Alberta Palæontological Society Bulletin

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# ALBERTA PALAEONTOLOGICAL SOCIETY


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**THE SOCIETY WAS INCORPORATED IN 1986**
**as a non-profit organization formed to:**

1. Promote the science of palaeontology through study and education.
2. Contribute to the science by: discovery; responsible collection; curation and display; education of the general public; preservation of palaeontological material for study and future generations.
3. Work with the professional and academic communities to aid in the preservation and understanding of Alberta's heritage.

**MEMBERSHIP:** Any person with a sincere interest in palaeontology is eligible to present their application for membership in the Society. Please enclose membership dues with your request for application.

**Single membership $20.00 annually**
**Family or Institution $25.00 annually**


**SOCIETY MAILING ADDRESS:**
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# Upcoming APS Meetings

Meetings take place at 7:30 P.M. in **Room B108,**
**Mount Royal University,** 4825 Mount Royal Gate SW, Calgary, Alberta.

**Friday, October 20, 2023—Dr. Christopher K. West,** Royal Tyrrell Museum.
***Reconstructing forests in deep time: Palaeoclimate and palaeoecology of early Cenozoic forests in Canada's High Arctic.***

**Friday, November 17, 2023—Dr. Hallie Street**, MacEwan University.
***More than monsters: Mesozoic marine reptiles.***

**Check the APS website for updates! albertapaleo.org/events/monthlymeetings**

**ON THE COVER:** Alberta trace fossils! Arthropod(?) trackways on erratic quartzite slab. Probably "Rocky Mountain Supergroup" (U. Carboniferous to Permian). King Creek, Peter Lougheed Provincial Park, Alberta. Image width 56.5 cm. Photo by Howard Allen.

# New APS Website Launched in September!

By Eric Campbell

If you've visited our website (**https://albertapaleo.org**) recently, you may have noticed a new look! The new head of the website committee, **Eric Campbell** (that's me!) spent most of the summer rewriting it from the ground up.

The new website was designed with both mobile and desktop users in mind, so you should be able to quickly and easily find the information you're looking for no matter how you access it. The new site also features some new design and aesthetics (including many more pictures from previous field trips), a new way of organizing the events and pages about The Society itself, and a refresh of the resources page to ensure that they are all current and up-to-date. The new technology choices should also enable us to add new information, pages, and features much more quickly than before.

The entire website is open-source, so if you're interested in diving right into the code just let me know and I can send you the link. Of course, it is still a work in progress and I welcome any suggestions for improvements! If you notice anything that needs fixing or if you are interested in contributing in any way, please feel free to reach out to me at **webmaster@albertapaleo.org**. You absolutely do not need to be technically inclined to help—I would love someone to help with writing, pictures and design, and many other aspects of the site. Finally, thank you to **Cory Gross** and **Vaclav Marsovsky** for having created the previous version of the website and for supporting me as we transitioned to this new one as well as to the rest of the executive of the Alberta Palaeontological Society for their comments and suggestions as the new website took shape. ❑

# Thank You!

Members **Steven Dixon**, **Tako Koning** and **Chris Marion** made monetary donations to APS over the summer. We all appreciate your generosity! ❑

# Upcoming Events

## October

### Dr. Christopher K. West

Curator of Palaeobotany, Royal Tyrrell Museum of Palaeontology, Drumheller.

### *Reconstructing forests in deep time: Palaeoclimate and palaeoecology of early Cenozoic forests in Canada's High Arctic*

**Friday, October 20, 2023, 7:30 P.M.**
**Mount Royal University, Room B108**

Fossil-rich early Palaeogene deposits on Ellesmere and Axel Heiberg islands, Nunavut, preserve a record of lush Arctic ecosystems rich in temperate and subtropical forest flora (*e.g.*, dawn redwood, swamp cypress, alder, birch, sycamore and magnolia) and fauna (*e.g.*, tapirs, alligators and terror birds).

These fossil remains represent some of the best deep-time analogs for the globally warm late Paleocene to early Eocene interval, a time when global temperatures were much higher than at present. This interval was also punctuated by several short-lived hyperthermal events—intense short-lived episodes of global warming that had a profound effect on terrestrial and marine ecosystems—that are potentially analogous to the pace and forcing of anthropogenic warming.

I will demonstrate how to reconstruct the palaeoclimate and palaeoecological aspects of an extinct ecosystem from plant fossils recovered from Ellesmere Island. Methods such as the Climate Leaf Analysis Multivariate Program (CLAMP) and Bioclimatic Analysis (BA) are used to provide quantitative estimates of temperature, precipitation, humidity, and length of growing season.

Traditional taxonomic methods coupled with census sampling and rarefaction provide complementary evidence of forest composition and diversity. These results are then compared with contemporaneous fossil sites from lower latitudes in order to assess how these ancient polar ecosystems fit within the broader narrative of North American ecosystems and climate during a globally warm interval in Earth history,

with implications for understanding processes driving latitudinal diversity gradients and polar amplification of climate change.

