Alberta Palæontological Society Bulletin

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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. Make contributions 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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THE BULLETIN WILL BE PUBLISHED QUARTERLY: March, June, September and December. Deadline for submissions is the 15th of the month prior to publication. Material for the *Bulletin* should be sent to:

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Requests for missing *Bulletin* issues should be directed to the Editor. Send changes of contact information to the Membership Director.

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, September 21, 2018—Barry Rogers, Alberta Palaeontological Society.
Stromatolites of southwestern Alberta including Chief Mountain
Followed by rock-and-fossil show-and-tell and social evening. See Page 3.

Friday, October 19, 2018—Chad Morgan, University of Calgary.
Research on trilobites of the Cambrian Stephen Formation. Pete Truch will give a 10-minute presentation on ***Ashfall Fossil Beds State Park, Nebraska.*** See Page 3.

Friday, November 16, 2018—Annie McIntosh, University of Alberta.
Dinosaur research, title to be announced. David Moore, Burgess Shale Geoscience Foundation, will give a brief presentation on ***Fossils of the Burgess Shale***.

Watch the APS website for updates!

ON THE COVER: Brachiopods, *Spinatrypa* sp. from the Late Devonian upper Fort Simpson Formation and/or lower Escarpment Formation, Hay River, NWT. Specimens are about 20 mm in width. Photo by APS member **Geoff Barrett**. See story on Page 12.

Upcoming Events

September

Barry Rogers

Alberta Palaeontological Society

Stromatolites of Southwestern Alberta Including Chief Mountain

Friday, September 21, 2018, 7:30 P.M.
Mount Royal University, Room B108

[*This 15-minute presentation will precede the social evening and fossil show-and-tell.*]

Barry first discovered stromatolites in the riprap on Waterton Dam during an APS field trip. He has since found them in the Waterton/Glacier National Parks and in other areas in southern Alberta and British Columbia. His talk will discuss their existence, the Lewis Thrust Fault and show pictures of these 1.4 billion old fossils on Chief Mountain, Waterton Lakes National Park, and in the Castle River drainage. Stromatolites are deposited by cyanobacteria and are confused by many with green algae. They took CO_2 from the air and combined it with calcium from the sea and are given credit for raising the oxygen levels that support our current environment.

Biography

Barry Rogers has a degree in Agricultural Engineering from the University of Saskatchewan and a Masters Degree from The University of Stirling, Scotland where he met his wife, **Kate MacBeth**. He has been a member of the Alberta Palaeontological Society for 15 years and is a wannabe Geologist/ Rockhound.

Bulletin back issues are available online:
www.albertapaleo.org/bulletinarchive.html

Dr. Terry Poulton

Geological Survey of Canada

Ammonites witnessed the growth of Canada

POSTPONED

Friday, September 21, 2018, 7:30 P.M.
Mount Royal University, Room B108

PLEASE NOTE! The previously scheduled talk by **Dr. Terry Poulton** has had to be postponed due to medical circumstances. Dr. Poulton's talk is tentatively rescheduled to April, 2019. Watch the APS website and the December and March *Bulletins* for updates. **Barry Rogers**' presentation will proceed as planned, followed by an end-of-summer social and show-and-tell session: if you have interesting fossil or rock specimens, please bring them along for discussion!

October

Pete Truch

Alberta Palaeontological Society

Ashfall Fossil Beds State Historical Park & National Natural Landmark, Nebraska

Friday, October 19, 2018, 7:30 P.M.
Mount Royal University, Room B108

[*This 15-minute presentation will precede the main speaker, **Chad Morgan**.*]

The Yellowstone Hotspot (located in Yellowstone National Park) has produced five super-volcano calderas in the last 14 million years. The Bruneau-Jarbidge caldera, resulting from the explosions of super-volcanoes between 12.5 and 10 million years ago have direct relevance to Ashfall, as this has been determined to be the source of the ash. Using single-crystal laser fusion Argon 40/Argon 39 dating, the volcanic ash (with adjustment) yields a date of 11.93 million years. This one eruption is called the "Tuff of the Ibex Hollow."

The ash from this event, averaging 30 cm in depth, blew into the hollow where a water hole existed. Over time, the Ash Hollow Formation resulted, consisting of tan sandstone and grey-white ash, which varies in thickness from 1 to 1.5 m. Captured in the ashbed, among other Pliocene critters, are fully articulated skeletons of rhinos *Teleoceras major*; camels *Protolabis heterodontus* and *Procamelis grandis*; three toed horses *Pseudhipparion gratum* and one toed horses *Pliohippus pernix*.

Excavating and leaving the skeletal remains *in situ* resulted in a unique method of display within the confines of a large, protective enclosed building. Thus, a visitor can see the bone beds and creatures exposed in their original mortuary poses, a number of which Pete will show in his summary presentation of a site visit made in 2017.

Biography

Pete and his wife **Doreen** are ardent travelers. In 2010 they joined the ranks of famous circumnavigators of the globe (in a ship) including Captain Cook's goat who surpassed them by having done it twice! They have been on every ocean of the world (as geographers have named them), although technically there is only one. In addition to having travelled to 68 countries, they have been in every jurisdictional part of Canada from Territories to Provinces, and now, with the visit to Ashfall Fossil Beds State Historical Park in Nebraska, have visited all 50 States.

Chad A. Morgan

University of Calgary

Highlights from the Middle Cambrian Stephen Formation

Friday, October 19, 2018, 7:30 P.M.

Mount Royal University, Room B108

The Middle Cambrian Stephen Formation has a long and storied history in palaeontology. The formation originally included the famous Burgess Shale lagerstätten found in Yoho National Park by **Charles Walcott** in the early 20th century, and has subsequently become one of the most internationally recognized rock units in western Canada.

During this talk an introduction to the historic background and the current cutting-edge science surrounding this formation will be discussed from Walcott to **Franco Rasetti**, to ongoing research at the University of Calgary. Results on trilobite taxonomic reassessments and biostratigraphic analyses for the formation will be presented as well as newly discovered fossils, including ~505 Ma bacterial filaments, and unusual geometric trace fossils found in the "platformal" (formerly "thin") Stephen Formation. Additionally, a brief introduction to an as yet unpublished and newly discovered Burgess Shale fossil site in Yoho National Park, which has yielded a large number of *Margaretia dorus* specimens will be presented. This site with its large population of *M. dorus* specimens may aid in deciphering the taxonomic affinity of this problematic Burgess Shale fossil (whether they belong more closely with modern algae or are tubes constructed by hemichordate worms). While the Cambrian may not always have the most impressively large fossils found in Alberta, this talk will hopefully reveal the amazing array of exciting science currently being undertaken and still left to be done on the half billion year old record found in western Canada.

