

How is technology influencing taphonomy?

I think not just taphonomy, but every aspect of palaeontology and investigation of fossil sites, like the ones here has been influenced by technology. Particularly dating technologies, the ability to look at isotopic analyses of sediments and bones. With taphonomy, I guess the technological advantages are in the areas of bone histology and bone chemistry. One of the things that has always plagued us has been understanding digenesis, the actual process by which things change over time and become true fossils. Because we can't sit there for a million years and watch it become a fossil, it's difficult to try and replicate, but with the new technological advances we are actually able to get in and really look at the fine grain histology and chemistry of the material and try and work out what that has undergone through its history, so for sure there are effects, who knows what they will do in the future. Hopefully really good things like robots to lift sediment bags out of caves. That would be good.

What about humans? Are there significant biases solely caused by the excavation and analysis processes?

Well, one of the things that you have to be very aware of if you re doing a very detailed taphonomic analysis, is that the last thing you want to do is bias your own sample. Some people will argue that if you're answering a specific research question you might not need to collect every single scrap of data. And that may be true. But fossil deposits are also finite resources so if you do collect as much as you can possibly collect at the time of excavation you don't need to go dig up another hole, say in a sensitive cave. I must say fossil site conservation was not something I had even thought of when I first started. It was just dig it up and then analyse it. Doing that very very finely detailed study in the fossil cave made me learn that you have to be so careful and so consistent in your methods so that you aren't actually biasing your own sample. I think if care is taken, and you plan a lot before you dig then you'll eliminate that, but there's always going to be a little bit of bias. For example if we want to do it perfectly we would even excavate out all the little bones, but that's crazy- you can't do it. So there are concessions but again if you're going to go in there with a heavy hand and say 'Oh, vertebrae suck,' I'll just chuck all them out, you're just wasting your time.Or a bulldozer.

Where do you believe we are currently at in understanding taphonomy? How do our current standards of taphonomy compare to previous understandings and how do you feel these will change in the future?

Even since I started doing this, the advances are huge in applying the large body of research that's been done. It's a bit like taxonomy, when you start digging up the world to determine the history of life on earth, you basically spend the first hundred years doing exactly that, you're describing species and identifying things. Taphonomy is not that dissimilar. In the early days, a lot of it was just doing experiments, doing tests, doing studies. What are the different bite marks? How does trampling affect bones? All that sort of stuff. Now we're really at the point where we can apply a lot of that information. So there is some really good stuff coming out of places like Spain, where they are using really finely grained taphonomic research to address big palaeoecological

issues. The same with hominid sites in East Africa, the taphonomy is really coming to the fore there, answering some really key questions about behaviour of early humans, how they used to process food and how that relates to their evolutionary history. I really think it's so intertwined with what is basically good quality palaeontological research that in a way I would hope that in the future the term is dissolved and what taphonomy is, is good quality research of fossil sites. It doesn't become something that's isolated, where you go out and you're a taphonomists, it's what everyone should be considering.

How rad are vegetarians?
They are so good. We are so good. Everyone else sucks in comparison.