**Biography**

Dr. Christopher West is the Curator of Palaeobotany at the Royal Tyrrell Museum of Palaeontology. Originally from Manitoba, he earned a BSc in Earth Sciences from the University of Winnipeg and later earned a BSc (Honours) in Palaeobiology and a PhD in Palaeobotany and Geology from the University of Saskatchewan. He was the Climates of the Canadian North Postdoctoral Fellow at the University of Alberta in the Department of Earth and Atmospheric Science, where he worked on late Eocene plant fossils from western Yukon. Dr. West was awarded the Governor General's Gold Medal for his work on the early Palaeogene fossil floras from the Canadian High Arctic. Dr. West has published on Cretaceous and Palaeogene plant fossils from Alberta, Palaeogene plant fossils from Ellesmere and Axel Heiberg Islands in the Canadian High Arctic, as well as Palaeogene and Neogene plant fossils from British Columbia. His research interests centre around using plant fossils to reconstruct ancient climates and ecosystems, providing valuable insights into the development of the modern forest biome in North America.

## November

### Dr. Hallie Street

Department of Biological Sciences, MacEwan University, Edmonton

### *More than monsters: Mesozoic marine reptiles*

**Friday, November 17, 2023, 7:30 P.M.**
**Mount Royal University, Room B108**

During the Mesozoic, while dinosaurs roamed the continents, marine reptiles diversified in the seas. Shallow seaways from this time were inhabited by three main groups of now-extinct marine reptiles: ichthyosaurs, plesiosaurs and mosasaurs. These groups of reptiles evolved from different terrestrial ancestors, but each faced similar challenges when they returned to an aquatic lifestyle. These reptiles independently developed modifications to their limbs and bodies that allowed them to move efficiently in an aquatic setting. Fossils from around the world, including right here in Alberta, inform us about the diversity of species that inhabited these seas and about how they lived. Ichthyosaurs are known for their shark-like silhouettes; different species of this lineage grew to massive sizes or hunted in deep, dark water. Plesiosaurs had the most disparate range of body forms, indicating that different species inhabited different ecological niches. Some of these body forms, including the elongated necks of the iconic elasmosaurs, evolved multiple times within this diverse group of reptiles. Mosasaurs diversified rapidly toward the end of the Mesozoic and many of the adaptations exhibited by these reptiles are directly related to their feeding preferences. Ancient marine reptiles were not dinosaurs, but they can help us understand life under the sea millions of years ago.

**Biography**

Hallie Street is currently an instructor for the Department of Biological Sciences at MacEwan University in Edmonton, Alberta. Her first exposure to palaeontology came as a child, when her parents took her walking along riverbanks in eastern Virginia, looking for fossil shark teeth. Hallie studied geology and environmental sciences at the College of William and Mary, where she realized that many of her term papers for her upper-level geology courses were about palaeontological topics—even for her class about igneous and metamorphic rocks. Hallie went on to receive a Master's degree at Marshall University, where she described a plesiosaur from Wyoming with an unusually flattened body shape. Hallie moved to Edmonton to pursue her Doctorate at the University of Alberta, studying mosasaurs with **Dr. Michael Caldwell**. Following her PhD, Hallie spent three years as a curatorial assistant at the Royal Saskatchewan Museum's T. rex Discovery Centre. Hallie has been teaching introductory biology and zoology courses at MacEwan for two years, and she continues to research ancient marine reptiles. ❑

# Program Summaries

## September

### Dr. Leslie Eliuk

Professional Geologist (Retired), Alberta Palaeontological Society

### *Maritimes to Mars? Stromatolites may be everywhere, even out of this World!*

### Friday, September 15, 2023, 7:30 P.M.
**Mount Royal University, Room B108**

[*This 15-minute presentation preceded our main speaker,* **Selina Viktor Robson**.]

Having just returned from a 17 year sojourn in lovely Lunenburg, Nova Scotia, Les attempted to add to **Tako Koning**'s "to do & see list" and those of any others interested in checking out more stromatolite localities, with four or so possible candidates offered. In part these are examples of Earth's oldest and by far longest-lived ecosystem—fossil and modern reefs. Microbial reefs, as evidenced by stromatolites, thrombolites and associated macro-features were the only reef-builders for 3 billion of the over 3.5 billion year record. And they still occur in stressed settings that exclude the more usual metazoan reef makers like corals, sponges, rudistid clams and higher algae.

Such a stressed setting is the terminal Windsor Group carbonates that preceded the salt-filled basins of the drying Early Carboniferous seas of the eastern Canadian Maritimes. While touring the scenic geological sites detailed in Hickman-Hild and Barr's 2015 Geology of Nova Scotia guidebook,* the Ingonish Wharf locality was visited. There, glacially-deposited boulders of various sizes contain pieces of the rock record of the Cape Breton Highlands and their component geological terranes. But spectacular *in situ* outcrops of dolomitized algal stromatolite reefs also occur along nearly a kilometre of shoreline. These apparently barely merited a mention in the guidebook, but caught my interest and are discussed here with a possible modern analogue. Further checking revealed they have been the subject of detailed study. This included the interpretation that they are not organic carbonates at all but actually seep deposits and slumps—according to **Paul Schenk** and co-workers in 2001.

This alternative, the possibility of abiotic origins, has been a continuing controversy in explaining the earliest origins of Precambrian stromatolites. Another speculative locality of very old Precambrian age, soon to be examined (I hope) is in the Jezero Crater lake basin on Mars. The nature of the lake margin carbonates would require much, much more proof since they would give fossil evidence of life out of this world. Finally, a more accessible but impressive example of Cambrian big microbial reefs is illustrated from Texas, the biggest lower 48 state of the USA. Stromatolites and reefs seem be everywhere—at least to avowed keeners.