Biography

Chad Morgan is a PhD candidate in the Department of Geoscience at the University of Calgary. He is currently conducting research on trilobite biostratigraphy of the Middle Cambrian Stephen Formation under the supervision of Dr. Charles Henderson and co-supervised by Dr. Brian Pratt (University of Saskatchewan). His research has taken him to Burgess Shale fossil sites in Kootenay National Park as well as field sites in Yoho and Banff National Park. His research interests include invertebrate palaeontology, trilobite taxonomy, carbonate sedimentology and ichnology. ❏

CPC 2018 Saskatoon Sept. 21–24, 2018

The 2018 Canadian Paleontology Conference (CPC) will be hosted by the Department of Geological Sciences of the University of Saskatchewan on September 21 – 24.

An icebreaker will be held on the evening of Friday, Sept. 21 from 6:30 to 9:30 in the Museum of Natural Science, attached to the Geology Building. Technical oral and poster sessions will be held on Saturday the 22nd and Sunday the 23rd. There will be a free public lecture by **Dr. Ryan McKellar** of the Royal Saskatchewan

Museum titled *Cretaceous amber: Glimpses of terrestrial ecosystems during the "Age of Dinosaurs"* on Saturday September 22 at 4:30 P.M. Following the presentation there will be a banquet of local Indigenous food for all conference registrants. A field trip to the Canadian Light Source Synchrotron and Wanuskewin Heritage Park (both in Saskatoon) is offered for Monday, September 24.

For more information and to register, please visit the conference website: **https://artsandscience.usask.ca/geology/news/conference.php** ❑

DRI Gala Dinner November 3, 2018

Support western Canadian dinosaur research

By Mona Marsovsky

Learn about the latest dinosaur discoveries while supporting western Canadian dinosaur research at the Dinosaur Research Institute (DRI) gala dinner on Saturday, November 3, 2018 at the Earl Grey Golf Club at 6540 20 Street SW, Calgary. **Dr. Caleb Brown**, Betsy Nicholls Post-Doctoral Fellow at the Royal Tyrrell Museum of Palaeontology will give a presentation, *The New Golden Age of Dinosaur Exploration in Western Canada*. In addition to the keynote presentation, this year's event will feature a three-course gourmet dinner and displays and presentations by Ph.D. and M.Sc. students from the University of Calgary and University of Alberta. A silent auction will allow guests to acquire incredible items including jewellery, event packages and dinosaur art. Try your luck in the raffle draws.

"Working at the track site." Photo by Guy McLaughlin.

All of the proceeds go to fund dinosaur research in western Canada. The Dinosaur Research Institute's mission is to fund western Canadian dinosaur research. The Dinosaur Research Institute (DRI) was registered as a charity in 1997.

Individual tickets are $175.00 per person and a tax receipt will be provided for a significant portion of the ticket price. For more information and tickets, e-mail **info@DinosaurResearch.com**, phone **Al Rasmuson** at (403) 861-0532 or mail:

Dinosaur Research Institute
P.O. Box 6353 Station D
Calgary, AB, Canada T2P 2C9

I hope to see you there! ❑

Find Microfossils in November and December 2018

By Risa Kawchuk

Help **Dr. Jessica Theodor** and **Dr. Alex Dutchak** of the University of Calgary sort through matrix (sediment) from the Cypress Hills Formation (middle Eocene) of Saskatchewan to find tiny fossils. All of the fossils found will be used to aid their research into this northern fauna. We will be using microscopes in Room B213 at Mount Royal University from 1:00 until 3:30 P.M. on the following Saturdays:

November 3, 2018
November 17
November 24
December 8

We are very grateful to Mount Royal University (especially **Mike Clark**) for allowing us to use their microscopes and lab.

Registration is not required but if you contact me, **Risa** (rhymes with Lisa) **Kawchuk**, **(587) 969-1440** or **rkawchuk@yahoo.com** and let me know you are planning to attend, then I'll be able to inform you in case we need to cancel a session. No experience is required. Bring tweezers to pick the tiny fossils from the matrix and a pen to label your finds.

Watch the December *Bulletin* for dates of fossil sorting sessions in winter, 2019. ❑

Betty Speirs 1931–2002
An Alberta Fossil Collector

By Dale Speirs

My mother Betty was an enthusiastic fossil collector who had a number of Paleocene species named after her. In middle age, after we kids had left home and gone off to university, she did extensive collecting along the Paleocene outcrops of the Red Deer River.

A Brief Biography of Betty Speirs

Betty was born in the hamlet of Hespero in 1931, near Eckville in west-central Alberta, about halfway between Sylvan Lake and Rocky Mountain House. Her father, Neil Humalamaki, died when she was a year old and her mother Emma took her and her three-year-old brother to Eckville. Emma's parents came from Finland (as did Neil) and homesteaded just north of Eckville in 1903. Suomalais, the Finnish language, was spoken in her home. Growing up in a rural area, Betty developed a love of nature. She did extensive wildflower and wildlife photography when I was a boy, and her subsequent interest in fossils was a natural development of this.

My father, Dr. Cecil Speirs, was born in 1927 and raised on a south Saskatchewan homestead during the drought and Great Depression. He graduated with a DVM from Ontario Veterinary College in 1951 and began searching for a place to set up his practice. Someone informed him that Eckville never had droughts, and this decided the matter for him. By that time my mother had graduated from Normal School (teacher's college, today the Department of Education at the University of Alberta) and was a

Figure 1. Betty Speirs collecting fossils at Burbank in 1984.

schoolmarm at Bentley, not far from Eckville. She and Cecil were married in 1952. I was born in 1955 and my brother Neil (named after his grandfather) in 1957.

In 1963 we moved to Red Deer, with Cecil's clinic on a quarter-section of land just north of Red Deer. We lived in town, at that time a ten-minute drive away. (Red Deer traffic is considerably worse today. In later years, Cecil liked to call the city "Red Light" Alberta.) In addition to his veterinary practice, Cecil kept about 200 head of rangeland Charolais beef cattle in various pastures along the Red Deer River, including Burbank (junction of Blindman and Red Deer Rivers) where once was a hamlet along the railroad, named after the famous botanist, Luther Burbank.

My father died in 1996 and the farm was sold. In 1998 Betty was diagnosed with congestive heart disease, which doesn't kill immediately but made her weaker and weaker until she had to give up fossil collecting. She died in 2002 (*Bulletin*, September 2002, p. 2). Betty has no grave. In accordance with her will, her remains were cremated and the ashes scattered at Burbank, which was her favourite fossil site.

The Beginning of Betty's Fossil Collecting

I entered the University of Alberta in 1973 intending to become a palaeobotanist with a B.Sc. in Botany. Prior to university I had done some fossil collecting with friends at Burbank and the Drumheller badlands, thus my interest. By the end of my first year it had become obvious that professional botany jobs were scarce on the ground, as the world suffered through the first oil price shock and subsequent budget cutbacks by universities and private industry. I changed my major and graduated in 1978 with a B.Sc. in Horticulture, figuring that if worse came to worst then I could always get summer jobs pushing a lawnmower. As it happened, after working a couple of years for private landscapers I got on permanently with the City of Calgary Parks Department and rose through the ranks, retiring in 2010 as Trouble Calls Supervisor.