Interview by Sam Arman

FEATURE FOSSIL

FEATURE FOSSIL 2
Procoptoceratops andrewsi
Granger and Gregory 1923

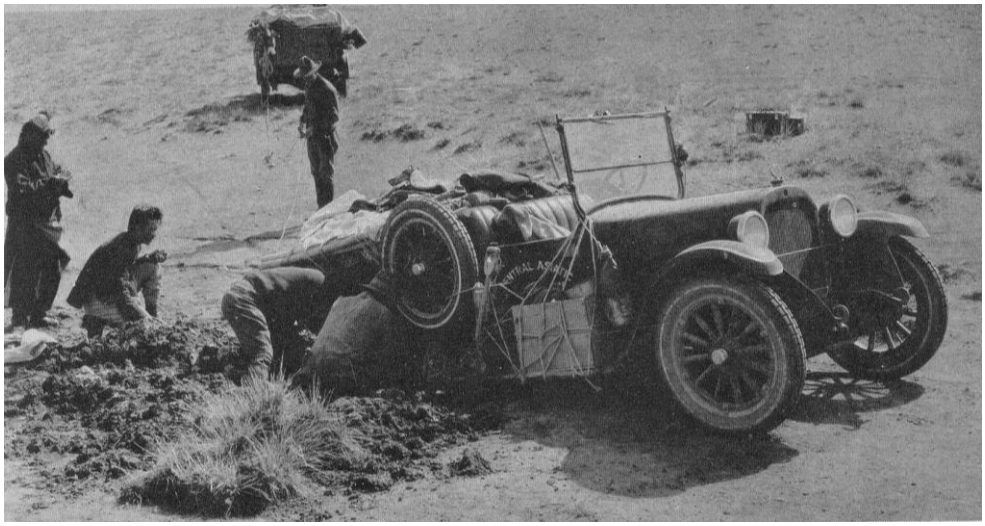
As master of sequels George Lucas fires another instalment of the Indiana Jones saga to cinemas worldwide, BEER'N'BONES looks at the inspiration behind the character; Roy Chapman Andrews.

They say that there is a grain of truth behind every story. Who exactly 'they' are I have never been sure, but the grains in this case refer to the highly fossiliferous sediments in the regions surrounding the Gobi desert in Central Mongolia. It was there that the epic Central Asiatic Expeditions took place in the 1920's under the direction of the American Museum of Natural History's Roy Chapman Andrews.
It is hard to underemphasise the magnitude of the expeditions. They were attempting nothing less than to document the entire palaeontology, zoology, geology, topography, archaeology and anthropology of a country roughly the size of Western Europe. The expeditions consisted of five journeys through Mongolia, from 1922 to 1930. Mongolia at the time was not the most attractive prospect for scientific work. An unforgiving climate, a revolution in Mongolia and civil war in China, from which the expedition was based during Mongolia's inhospitable winter, made even undertaking the expeditions from the outset a mammoth task.

Palaeontologists Granger and Gregory with the Mastodon Platybelodon *jaw.*

Transport for the expedition's supplies was achieved through the procurement of a camel caravan, with a fleet of seven motor cars used for exploring the various localities. The use of motorcars in the Gobi was unheard of before the expedition, and in this the expedition's ground breaking work cannot avoid puns, especially on the occasions where the vehicles broke through the sun baked surface becoming hopelessly bogged. Encounters with the indigenous Mongols were also varied. Western attitudes around this time were still somewhat backwards towards indigenous races, and in some cases Andrews professed a serious distrust of some he encountered, particularly the religious lamas, of whom he said, 'as a whole, they are a bad lot, and I believe the decadence of the Mongol race is more directly attributable to the introduction of this pernicious religion than to any other cause...the lamas are human parasites mentally and morally deranged.' To the contrary, he also muses on the tremendous hospitality, trust and altruism of those living in the traditional nomadic fashion. He proclaims the extraordinary efforts of the caravan, which always kept to arrangements despite multiple problems, and the remarkable delivery of a letter which he received addressed 'Roy Chapman Andrews, Somewhere in Mongolia'. One of the expedition's Mongolian guides, "Buckshot" was even sponsored a years training in fossil preparation at the museum after demonstrating remarkable care and skill in the field.