* Hild, M.H. and Barr, S. 2015. Geology of Nova Scotia, field guide: Touring through time at 48 scenic sites. Boulder Books, 272 pp. ISBN 978-1927099438.

**Biography**

Leslie Eliuk has a University of Alberta Zoology/Geology BSc (1968) and Geology MSc (1969, in 9 months, under Professor **Charlie Stelck** on K/T palynology). He apparently is slowing down after four decades since he took nine years to get a PhD at Dalhousie University, Halifax, Nova Scotia in 2016 (on the Abenaki carbonates adjacent to the Sable Island delta and advised by **Professor Grant Wach**). He previously spent thirty years as a Shell Canada petroleum geologist primarily concerned with carbonate reservoirs and sour gas. Then ten years consulting on and studying mainly Jurassic-Cretaceous carbonates offshore Nova Scotia. Somehow all those years have not diminished his enthusiasm for carbonates and reefs. These include even the oldest kinds—the microbialites forming stromatolites and other pre-metazoan type reefs. During those years he helped the Canadian Society of Petroleum Geologists (CSPG, now the Canadian Energy Geoscience Association, CEGA) in various ways such that they bestowed Honorary Member status on Les in his 76th year.

## Selina Viktor Robson

University of Calgary

## *Lend us your ear: Using auditory region morphology to resolve the evolutionary relationships of camels*

### Friday, September 15, 2023, 7:45 P.M.
**Mount Royal University, Room B108**

Despite camelids currently inhabiting South America (llamas, guanacos, alpacas, vicuñas), and Asia and Africa (camels), the family originated in North America about 46 million years ago. Camelids evolved alongside other endemic North American artiodactyls (even-toed hoofed mammals) such as oreodonts, protoceratids and oromerycids, but camelids are the only surviving family.

The North American fossil record is rich with camelid material, with over 100 extinct species being described, but the evolutionary relationships of these early camelids are poorly understood. Furthermore, the relationship between camelids and other artiodactyl families—both North American and Eurasian—continues to be a source of controversy.

Phylogenetic analyses based on morphological data repeatedly recover camelids as being close to ruminants (*e.g.*, cows, sheep, pronghorn, giraffes), but molecular phylogenetic analyses recover camelids in a far more ancestral position, sometimes placing them as one of the oldest branches in the artiodactyl tree. The suborder Tylopoda contains camelids and their purported extinct relatives, but because these relationships are unresolved, the composition of the suborder is indeterminate. Previous work has been constrained by the quality of the available fossil specimens; only the externally visible features could be studied, limiting the information gathered.

There has now been a burst of research using computed tomography (CT) scanning to image the internal anatomy of fossils. These new data provide additional information that may be critical in resolving the evolutionary relationships of many extinct clades, including Camelidae and Tylopoda. Using recently acquired CT data, I conducted a phylogenetic analysis of basal camelids—the results indicate that there may be multiple unnatural groupings, and some "camelids" may not actually belong within Camelidae. Additionally, previously unknown aspects of the internal ear region indicate that the relationships of camelids to other artiodactyls are more complicated than previously thought; it is quite likely that several "tylopods" do not belong in the suborder, necessitating a large revision of artiodactyl systematics.

**Biography**

Selina Viktor Robson was born and raised in Oregon and as a child, they spent many weekends walking along the Pacific coast collecting invertebrate fossils. Selina Viktor was always interested in natural history and science; when they discovered their love for palaeontology during their undergraduate studies, they never looked back. They completed their BSc in Geology at the University of Oregon (2016), then went on to do an MSc in Evolutionary Biology at the University of Calgary (2018). Selina Viktor is currently a PhD Candidate at the University of Calgary, co-supervised by **Dr. Jessica Theodor** and **Dr. Craig Scott**. They specialize in hoofed mammal evolution, cranial anatomy, and phylogenetic systematics. ❑

**Your Society needs Volunteers!**

**Please THINK about volunteering for APS!**

# Dinosaur Research Institute Dinner October 14, 2023

By Mona Trick

Support dinosaur research while enjoying an elegant meal and stimulating presentations and conversation. The Dinosaur Research Institute will be hosting its annual dinner on Saturday, October 14, 2023 (starting at 6:00 P.M.) at the Earl Grey Golf Club (6540 20 Street SW, Calgary). **Dr. Caleb Brown**, Curator of Dinosaur Systematics and Evolution at the Royal Tyrrell Museum of Palaeontology will give the main presentation. In addition, PhD and Masters students from the University of Alberta and University of Calgary will present on their research. There will be a silent auction of incredible items including wine, event packages and art. All proceeds support research into western Canadian dinosaurs by graduate students.

Tickets are $175.00 per person. A tax receipt will be issued for a significant portion of the ticket price.

To register, e-mail **info@DinosaurResearch.com** or phone (403) 861-0532.

Payment can be made in either of two ways:
1) Interac-E-transfer to **info@dinosaurResearch.com**
2) Cheque payable to "Dinosaur Research Institute" mailed to

**Dinosaur Research Institute**
**PO Box 6353 Station D**
**Calgary, Alberta T2P 2C9** ❑

# Microfossil sorting sessions in November and December, 2023

By Mona Trick

Help **Dr. Jessica Theodor** and **Dr. Alex Dutchak** of the University of Calgary find tiny fossils in the matrix samples from the Cypress Hills Formation (middle Eocene) of Saskatchewan, to aid their research.