In my first year as a university student I read a 1965 Geological Survey of Canada report by W.A. Bell (Bell, 1965) which mentioned some plant fossil localities near Red Deer. Since they were only a few minutes drive away from our home, I began tracking down his locations. The Burbank site was fairly obvious and the cliffs were easily accessible.

The Joffre site required some detective work, but I found it on the side of Highway 11 where it crossed the Red Deer River east of the city. It was barely visible, overgrown by vegetation, with only a metre or two of strata visible. I enlarged it a bit and my mother came along later to help and collect specimens.

Directly across the river were steep cliffs. My mother didn't like to climb them, but I was a foolhardy young man back then. The strata held numerous small Paleocene fossils such as fish vertebrae, mammal bone fragments and freshwater snails. The difficulty in climbing the cliffs meant that I only worked the site a few times. At the top of the cliff were Pleistocene palaeosols that were completely inaccessible except by ropes. I could only look at them from a distance. I tried to interest my Soil Science professors in them but had no luck. To this day I don't know if anyone has studied them.

Figure 2. Slab of matrix with leaf fossils from Burbank.

When my friends and I drove to Drumheller to collect fossils there, we took Highway 595 which runs from southeast Red Deer toward Delburne. Along the way the highway cut through a sandstone ridge. We naturally stopped to inspect it and discovered massive quantities of what were years later identified as *Joffrea speirsii* seedlings.

Getting Serious

I abandoned fossil collecting while working for my horticulture degree but the localities were not forgotten. Betty began working all the sites and by sheer perseverance over the next two decades accumulated huge quantities of Paleocene fossils. The Burbank site was not accessible during the spring floods, so she would work the Joffre and Highway 595 sites then switch to Burbank in late summer when river levels fell. Betty expanded the Joffre site enormously, excavating along the slope both horizontally and

Figure 3. *Metasequoia* leaves, cones and seedlings collected by Betty Speirs at the Joffre Bridge locality.

vertically. Bell would have been impressed. Figure 1 is a photo of her collecting on the Blindman River side of Burbank in late autumn when the river level was at its lowest and the fossil strata were exposed.

I had introduced Betty to my palaeobotany professor, Dr. Wilson Stewart and from there she met others such as Alex Chandrasekharam, Ruth Stockey and **Georgia Hoffman**. The U of A staff began revising the nomenclature of the fossils. Prior to their work, it was the custom of Tertiary palaeobotanists to compare fossil leaves with extant leaves and assign them to whatever seemed familiar. As an example, what is today called *Joffrea speirsii* was originally described as *Populus* (poplar) and later *Cercidiphyllum* (Katsura tree), both extant genera. Stewart was fond of pointing out in our palaeobotany class that if you believed the original descriptions, then what the palaeobotanists were saying was that angiosperm evolution came to a complete stop 65 megayears ago. This obviously could not be.

Betty was able to help with the revisions because her massive collections provided ample leaf specimens, inflorescences, individual flowers, seeds and stems with vascular preservation. Figure 2 shows a typical slab from Burbank that she collected. Figure 3 is an example of the many *Metasequoia* specimens from Joffre Bridge. The *Joffrea speirsii* seedlings from Highway 595 were a highlight of her collecting (Figure 4). She had also collected fossil aquatic insects and fishes from the Paleocene deposits.

In 1984 the University of Alberta hosted the International Organization of Palaeobotany World Congress. Betty received a special award for her contributions to field palaeobotany. She was delighted to guide a tour to her localities.

Figure 4. Seedlings of *Joffrea speirsii*.

Paleocene Species Named After Betty Speirs

Pseudolimnophila speirsae is an aquatic insect described by Dennis Wighton (Wighton, 1980). Betty had found both the bodies and the wings of the insect. Figure 5 shows an example of the wings. Note that the veins and colour pattern are preserved in the fossil.

Figure 5. Insect fossil, *Pseudolimnophila speirsae*.

Joffrea speirsii is a tree described by Peter Crane and Ruth Stockey (Crane and Stockey, 1985). Figure 6 shows a few specimens collected by Betty. A typical leaf is in the centre. Starting at top and going clockwise are stem fragments, seed capsules, inflorescence, seedlings, and stem fragments.

Figure 6. *Joffrea speirsii*.

Platananthus speirsae is a tree described by Kathleen Pigg and Ruth Stockey (Pigg and Stockey, 1991). Figure 7 shows examples of leaves, flowers, and fruits.

Speirsaenigma lindoei is a smelt fish described by Mark Wilson and Robert Williams (Wilson and Williams, 1991). Figure 8 shows several partial examples of the fish.

Ricciopsis speirsae is an aquatic liverwort described by Georgia Hoffman and Ruth Stockey (Hoffman and Stockey, 1997). In that paper, the authors also named the Paleocene oxbow lake in which the the fossil-bearing sediments accumulated as "Lake Speirs." An example of the fossil is shown in Figure 9.

Figure 7. *Platananthus speirsae*.

A detailed geological description of the Joffre Bridge site was published by Hoffman and Stockey (1999). This paper discusses the flora and fauna of the site and places the fossils into geological context. ❑

References

Bell, W.A. 1965. Illustrations of Canadian fossils. Upper Cretaceous and Paleocene plants of western Canada. Geological Survey of Canada, Paper 65-35.

Wighton, D. 1980. New species of Tipulidae from the Paleocene of central Alberta, Canada. Canadian Entomologist, 112(6): 621–628.

Crane, P.R. and Stockey, R.A. 1985. Growth and reproductive biology of *Joffrea speirsii* gen. et sp. nov., a *Cercidiphyllum*- like plant from the late Paleocene of Alberta, Canada. Canadian Journal of Botany, 63(2): 340–364.

Pigg, K.B. and Stockey, R.A. 1991. Platanaceous plants from the Paleocene of Alberta, Canada. Review of Palaeobotany and Palynology, 70 (1–2): 125–146.

Wilson, M.V.H. and Williams, R.R.G. 1991. New Paleocene genus and species of smelt (Teleostei: Osmeridae) from freshwater deposits of the Paskapoo Formation, Alberta, Canada, and comment on osmerid phylogeny. Journal of Vertebrate Paleontology, 11(4): 434–451.

Hoffman, G.L., and Stockey, R.A. 1997. Morphology and paleoecology of *Ricciopsis speirsae* sp. nov. (Ricciaceae), a fossil liverwort from the Paleocene Joffre Bridge locality, Alberta, Canada. Canadian Journal of Botany, 75(9): 1375–1381.

Hoffman, G.L. and Stockey, R.A. 1999. Geological setting and palaeobotany of the Joffre Bridge Roadcut fossil locality (Late Paleocene), Red Deer Valley, Alberta. Canadian Journal of Earth Sciences, 36(12): 2073–2084.