The 'Indiana Jones' aspects of the expeditions are interesting in their own right. While modern field trips stress the importance of keeping beer on ice and MP3 players charged, the Central Asiatic Expedition members were fully armed at all times. While the fictional 'indie' passed his time infuriating Nazis, Andrews and his team dealt more with the various factions fighting for control of China. On many occasions they were fired upon, either in attacks, or in what they called 'target practice'. Such attacks were not overwhelmingly dangerous. The soldiers' lacked any real training and were using far less advanced weapons than the expedition members. A certain amount of western pride was also apparent, 'The only reason we were not riddled with bullets is because the Chinese is the world's worst shot.' This statement was refuted later however, with Andrews shooting himself through his femur and knee. 'Brigands' attacks were also constant and one member of the team, in a scene far to cool for Indiana Jones, engaged them with a rifle at arms length while driving over the sand dunes. Another adventure chasing a fox found two of the crew stranded and disoriented with no fuel, warmth or water heading into a below freezing night with no tracks or landmarks to guide them back. In true palaeontological style though, a few careful observations of underlying rock led them back to the deposit where they were camped. Other inconveniences though were less threatening. A jaw of a new titanothere (rhinoceros-like ungulate) and part of a rhinoceros skull were eaten by a dog after being plastered in flour. Upon making an attempt at a further skull, the dog was shot. It was not the only animal to be killed in camp. A single night yielded 47 dead vipers on one occasion. The expedition made had no qualms about killing native wildlife, indeed as a zoologist, Andrews made extensive 'collections' of the local fauna, as well as the Antelope, which served as the staple meat in their diet. Full scientific value was achieved in this, by first chasing down the target by car, so as to learn the running speeds of their quarry.



The magnitude of the palaeontology can in no way be summarised here. The magnitude of the journey meant that fossiliferous deposits were discovered almost daily, with the help of Mongolia's desert winds eroding away the landscape all the while. Among the localities, there were deposits from the Jurassic all the way through to the Holocene with all intermediate periods. While collecting was carefully controlled, the 'museum bias' of the expedition was clear, with only the specimens of particular taxonomic or display use being kept. Among these were *Baluchitherium* (now considered a synonym of either *Paraceratherium* or *Indricotherium*), the largest land mammal to ever live, with one specimen being uncovered standing upright and surmised to have been a victim of quicksand. Another deposit held twenty specimens of *Platybelodon* the shovel-tusked mammoth, including a mother with unborn child in the pelvic cavity. They also uncovered some of the first known mammals of the Mesozoic in cretaceous strata. The palaeontological side of the expedition culminated in the publishing of 51 publications documenting 218 fossils, including 4 new families, 64

new genera and 148 new species.
The feature fossil itself was found completely weathered away from the sandstone, sitting on rock a few meters from where the expedition had stopped to rest for lunch. The generic name arises from the Greek words for 'first-horned-face' in reference to the expeditions belief that *Protoceratops* was a basal ceratopsians (in actuality it is quite derived). Throughout the expedition seventy skulls and 12 complete skeletons of *Protoceratops* was found, in all of its life stages. This included multiple conglomerations of eggs, the first dinosaur eggs ever found, one nest complete with the egg-stealing *Oviraptor* (subsequent studies have shown those eggs actually belonged to *Oviraptor).* These specimens have provided valuable tools for studying the massive frills that are prevalent throughout the ceratopsians. The frills appear to achieve their greatest dominance as the animals reach maturity, and showed considerable sexual dimorphism, signifying that they were probably used for display. This finding is also supported by the lack of stabilising bone found in the frills, which would make them unsuitable for defence. *Protoceratops* reach about 60cm in height, and 1m in length, and are believed to live in herds. Ceratopsians are also characterised by their parrot-like beak, with sturdy, teeth that are constantly replaced, facilitating their browsing herbivore diet. Having evolved from the bipedal *Psittacosaurus*, the quadrupedal ceratopsians still possessed elongated hind legs, leading to much speculation on their locomotion. There are two species recognised, *P. andrewsi* named after Andrews, and a subsequent species, *P. hellenikorhinus*, with the two being differed on the basis of size. There is also some speculation that Scythian nomads invented the Griffin myth on the basis of *Protoceratops.*

Sam Arman

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Think you can do better? Send your reviews, essays and dirty limericks to Sam

Protoceratops andrewsii *as on display in the AMNH. The one on the right is from the original expeditions.*