We will be using microscopes in **Room B213** at Mount Royal University (Main Building, upper level)

from 1:00 until 3:30 P.M. on the following Sunday afternoons:

**November 5, 2023**
**November 26, 2023**
**December 10, 2023**

We are very grateful to Mount Royal University for allowing us to use their microscopes and lab.

Registration is not required, but if you let me (**Mona Trick**) know that you are planning to attend, then I can inform you if we need to cancel a session. Contact me at (587) 578-4579 or **giftshop@albertapaleo.org**. No experience is needed. Bring tweezers (with pointed ends) or a small paint brush to pick the tiny fossils from the sample and a pen to label your finds.

Watch the December *Bulletin* for dates of sorting sessions in January and February, 2024. ❑

# DOI.org—is it a useful system?

By Vaclav Marsovsky

What is DOI.org? It is a not-for-profit organization. The acronym stands for Digital Object Identifier. You may have noticed that your favourite technical journal has adopted the use of this system. The journal I receive adopted it in 2022 (in the paper copy I received just now, it grabbed my attention). This system has almost completely monopolized the references section in many papers. No more direct links to the original journals in the references, or having to do your own searches using Google or other search engines. It is like Zoom taking over from Skype—swiftly and quietly.

Apparently it was founded in 1996 and introduced in 2000, but is just now being widely adopted. This system reminds me of the Dewey Decimal System used as a library filing system for books, the UPC bar code system in retail stores or even the QR code system for mobile devices. Time will tell if the DOI organization will have the longevity of those other systems or go out of style or become something else. On the **doi.org** website it states that a unique digital identifier of an object (ugly string of letters and numbers at least 25 characters long) can be physical, digital or an abstract, to keep track of things. They say that the world cannot rely on URLs as identifiers, where "404: not found" is a constant nuisance. URL stands for Uniform Resource Locator (URL), commonly termed a web address. URLs come and go and are not stable. Old ones quit working. But DOI itself relies on URLs, too. Of course it is more complicated than that: it uses "persistent identification" within metadata. DOI employs Registration Agencies that provide services to registrants.

When you click on a DOI number link, you are automatically redirected to the website of the source journal where the paper was originally published, like *Canadian Journal of Earth Sciences*, or *Journal of Vertebrate Paleontology*. The full article can be open access or paywalled—it depends on the source journal. DOI does not store the articles on their own servers.

Recently, when I did some reference searches inside *Journal of Vertebrate Paleontology* using the DOI links provided, I found that half of them were dead ends. That's a problem. I don't know if this is typical, or because the system is new, "only" 23 years old. I did find a resolution system on the DOI website where dead ends get fixed, as well as multiple URLs and duplicate DOIs get resolved. There is even a real-time counter on their website that shows millions and millions DOIs getting resolved. I imagine some things are getting fixed and some are breaking.

**"Recently I did some searches using the DOI links . . . half of them were dead ends."**

So is humankind further ahead? Maybe. You can use DOI or Google, or go directly to the website of the source journal. Time will tell, but it has to be reliable. This finder/identifier system added thousands of servers to the planet, so probably not good for the environment. Did you know that Google had 2.5 million servers eight years ago already in their server farms consuming huge amounts of power? DOI does not disclose how many servers they are adding to the planet.

If you want to know more about DOI, Wikipedia has a an excellent explanation what it's about: **https://en.wikipedia.org/wiki/Digital_object_identifier** ❑

# Devil's Coulee, Alberta

## Review of Field Trip 2023-1, June 17

By Mona Trick

Luck was on our side during the APS field trip to Devil's Coulee on Saturday, June 17, 2023. Although the area had received substantial rainfall the previous week, the trails through the badlands were dry. Although rainfall was predicted for that afternoon, the rain held off until after we had left. It was sunny with a nice cooling breeze and hardly any mosquitoes!


**APS members** watch a presentation at the museum in Warner. Photo by Mona Trick.

Twenty APS members assembled at the Devil's Coulee Dinosaur Heritage Museum in Warner, Alberta at 9:30 A.M. Our timing was perfect—new staff were being trained by **Wendy Sloboda** and her Dad, **Ed Sloboda**. We got an extra special introduction to the Devil's Coulee Dinosaur Museum, right from Wendy herself, the person who first brought the dinosaur eggshell to the attention of the late **Dr. Len Hills** (University of Calgary) in May, 1987. Dr. Hills then notified **Dr. Philip Currie** (Royal Tyrrell Museum of Palaeontology) who commenced an official search for dinosaur eggshell at Devil's Coulee.

**Dinosaur nest** mockup on display at the Devil's Coulee Museum. Photo by Mona Trick.

The badlands area, an exposure of the Upper Cretaceous Oldman Formation, is dated to 75 million years old.

Our original schedule specified touring the museum in the morning

**Wendy Sloboda** (centre) discusses a large dinosaur footprint. Photo by Mona Trick.

and then hiking into the Devil's Coulee egg site later in the afternoon. The staff kindly accelerated our schedule so that we could visit the egg site before the forecasted afternoon rain showers.

Ed Sloboda led our car convoy to Devil's Coulee.

We started the coulee tour at 12:15 P.M. Wendy Sloboda led the extended tour up and down the coulees that make up the trident of Devil's Coulee. She pointed out the sites where *Troödon* eggs and the eggs from two kinds of hadrosaurs were found. We also saw locations where other fossils had been found and an isolated dinosaur footprint.