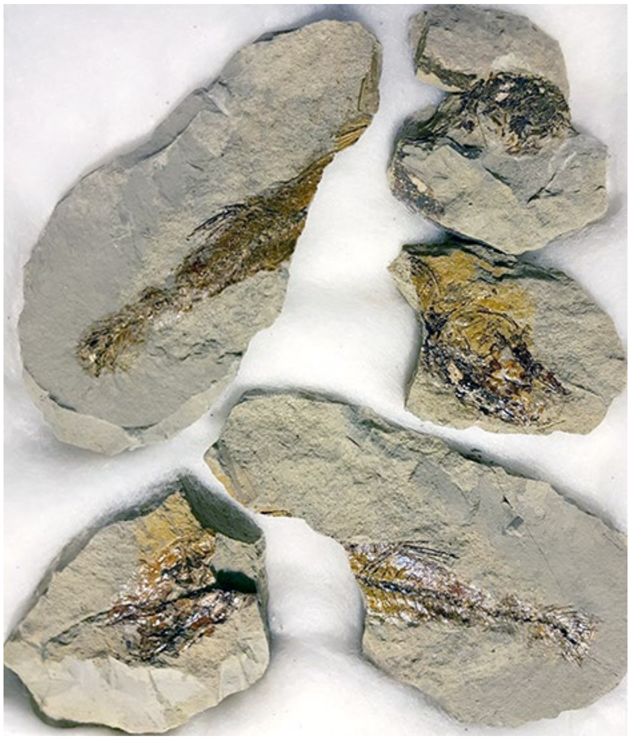


Figure 8. *Speirsaenigma lindoei* fish fossils.

Figure 9. *Ricciopsis speirsae*, a liverwort.

Further reading

Alberta Palaeontological Society. 1988. Field trip #88-1, Joffre Bridge (Red Deer area). Alberta Palaeontological Society Bulletin, 3(3): 4.

Alberta Palaeontological Society. 2002. In memoriam: Mrs. Anna Elizabeth (Betty) Speirs. Alberta Palaeontological Society Bulletin, 17(3): 2.

Braunberger, W. 1987. Field trip no. 1, Red Deer area field trip. Alberta Palaeontological Society Bulletin, 2(3): 5.

Marsovsky, M. 2003. Library notes: Books donated by the estate of Betty Speirs. Alberta Palaeontological Society Bulletin, 18(1): 2 – 4.

Interested in an APS Field Trip to Grande Prairie in 2019?

By Mona Marsovsky

Before November 2, 2018, I need to know if you are interested in participating in an APS field trip to Grande Prairie, Alberta, on August 16–18, 2019 (or August 15–19, 2019 for the five-day version). The field trip would only proceed if there are enough participants, at least eight people. Since the drive from Calgary to Grande Prairie takes at least eight hours, no less than three days would be required (one day to drive up to Grande Prairie, one day to see the Philip J. Currie Dinosaur Museum and one day to drive back to Calgary). We could also add the one-day “Palaeontologist for a Day” program at the Museum to make a four-day Grande Prairie trip. There is also an option to extend the trip to a total of five days and also visit the two dinosaur trackways in Tumbler Ridge, BC on one day and then the Hudson’s Hope (BC) Museum and W.A.C. Bennett Dam on the next day.

Below I have summarized a tentative itinerary for the three day Grande Prairie only and the five day Grande Prairie and Tumbler Ridge field trips. **Note that these trips will NOT include an opportunity to collect fossils.**

Three-day Grande Prairie Field Trip

Day 1, Friday: Drive to Grande Prairie, stopping for a backroom and gallery tour of the new Royal Alberta Museum in Edmonton enroute. Overnight in Grande Prairie.

Day 2, Saturday: Visit the Philip J. Currie Dinosaur Museum and take the bonebed tour. Overnight in Grande Prairie.

Day 3, Sunday: Drive to Calgary with a stop at Grande Cache Interpretive Centre (to see the dinosaur track display) and Jasper. Drive to Calgary via the Ice Fields Parkway and Banff.

Five-day Grande Prairie and Tumbler Ridge Field Trip

Day 1, Thursday: Drive to Grande Prairie, stopping for a backroom and gallery tour of the new Royal Alberta Museum in Edmonton enroute. Overnight in Grande Prairie.

Day 2, Friday: Visit the Philip J. Currie Dinosaur Museum and take the bone bed tour. Drive to Tumbler Ridge to stay overnight.

Day 3, Saturday: Visit the Tumbler Ridge, BC Cabin Pool Tracksite and the Wolverine Tracksite. Overnight in Tumbler Ridge.

Day 4, Sunday: Drive to Hudson's Hope BC to visit their dinosaur museum. Visit the Peace Canyon Dam and W.A.C. Bennett Dam, at which important dinosaur trackways have been found. Drive to Grande Prairie to stay overnight.

Day 5, Monday: Drive to Calgary with a stop at Grande Cache Interpretive Centre (to see the dinosaur track display) and Jasper. Drive to Calgary via the Ice Fields Parkway and Banff.

Approximate Costs

There are three options.

a) Rental van (15 passenger) which I would drive. Stay in hotels. A minimum of eight people are required and maximum of eleven can be comfortably accommodated. This option requires each person to pay a non-refundable deposit. The van rental and fuel costs would be split between the van occupants. For the quoted costs, I have assumed the minimum number (eight) in the van.
b) Drive yourself and stay at hotels.
c) Drive yourself and camp.

The listed costs do NOT include suppers. These approximate costs assume an average gasoline price of $1.25 per litre for the three-day Grande Prairie only trip and $1.30 per litre for the five-day trip. GST is included in the costs. The costs include all admissions and tours, hotels or RV campsites (double occupancy) for each night, lunches, snacks, and breakfasts. Breakfasts are not included in the camping option.

Three days, Grande Prairie

Group Van:	$447.00
(with non-refundable deposit of $200.)	
Drive yourself and stay in hotels:	$347.00
Drive yourself and camp:	$329.00

www.albertapaleo.org

Five Days, Grande Prairie and Tumbler Ridge

Group Van:	$781.00
(with non-refundable deposit of $310.)	
Drive yourself and stay in hotels:	$616.00
Drive yourself and camp:	$513.00

Before I proceed with organizing this potential trip, I need to know how many people are interested. Provide the following information to myself, Mona Marsovsky, **giftshop@albertapaleo.org** or (403) 547-0182, **BEFORE November 2, 2018**:

a) Which trip you would attend (3 day or 4 day or 5 day or if any of those options would be OK).
b) Which option (group van, drive yourself and stay in hotels or drive yourself and camp) you would prefer.