We finished our hike at 4:00, tired but amazed at all of the different quarry sites and the wealth of fossils in the Devil's Coulee.

We want to convey a special thank you to Wendy, Ed, and all the staff at the Devil's Coulee Dinosaur Heritage Museum for an excellent and memorable tour. ❑


**Fossil display** installed at the Devil's Coulee field location shows typical fossils found at the site. Photo by Mona Trick.

**We survived** the extended tour of Devil's Coulee! Group photo by Ed Sloboda.

# The K–Pg boundary at Knudsen's Farm, Alberta

## Review of Field Trip 2023-2, July 8

By Eric Campbell

The day dawned clear and crisp on the morning of Saturday, July 8 as many members of the Alberta Palaeontological Society gathered in the hamlet of Huxley to examine evidence of what was probably the worst single day in the history of the Earth: the day an asteroid impacted near the coast of Mexico, ending the age of dinosaurs and ushering in the age of mammals.

Despite the dramatic nature of the events that we were interested in, the field trip itself began in a more subdued fashion. Many of those in attendance were bleary-eyed from having woken up early for the drive to Huxley, but that was soon fixed by the generous donation of coffee from one of the better-prepared people in the group. The meeting place was at the front of Huxley's community hall. Frequent mention was made of the cleanliness of the washrooms, with a steady stream of people leaving them only to exclaim at their near-surgical sterility; especially impressive given the population of Huxley is less than 100 people.

**Tako Koning**, who led the trip, began in his signature fashion: a detailed lecture with plenty of accompanying figures! He gave a comprehensive account of the Cretaceous-Paleogene (K-Pg) extinction event, including the events leading up to it and the story of how its cause, a massive asteroid impact, was uncovered by the father-son team of **Luis and Walter Alvarez**. This groundbreaking discovery was confirmed by the presence of a worldwide layer of iridium-rich clay, and later by the discovery of Chicxulub crater, but not before causing some controversy in the palaeontological community as they grappled with this groundbreaking hypothesis. He also discussed the site on the Knudsen's farm in particular. Since it is one of the most easily-accessed exposures of the K-Pg boundary in Canada, it has been

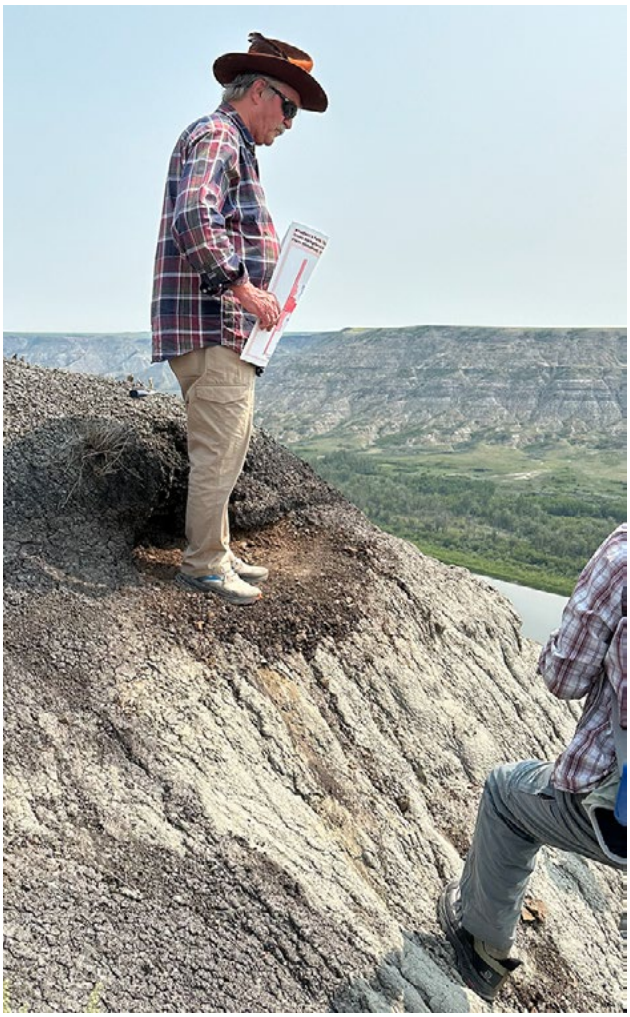
**Tako detailing the geology** and timeline of the K-Pg boundary, as well as the importance of the Knudsen's Farm locality to our understanding of the event. Photo: Eric Campbell.

extensively documented and contributed greatly to our understanding of the event itself.

With the preliminaries out the way, the members piled into their cars and headed to Knudsen's Farm. We were greeted there by **Mrs. Marion Knudsen**, who told us many stories of palaeontologists coming to excavate on or near their land going back many decades. Particularly intriguing was the story of a *Tyrannosaurus rex* skull which had proven too difficult to excavate and so was still on the edge of their property. Then, with the somewhat cryptic instructions to "turn right near the big rock," we were on our way!

**The scramble down** to see the exposure. "Easily accessed" is relative! In the background is the always-spectacular layering of the Red Deer Valley. Photo: Eric Campbell.

Despite the legendary flatness of the prairie landscape, finding the correct big rock—which had apparently arrived in the last few years (possibly as a prank?)—took longer than expected. But after a few detours we managed to find the rock, and with it the exposure of the boundary layer. After a brief scramble down, we were presented with the exact layer representing the ash and other particulates from the asteroid itself. It was truly humbling to think of the quantity of material that was able to create a layer like that throughout the entire world—and of the devastation that must have occurred at the time of impact.



**Tako going over the geology** of the boundary and what each of the layers represents. Somehow seeing them in person was affecting in a way that no amount of textbook illustrations or diagrams could be. Photo: Eric Campbell.

**Closeup of the boundary itself**. The brownish clay (arrow) is the impact layer, with mudstone below it and sub-bituminous coal above. Photo: Eric Campbell.

**Fossil hunting** in the Cretaceous—below the impact layer! Photo: Eric Campbell.

**Group picture** taken right above the exposure. Fourth from the right is our generous host, Kent Knudsen. Photo: Beatriz LeBlanc.

After another brief lecture by Tako explaining the geology behind what we were seeing, we were left to do some exploring. Perhaps unsurprisingly, the fossil hunting began immediately thereafter, with several small bone fragments and possibly turtle shell found in short order (all were left where they were found).

All good things must come to an end, and soon it was time for us to go. After another, more challenging scramble back up to the cars, we left the farm. While some had to head home immediately, others took the opportunity to have lunch along the west bank of the Red Deer River at the nearby Dry Island Buffalo Jump Provincial Park, another location where the K-Pg boundary is visible. All in all, the day was truly remarkable, providing us with the perfect opportunity to appreciate the wonders of the natural world as we explored this snapshot of Earth's history at the K-PG extinction exposure. ❑

# Book Review

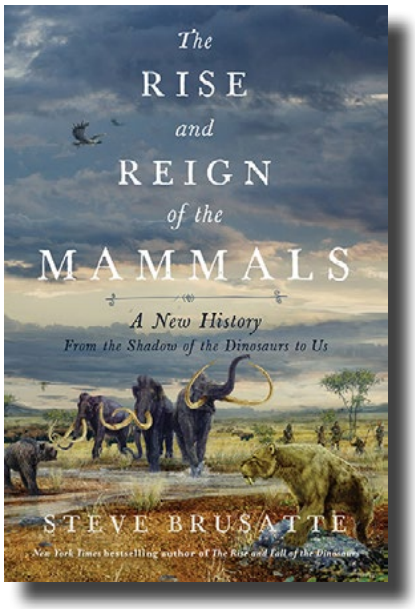
By Vaclav Marsovsky

***The Rise and Reign of Mammals: A New History From the Shadow of the Dinosaurs to Us*, by Steve Brusatte, 2022. Mariner Books, 500 pp. Paperback, CDN$24.99, ISBN 978-0-06-295156-4.**

Steve Brusatte is an American palaeontologist who teaches at the University of Edinburgh, Scotland (as of this writing).

The mammal book comes four years after his book on dinosaurs which is now in the APS library (Reviewed in the *Bulletin*, March 2023, p. 17).

Brusatte has a talent for bringing complex ideas and presenting them in a way that everyone can understand. The style is similar to his book on dinosaurs. It is structured chronologically and he discusses mammals from all continents except Antarctica. He gives examples of the mammals of their respective times and their significance, with names most of us have not heard unless you are a specialist in this field.




He starts with the pelycosaurs, progresses to therapsids, then Mesozoic mammal lineages—mostly small rat size, most of which went extinct by the Cretaceous, some only known by their teeth—then the explosion of diversity of mammals once dinosaurs went extinct. The book ends with speculation on the future of mammals. The book includes black- and-white pictures of places, palaeontologists and skeletons. He even draws a connection with the "Unabomber," Ted Kaczynski! Included are illustrated reconstructions of extinct mammals nicely done by artist Todd Marshall, which help to visualize what these animals may have looked like (most Mesozoic ones look like rats).

The book is written for the general public—easy to read, no complex anatomy lessons or language. The author combines science with the people involved, stories about the discoveries (where, when and who) over the last 200 years, right up to 2021 and even stories about some of the avocational people (*i.e.* amateurs) who made the discoveries.

Molecular biologists are in the process of reorganizing the mammal relationships on the evolutionary tree. This revolution started about twenty-five years ago, primarily with Mark Springer, after mapping of DNA got underway. It is hard to find this new kind of information outside of technical journals, which are hard to access by amateurs or the articles are simply too technical. Brusatte introduces some of these new relationships based on DNA results. There are two big clades proposed, one for African mammals with the name "Afrotherians" and another for European/ Asian mammals. These techniques can reveal some surprising results, such as the discovery that pangolins are not closely related to anteaters but are closer to cats and dogs. In addition to mapping the relationships, DNA is also used as a clock. The number of differences between two groups are counted and if the rate of mutations is known, one can calculate when two species last shared a common ancestor.

Unfortunately, DNA evidence does not always match evidence from the fossil record and Brusatte gives some examples of the mismatches. For example, DNA indicates hooves evolved multiple times in different lineages and shapes of teeth can have a similar appearance in members of different branches of the evolutionary tree. There are many stories of parallel evolution. Brusatte puts it like this: the mammalian evolutionary tree is more a reflection of geography than anatomy. This is particularly true between continents that were isolated for a long time, such as Africa before Arabia docked.