Feel free to contact me with any questions or suggestions. If not enough people contact me before November 2, 2018, I will NOT proceed with organizing this APS field trip. ❏

Fossils in the News

Rare baby snake fossil found in amber from Age of Dinosaurs.

www.cbc.ca/news/ (search "baby snake fossil")

Fossil of "first giant" dinosaur discovered in Argentina.

www.bbc.co.uk/news/ (search "Ingentia")

World's "oldest coloured molecules" are bright pink.

www.bbc.co.uk/news/ (search "oldest coloured molecules")

Ancient human, giant sloth remains found in world's biggest flooded cave.

www.cbc.ca/news/ (search "sloth flooded cave")

"Amazing dragon" discovery in China reshapes history of dinosaurs' evolution

www.nytimes.com/ (search "Lingwulong")

[*Thanks to Phil Benham and Evelyn Wotherspoon.*] ❏

The Great 2018 Expedition to the Hay River Area, Northwest Territories

Article by Pete Truch; photos by the author except where noted.

Since my wife **Doreen** and I are both deaf, the phone was on speaker when **Wayne Braunberger** called and asked if I would like to join him and **Don Sabo** on a trip to Hay River. All Wayne could hear was Doreen's excited yell of "Yeah! Yeah!" It wasn't so much for my excitement at the prospect, but from her own perspective: "Take him, take him—a whole week of rest—YES! YES!"

For Wayne this would be his sixth trip; for Don his third, and for me—a relative virgin—only my second. I had the first-time privilege back in June 2006 with an APS expedition, which **Keith Mychaluk** captured in a well-written article (*Bulletin,* September 2006; pp. 4 – 8). An opportunity to go with two very knowledgeable geologists and founding members of the Society was too good to pass up, so I quickly revised previous plans that I had made.

As for other APS members, **Geoff Barrett** holds the record at ten trips to this locale (email confirmation from Geoff), not-so-closely followed by **Harvey Negrich** and Wayne, tied now at six apiece. When I asked, Geoff said he would go again.

What prompts so many of us to go and want to return to this very distant place (1580 km from Calgary)? Is it the thrill of the hunt? Or that final reward when you hold some treasure in the palm of your hand? (I usually find the worst specimens). Memories of beautiful specimens—found by others, of course—*Phillipsastrea* sp. rugose corals ("cow pies"), brachiopods such as *Atrypa* sp, and stromatoporoids, to name a few. Add to that the geology of the Pine Point mine, yielding calcite and dolomite crystals, galena, sphalerite, pyrite, marcasite and others (see **https://www.mindat.org/loc-21144.html**). Such pictures swirled through my thoughts and whirled and mixed into a jumble in the excitement of anticipation as we were driving for the second day, nearing the 60th parallel.

Figure 1. L–R: Pete Truch, Wayne Braunberger and Don Sabo (geologists are tall) stand at the Visitor Centre sign. Photo snapped by an anonymous tourist.

The NWT Visitor Centre at the Alberta-NWT border (Figure 1), our first stop in the area, has expanded and

Figure 2. Local map. Using Hay River as a base, we travelled as far north as Lady Evelyn Falls; south to Wood Buffalo National Park; and three times to Pine Point (near the circled red 6 on the map).

now displays well-prepared taxidermy specimens of muskox, polar bear, wolverine, wolf, and caribou. My certificates (obtained from the site) of the "Order of Arctic Adventurers North of 60° Chapter" are dated June 10, 2018 and June 4, 2006 respectively—twelve long years between. I am appreciating the invitation more every day.

Shortly after leaving the Visitor Centre, we stopped at Alexandra Falls (Figure 3), the first highlight of the sightseeing (tourist) portion of the expedition. I had slotted the trip into the categories of tourism (sightseeing); nature (wildlife); geology; mineralogy; and of course, palaeontology. Fortunately we were rewarded with all—except one specific item.

Figure 3. Alexandra Falls, one of the Twin Falls Gorge Members on the Hay River near Enterprise. The drop is approximately 30 m. Wayne thought a kayaker deliberately went over the falls some years ago and survived.[1]

Figure 4. Hay River looking downstream from the base of Alexandra Falls toward Louise Falls. Cliffs are fossiliferous Devonian limestone.

The weather forecast for the week had been promising, as it was supposed to be cloudy, with highs near 14° C accompanied by afternoon showers. After visiting to the falls we had decided to go in search of brachiopods along the river's edge first thing Monday morning, since weather here can be unpredictable. Sure enough, Monday morning, 7:00 A.M., it was pouring rain—buckets of it. The temperature hovered near 6° C. Executive decision: Pine Point, where it might be raining less and where there was less likelihood of having to wallow through mud. Don was also in search of good specimens for a rock garden. With rain came the wind and the accompanying wind chill, apparently −7° C!

We spent part of the day at the core boxes (Figure 6), which are the few remaining items left by Pine Point Mines Limited (Cominco was a 78% stakeholder) when it ceased operations starting in 1986. Keith cites a figure of 600,000 m of core drilled over the operation of the mine, stored meticulously in sealed wooden boxes, labelled with aluminum strips and stacked by pit number. In the twelve years since my last trip, natural reclamation in this area of discontinuous permafrost and all the rummaging by

Figure 5. Unique "table-style" Louise Falls, second of the Twin Falls Gorge. Such scenery is almost worth the price of admission alone and is certainly one of the trip draws.

1. At least two kayakers are credited with running the falls: Americans Ed Lucero in 2003 and Tyler Bradt in 2007 (source: Wikipedia).

Figure 6. Top left: Cominco left its core boxes behind, having abandoned the mining lease in 2001. I presume the company felt no liabilities could result from leaving the boxes. Top right: Cores were cut in a systematic fashion to determine where the best lead (galena) and zinc (sphalerite) ore could be found. Each core was examined by geologists and then stored in these wooden boxes. Half cores indicate sampling for ore quality. Each box was labelled with an aluminum tag recording the pit, core sequence and core lengths. Lower left: Nature is reclaiming the area with poplar trees. The boxes, some hardly touched in 2006, are now well pilfered by the human element. Lower right: The traditional pose when a neat item is found. In this case Wayne is pointing out a calcite crystal making up this piece of core. Wayne and Don are bundled up because it was only 6° C with a wind chill that made it -7° C this day! My hands were so cold after a couple of hours exposure, that I could only peel half of my orange.

many people showed in the condition of the boxes (Figure 6). Compare the trees in these photos with a photo taken by Keith in 2006 (*Bulletin* Sept. 2006 p. 6). Many good geological specimens were found in the cores, including brachiopods (Figure 7).

A brief history of the Pine Point area

The main reference for this next section is a report by JDS Energy & Mining Inc. (2017).

Knowledge of lead/zinc deposits dates back to R. Bell's Geological Survey of Canada report of 1899. Several years of exploratory drilling and shaft probing followed. However, it wasn't until 1961 when the Federal Government, along with Canadian National Railway, agreed to build a railroad link to Hay River from Pine Point on the basis of Pine Point Mines

Figure 7. From the core boxes, an example of brachiopods of unknown species, possibly *Atrypa*. Centimetre scale.

Figure 8 (top): Don and a handmade Pine Point sign. The site dates to 1898 when some mining claims were staked in the area. **Figure 9** (lower): In 1951 Pine Point Mines Ltd. was formed by Cominco to explore the possibility of extracting lead and zinc. In 1961 a rail link was started to Hay River. Mine ore could then be transported by rail all the way down to Cominco's smelter in Trail, BC. By 1963 the town of Pine Point was taking shape. This is the main road and what's left of the town centre. A large archive of photographs of Pine Point in its heyday can be seen at the website **http://pinepointrevisited.homestead.com**

Limited (Cominco) opening up mine production.