The book has ten chapters. It begins with the earliest synapsid stem mammal (not yet a true mammal) living in a *Calamites* and *Lepidodendron* coal swamp, and Brusatte paints a picture of what that environment may have been like. A keystone moment took place at this time, approximately 325 million years ago, where a split in the skull openings behind the eye took place—a split into diapsids (with two openings) and synapsids (with a single opening). Mammals are on the synapsid line. The split took place shortly after evolution of the amniotes. These are tetrapods named after amniote eggs with special membranes that surround the embryo. Eggs no longer had to be laid in water. Pelycosaurs, of which *Dimetrodon* is a representative, are on the synapsid line. Pelycosaurs underwent a dental revolution

of differentiating teeth. A later group, therapsids, differentiated their teeth even further and evolved advanced features for chewing and more efficient locomotion. They used to be called "mammal like reptiles," but apparently that terminology is out because reptiles are a branch of the diapsid line, so they should not be named with synapsids.

Among the therapsids, Brusatte covers the dicynodonts ("two dog teeth"), dinocephalians ("terrible headed") and gorgonopsians ("mythological beast"). It is thought that these therapsids replaced their teeth throughout life because the teeth did not occlude precisely like modern mammals; some had hair, and warm blooded physiology may have originated with these animals.

At the end of the Permian, an extinction occurred where a shocking 70 – 90% of surface vegetation disappeared and the ecosystem failed. Cynodonts, which are advanced therapsids, survived the extinction because they were smaller and could survive in burrows. Most other larger therapsids went extinct at the end of Permian, or soon after. Cynodonts brought in many innovations in the skull, in the vertebral column, which made them more flexible, and began to walk upright rather than with legs sprawled to the side. They could move and breathe more comfortably as they walked. The Triassic is when the first true mammal appeared and a cynodont was the ancestor. *Thrinaxodon* (an advanced cynodont) and *Morganucodon* (*almost* a true mammal) are near the evolutionary line to us. Exactly when "true mammals" originated depends on the definition of a mammal. Brusatte presents the old definition, based on the shifting of the jaw joint, where some bones of the jaw were free to become part of the hearing apparatus, versus the new definition which is based on crown groups. The Triassic is also the time when some lines stopped replacing their teeth repeatedly and limited their replacement.

Jurassic and Cretaceous mammals were highly diverse. None were bigger than a badger. These animals evolved different lifestyles: some were climbers, diggers, swimmers and even gliders, like flying squirrels. They evolved different shapes of teeth depending on their diet. In the Cretaceous there were many new foods to eat as flowering plants and new insects appeared. There was a "Cretaceous Terrestrial Revolution."

"Tribosphenic" molar teeth evolved during the Triassic and Jurassic—apparently not just once, but several times. This tooth shape is good for shearing and grinding. There is a "therian" version and a "monotreme" version of tribosphenic teeth. But the two types of tribosphenic teeth evolved independently, probably in the Jurassic.

A mammal was found in 160 million year old rocks in Liaoning, China with tribosphenic teeth. Before the Cretaceous, a hypothetical mammal with tribosphenic teeth (which mammal and on what continent has not been determined) split into two tribes: the metatherians and eutherians. Metatherians are modern day marsupials and eutherians include the placentals.

The subject of metatherians and eutherians and their differences includes a discussion of their reproductive systems, presence of the placenta and presence/absence of accessory bones in the abdominal cavity called epipubic bones (they are paired). Initially it was thought they were only for supporting a marsupial's pouch. But indications are that they serve other functions because they are also found in some cynodonts, multituberculates, the egg laying monotremes, and even some Cretaceous basal eutherians from the Gobi Desert. Marsupials have a fertilized egg briefly encased in a shell. Then the offspring hatches *in utero*, is implanted in the mother's uterus and is nourished by a placenta. The marsupial placenta is small and simple. The miniature offspring is born and moves to the mother's pouch. Brusatte presents a theory on how lactation in mammals evolved and developments in the throat to enable an infant to suckle and delay the development of teeth. All three lines lactate: the placentals, marsupials and monotremes.

The author covers the innovations in three extinct Mesozoic groups, the docodonts, haramiyidans and multituberculates, and what makes them distinct. These are three evolutionary lines that appeared for a time in the Jurassic and then went extinct.

In the Hell Creek Formation, the vast majority of mammals were multituberculates and metatherians like *Didelphodon*. Eutherians (placentals) were less common. According to Brusatte, only 7% of mammals survived the K/T extinction in North America. North America was relatively near the asteroid impact, so perhaps the survival rate on other continents may have been higher. Paleocene survivors were even smaller than most of the Cretaceous mammals and they were the ones with generalized omnivorous diets that could feed on things like seeds. There was a turnover with more eutherians than metatherians in the Paleocene.

The second half of the book covers the Cenozoic Era. Mammal populations quickly recovered after the

asteroid impact. Placentals, marsupials, monotremes and multituberculates all made it through.

Brusatte includes a section on eutherians from New Mexico, which illustrates just how "outrageously diverse" mammals became in the Paleocene. These were Paleocene condylarths, named by E.D. Cope, which were archaic mammals; some were pig size—and pantodonts (even larger). They were already present by 64 million years ago. DNA suggests that the orders of mammals that we recognize today, like primates and rodents, may have had a common ancestor in the Cretaceous. But alternatively, they may have evolved from some Paleocene condylarth that has not yet been recognized.

Brusatte discusses the movement of primates, rodents, perissodactyls and artiodactyls between continents when the continents reconnected at various times during the Cenozoic and migration took place. He traces the evolution of whales from artiodactyls, with addition of vertebrae to their vertebral column, addition of teeth in the jaw and modification of teeth to simple pegs in the toothed whales, elimination of tooth replacement, adaptation of feet to paddles and then elimination of limbs entirely.