A hydro dam was constructed on the Talston River, generating 18.6 megawatts of power for the mine site, the town site and Fort Smith in Wood Buffalo National Park. Those power lines still exist and operate today. By 1964 the rail line was completed, after three years of effort. The town site itself was started in 1963. Its population, according to the Federal Census, peaked in 1976 at 1,975 persons. Pine Point was a complete town, down to sporting facilities, and when the mine ceased operations the buildings and mine equipment were sold and moved out. The end of the 1990s left only the railway bridges and roadbed. The town was reduced to paved roads and sidewalks with trees starting to take root in a natural reclamation process (Figures 8, 9, 10).

Geology of Pine Point

The geology, especially for me, the non-geologist, was intriguing. Post-glacial swamps cover the region of discontinuous permafrost. On the surface, there is little outcropping of ore-bearing rock. Instead, deep layers of Pleistocene glacial deposits cover non-mineralized layers of Middle and Upper Devonian rocks. The "pay-dirt," ore-bearing Middle Devonian sedimentary layers formed with the influx of mineralizing brines into karst-based limestone cavities. These former sinkholes, a recent example of which can be seen in the area—Angus sinkhole in Wood Buffalo National Park (Figure 11), filled with ore in ninety-seven known areas. Cominco, between 1964 and 1988, mined forty-nine of them. I believe only two of the pits are currently water-free. All the remainder are water-filled, as shown in one example, Figure 38.

The ore in the former sinkholes with some mineralizing trends between them, occur in three groups: North, Main and South, over a 68 km strike distance and 6 km width. Wayne, from his six visits, is currently working on a personal project to correctly map them. The ore occurrence is classified as a "Mississippi Valley Type" (MVT) carbonate-hosted lead-zinc sulphide deposit. Geologically speaking, "MVT lead-zinc deposits are a varied family of epigenetic [formed near Earth's surface] deposits that develop in dolostone and in which lead and zinc are the major commodities." (JDS Energy & Mining Inc., 2017, p. 8-1). Pine Point is the best known Canadian example of MVT with other Canadian deposits at Nanisvik, Polaris, and Grey River.

The ore examples shown (Figures 12, 13, 55) are the type of material that provided 2,023,000 tonnes of lead and 4,569,671 tonnes of zinc extracted from some 64,294,130 tonnes of concentrate over the life of the mine (JDS Energy & Mining Inc., 2017, p 6-7). Currently there are efforts underway in studying the potential of re-opening the area to further mining.

We spent the remaining time on Monday exploring a couple of previously-visited pits. Tuesday began with no let-up in the rain, so we decided that our time would be best spent exploring

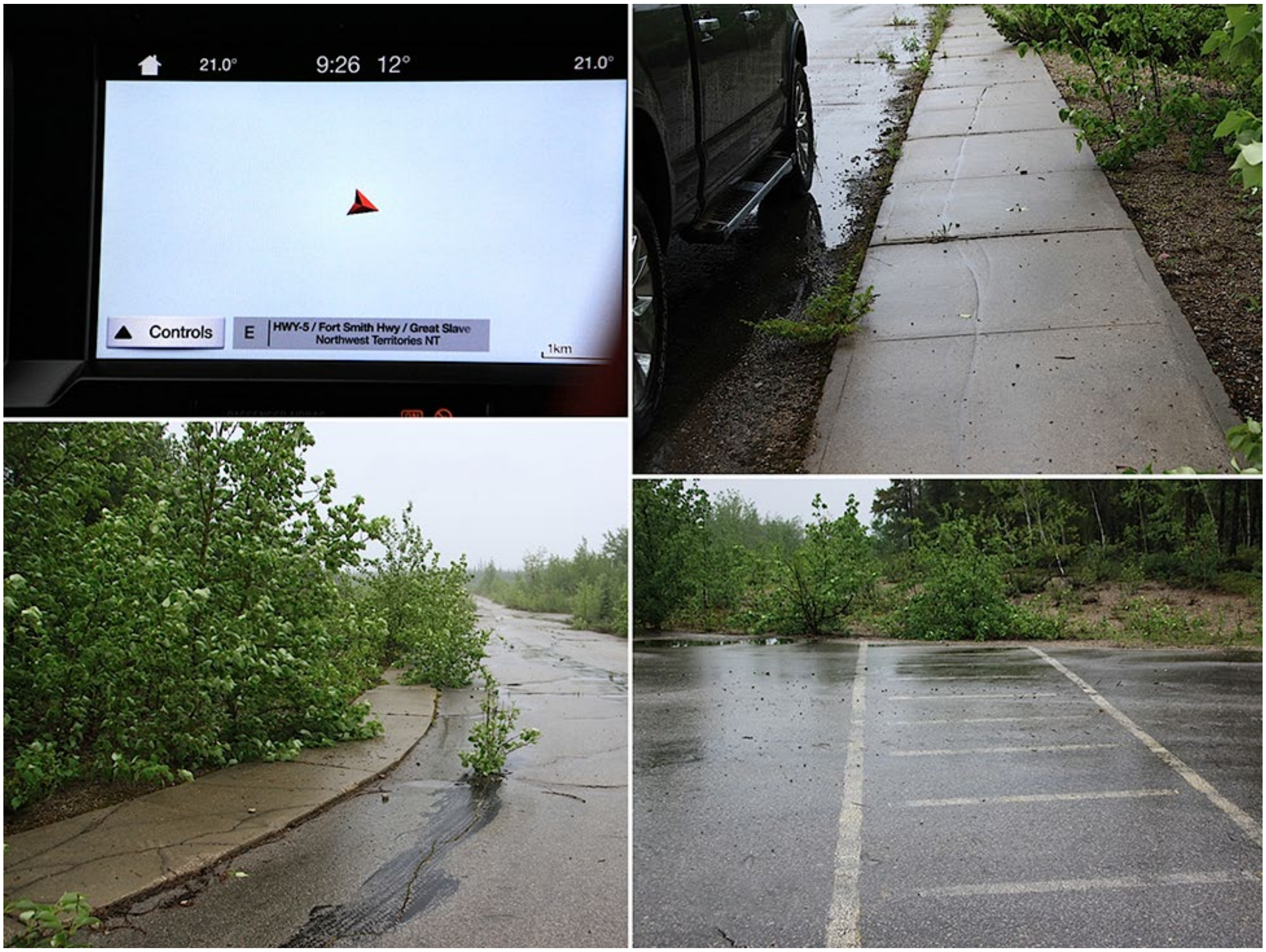


Figure 10. Top left: Welcome to *Terra Incognita*—I took this shot of the GPS unit in Don's truck, along Highway 5 on the first day. As you can see, it's a very blank screen—GPS position but no map base! Good thing that Wayne and Don knew where they were going. Temperatures dropped and we never saw anything higher than 6° C for the next 3 days! **Lower left**: Roads to former homes. In 1986 when the mine ceased operations, all houses, schools, an arena, etc. were sold and moved to Hay River, Fort Resolution and parts of Northern Alberta. It had been a vibrant town with a reported peak population of 1,975 in the 1976 Federal Census. **Lower right**: A crosswalk that now leads to nowhere. **Top right**: Some "fossil tracks" in the sidewalk likely date to 1963. Kids are the same everywhere—who can resist riding a bike in not-quite-set concrete? Aside from these roads, sidewalks and power poles there is nothing left of the town and trees are starting the reclamation process. The entire mine mill facility and all associated buildings were gone by the early 1990s.

Figure 11. Left: Explanation sign of sinkhole formation. **Right**: Angus sinkhole, Wood Buffalo National Park. Its dimensions are 30 m deep, 100 m across the top.

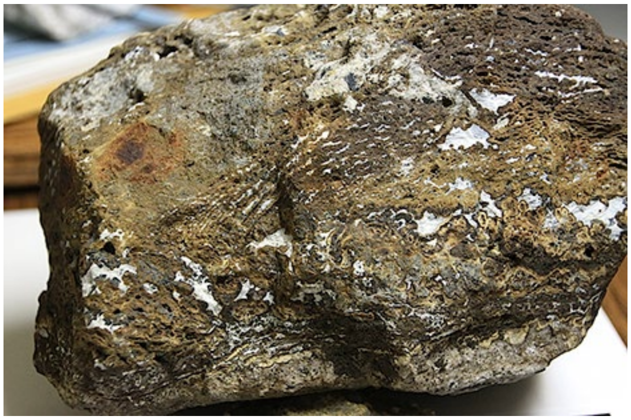


Figure 12. A small sample of high-grade zinc ore extracted from one of the former mine pits and fortunately dropped in the spoil pile. It now resides in my office.

Figure 13. I like this sample (now sitting beneath our spruce tree), as it shows the ore deposited by mineralized brine that penetrated former cavities in the limestone.

new pits and visiting some older ones (that were still driveable, given the wet conditions). The brachiopod site on the bank of the Hay River was out of the question. Fortunately, rain at Pine Point was not as bad as on the other side of Great Slave Lake. The lake is the tenth largest lake (by area) in the world, which helps explain the presence of the Coast Guard in Hay River town. It's also a good source for the delicious whitefish served in the local restaurants.

Figure 14. Don examines a small lagoonal reef.

Figure 15. Reindeer lichen (*Cladonia rangifera*).

Figure 16. Top left, top right: views from top of exposed Alexandra Member Devonian reef. **Lower right**: Don photographs the vista. **Centre**: Tamarack (*Larix laricina*) foliage. **Lower left**: Eroded gap through the reef exposure allowing descent to exposure below.

As already mentioned, Don was looking for good rock garden specimens and of course anything else of interest, so a second day at Pine Point was worthwhile. We checked out some distant pits on the south side of Highway 6 and then proceeded to other familiar ones nearer the old town site. Wayne found a cluster of brachiopods, more of which I later found on Thursday in a far distant part of the same spoil pile. An area that previously had a lot of rugose corals (Figures 53, 54, Appendix 1) was pretty well picked-out. However, many excellent crystals of calcite, dolomite, zebra dolomite (Figures 56 – 58, Appendix 2), pyrite, and chalcopyrite were found. Hunting was good, even for me!

Wednesday turned out to be our best weather day, so we focused on fossils and sightseeing/exploring. Stops north of Enterprise included small lagoonal reefs that Keith had tried to swim from (*Bulletin,* Sept 2006, p. 7, fig. 7). Don was examining it in detail (Figure 14) but found no trace of Keith's snorkel: he must not have lost it in the plunge. I did spot some reindeer lichen on the reef surface (Figure 15), an example of Nature reclaiming the minerals it had previously used in reef building.

We stopped at a large Devonian reef exposure (Alexandra Member, Twin Falls Formation) that offered a beautiful vista of the valley below (Figure 16). Through a split in the reef (Figure 16, lower left) we could have gained access to the valley below, but decided not to go down.

Among others, black spruce (*Picea mariana*) and tamarack trees (*Larix laricina*) comprised the boreal forest pictured before our eyes, the beauty of which is barely discernable in the photos. Tamarack are a deciduous conifer species, much like our nearby mountain larch, so the needles (inset in the photo mosaic, above) change colour in the fall. The word *tamarack* is an Indigenous word for snowshoes. At our feet, Don spotted exposed ancient coral and one could see other lagoonal reef features in the landscape.

We found several large stromatolites in a road cut (Figure 17) and oncoids (smaller, spheroidal stromat-

Figure 17. Stromatolites exposed in a road cut.

Figure 18. Oncoids. Centimetre scale.

olites; Figure 18) "which suggest deposition within a shallow water environment behind the main reef-mass." (Jamieson, 1967). McNallie Creek Falls (Figure 19) exposes a good cross-section through the reef-complex of the Alexandra Member. The water level was too high for us to get down to the creek below the falls as we did in 2006. Therefore, we couldn't determine if owls again chose to roost in the hollow at the base of the falls (*Bulletin,* Sept 2006, p. 8, fig. 9).

Another road cut on the way to Lady Evelyn Falls yielded a few brachiopods and several pieces of rugose corals, at least for Don. Lady Evelyn Falls on the Kakisa River (Figures 20, 21) is another sightseeing treat, as is a sign (Figure 22).

The first sign we encountered warned:

STEEP TRAIL
HIGH DEGREE OF PHYSICAL
FITNESS REQUIRED
MAY BE ICY OR SLIPPERY

It should have been posted where we intended to go for brachs on the Hay River!

One of the strange things about Lady Evelyn Falls is that I couldn't find out who the falls were named after. There was nothing about her on signs and brochures—even the Park Superintendent didn't know. Even online searching yielded nothing the first time round! So I invented a story: "Lady Evelyn sounds like the name of the

Figure 19. McNallie Creek Falls.

Madame who ran the best brothel in Hay River." Later on, back in Calgary, more online research led to a more likely story for the naming. William Cavendish, the 9th Duke of Devonshire, was Canada's Governor-General from Nov 11, 1916 to Nov 11, 1921. His wife, Lady Evelyn, Duchess of Devonshire, had other places named for her in Canada, but there was no mention of these Falls. Maybe my story is somewhat fitting after all, as she was also titled "Mistress of the Robes" to Queen Mary.

Figure 20. Don Sabo and Wayne Braunberger with Lady Evelyn in between.

Figure 21. Lady Evelyn Falls.

Figure 22. An interesting Territorial Park sign.

Unlike our experience on the 2006 trip, we saw a lot of wildlife, including the small-eagle-sized raven who had his eye on us. It took a while, but I finally caught him in sending a caw message (Figure 23).