The author covers the relationship of South American ungulates to North American ungulates. DNA analysis on a *Taxodon* (a victim of megafaunal extinction) from South America indicates it is a descendant of the perissodactyls. He also discusses how some marsupials mimic placentals when they evolve in isolation, like *Thylacosmilus,* which mimics the North American saber tooth cat.

He traces elephant evolution from the 20 cm tall *Eritherium* to the 20 t *Palaeoloxodon*. He covers the bats, which have the largest number of species after the rodents, the adaptation of their limb for flying, and echo location and how it works. Echo location developed in the toothed whales independently. Brusatte then traces the appearance of grass and how mammals adapted to this abrasive diet by developing high crown teeth or teeth that never stop growing. This took place independently in various mammal lineages. He covers the megafauna of the Pleistocene, the Ice Age mammals, the last 2.7 million years and presents theories on their extinction.

The last chapter traces the evolution of primates—apes and humans—and how humans influence the diversity of mammals in the wild and how domestication may influence diversity. Humans can make their own mammals by cloning and in the future may bring back extinct forms. ❑

# Fossils in the News

*CTV News online*

## Massive fossil discovered near Morden

Researchers at the Canadian Fossil Discovery Centre in Morden, Manitoba have found the skeleton of another giant mosasaur in Upper Cretaceous rocks of the Morden area. The associated bones uncovered so far do not form an articulated skeleton, but their close proximity suggests that they likely belong to a single individual. The Morden area has produced a number of marine reptile fossils over the years, including the famous "Bruce," the largest mosasaur skeleton displayed anywhere in the world. **https://winnipeg.ctvnews.ca/massive-fossil-discovered-near-morden-1.6504696**

*Reuters.com*

## Ancient whale from Peru may be most massive animal ever on Earth

The world's biggest fossils just keep getting bigger. Now, Peruvian palaeontologists have unearthed an enormous whale ancestor from Eocene age coastal rocks in Peru, they're calling *Perucetus colossus*. The animal was built more along the lines of a manatee than the modern whales we're more familiar with. Artists' reconstructions show a creature with a relatively tiny head on an enormously inflated body. The bones are very large and very dense, to counteract the animal's bouyancy in seawater. Weight estimates of the living *Perucetus* range widely, from about 77 t to 340 t, which would make it heavier than a blue whale, though not as long: *Perucetus* was about 20 m long, compared to a blue whale's 33+ m. **https://www.reuters.com/** [search "Perucetus"].

*WIPS Trilobite Tales*

## *Treatise* volumes now available online

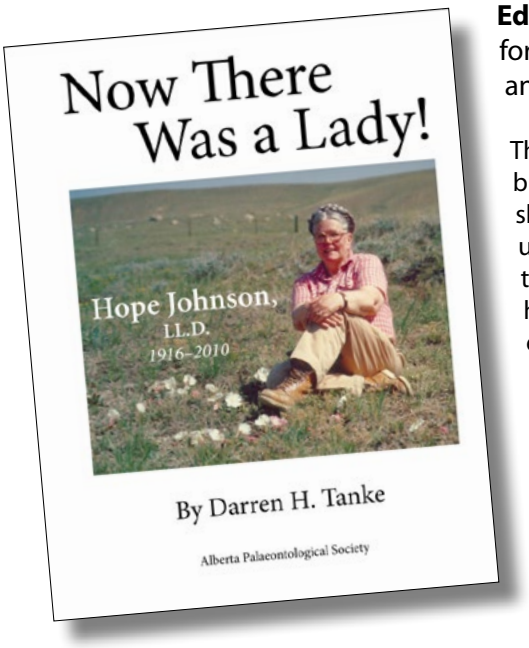
Big news for invertebrate palaeontology buffs! The *Treatise on Invertebrate Paleontology*, formerly available only as expensive, hard-to-find hardcover volumes, has been digitized and made available online and Open Access. All 53 volumes, some updated, are available as PDFs. **http://paleo.ku.edu/digitaltreatise/digitaltreatise.html**.

[*Thanks to Vaclav Marsovsky and Dan Quinsey – ed.*]

# Now There Was a Lady!

## Hope Johnson, LL.D. 1916–2010

### By Darren H. Tanke




**Edited and published by the Alberta Palaeontological Society** with forewords by palaeontologist Dr. Philip J. Currie, artist Allan C.J. Jensen and geologist, museologist, naturalist and writer, David A.E. Spalding.

The 2010 passing of Hope Johnson marked the end of an era for Alberta's vertebrate palaeontology communities. Her death affected other disciplines, too, as she travelled in many circles within the province for 65 years. How many among us can truly say they never knew her personally, saw her art work, or learned to identify Alberta prairie plants, or Late Cretaceous bones and teeth through her fossil identification books? During much of her middle and later life, and especially during the late 1950s to 1980s, Hope was a well-known and respected powerhouse in the Albertan amateur and professional vertebrate palaeontological communities. She was also heavily involved in the naturalist and visual arts communities as well as charitable organizations. This book focuses on her extensive activities in Alberta vertebrate palaeontology and provides examples of some of her fossil and botanical drawings and paintings.

Coil bound, 283 pages; extensively illustrated in black and white, with 30-page colour section showcasing Hope Johnson's art. Includes index.
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