One stop on the way back south, at an old gravel pit, yielded a possible nautiloid fossil. The pit had been dynamited since Wayne had been here last, so everything was quite different.

Leaving this pit and making our way back to Enterprise, we encountered a black bear and cubs

Figure 23. A rather large raven (*Corvus corax*) at Lady Evelyn Falls. He is just slightly smaller than a small bald eagle, so quite a big bird. They are also well known for their intelligence. I'm not sure what he was thinking, but he was staring pretty intently (left). He then sent a message to his buddies: "The short fat guy is probably OK to eat, but the two tall geologists are probably hard as rock."

Figure 24. Black bear (*Ursus americanus*) and cubs.

(Figure 24). We watched for about fifteen minutes as momma grazed and the cubs played with a large piece of plastic trash. She didn't seem the least bit fazed by our presence, even when another vehicle pulled up alongside us: she just kept eating. Finally, Momma barked orders, both cubs came running and the whole family disappeared into the bush.

At one of the pits in the Pine Point mine site, Wayne had found bear tracks, likely a week or so old. We didn't see anything that day. However, a couple of days later, at the same pit, Don came down from the top of a spoil pile because he saw fresh bear tracks up there. We confined our mineral searching to the area I was in, as there were no tracks. As we drove away from that particular pit, a mother black bear and her cub ran across the road right in front of us. I think she was watching us the whole time.

Figure 25. Red fox (*Vulpes vulpes*) with prey.

The near-the-highway pit just outside of Enterprise yielded several coral specimens, including *Phillipsastrea* (Figure 39), small brachiopods (likely *Atrypa*; Figure 40) and coral segments (*Thamnopora*;

Figure 41; refer to Appendix 1 for several examples of fossils found in the local area—Thanks again to Geoff Barrett.) We explored the possibility of getting down the riverbank for Thursday. It looked promising if it didn't rain again.

Unfortunately Thursday, our fourth and final day, started out like the rest: rain with temperatures of 6° C. We joked with Don about his new truck's external temperature sensor being broken. So much for the riverbank. Wayne had been to Wood Buffalo National Park before and remembered a sinkhole (Figure 11). Since it was pouring rain in Hay River when we left, we knew it was too dangerous to get to the river bank near Enterprise to search for the beautiful brachiopods (*Cyrtospirifer*) that are found there, so we opted for Wood Buffalo and Pine Point.

Figure 26. Thanks for taking this photo of the author goes to Don Sabo. Of course, he did the best he possibly could given what he had to work with.

Figure 27. Wood bison, *Bison bison athabascae* in Wood Buffalo National Park.

On the way, Don spotted a red fox (*Vulpes vulpes*). Now foxes and sightings of such may be common, but not to any of us—especially one that had prey in its mouth. You can see the effect of the rain on its coat (Figure 25).

Wood Buffalo National Park was founded in 1923 and became a UNESCO World Heritage Site in 1983. The Park area (bigger than the country of Switzerland!) was set up to protect the nesting area of the then about forty whooping cranes left in the world. It was successful, as their numbers have now grown into the hundreds, but of course they are still very much on the brink.

We also came across a herd of wood bison (Figures 27, 29). *Bison bison athabascae* is a distinct subspecies from their plains bison cousins of the south. They are larger than their southern brethren and have more aggressive/defensive horns.

After viewing the Angus sinkhole and the bison herd, we had some slightly better weather (lighter rain) when we hit the Pine Point mine pits. There was a bit of Mars-like topography given the sulphide mineral environment (Figure 28). Sulphur is also present in the form of yellow crystals of native sulphur (Figure 33). Much of the pyrite in contact with moisture reacts and deteriorates. Some crystals survive, along with something I had never heard of before—marcasite—the same chemical composition as pyrite (FeS_2), but having elongated, orthorhombic

Figure 28. Mars-like terrain often visible in patches. Sulphide base quickly weathers in contact with moisture. Occasional crystals of pyrite and marcasite can be found in these areas.

Figure 29. Wood bison bulls, cows and calves.

Figure 30. Spear-like crystals indicate this sample may be marcasite.

Figure 31. Cubic crystals identify this specimen as pyrite.

crystals ("spear-pyrites") instead of the classic pyrite cubes (Figures 30, 31).

Figure 32 shows one of the pyrite specimens that I put into my curio cabinet in 2006. They have deteriorated somewhat in the past twelve years, but are still in reasonable condition.

At the same pit where Wayne saw bear tracks, we found a new "Tar Mountain Volcano" (Figures 34 – 36), a most unusual and unexpected feature. The tar is a naturally occurring crude oil that accumulated

Figure 32. Weathered fine-grained or massive pyrite.

Figure 33. Sulphur crystals found in core in 2006.

Figure 34. "Tar volcano" approximately 2 m tall.

Figure 36. Note the flow pattern in this sample of tar.

Figure 35. Calcite crystals amid the tar.

in the porous dolomite rock and when exposed to the sun, heats up and oozes out of the rock—true "tar sands".

Don and I also found several brachiopods in the last spoil pit we examined that day. I continued down one way along the spoil pile and Don went the other. We lost sight of each other and a couple of hours later caught up with Wayne at the truck. Don was excited to share a find with us, so off we went.

I have to call this "Don's Vug Vault" (Figures 37, 38). Wow! Fantastic find—what a collection of calcite crystals. I thank Don for sharing this. I would love to have been able to take away the beautiful dolostone boulder, but would have needed a small crane—which could not even make it to this walk-in-only area. Too bad!

Friday morning was our departure day and still a light drizzle fell. Rain could have spoiled the entire trip, but we weren't just focused on collecting fossils. Indeed, anyone with only that goal in mind may have come away disappointed, as many of the better collecting spots were too wet to access. Because we three were broad-brush focused instead, we experienced a truly memorable trip: great scenery, incredible wildlife, fantastic geology, super mineral specimens and successful palaeontology. The only goal we missed: the potential search for more *Cyrtospirifer* brachiopods (Appendix 1) at the riverbank. Wayne thought that only two of the six times he'd been here was he able to get down to the river's edge. Something to look forward to next time. Will there be a next time? Just ask my wife! ❏

References

Jamieson, E.R. 1967. Upper Devonian outcrops, Hay River area. International Symposium on the Devonian System, Calgary. Guidebook for Field Trip A-11.

JDS Energy & Mining Inc. 2017. NI 43-101 Preliminary economic assessment technical report on the Pine Point Zinc Project, Northwest Territories, Canada, prepared for Darnley Bay Resources Ltd., June 1, 2017.

Figure 37. Don Sabo at work in "Don's Vug Vault."

Figure 38. Top right: Beautiful boulder of vuggy dolostone, vugs lined with dolomite (white) and calcite (yellowish) crystals. **Top left and lower right**: Close-ups of crystal-filled vugs, rock hammer for scale. **Lower left**: turquoise water-filled mine pit where "Don's Vug Vault" was found.

Appendix 1. Examples of typical Hay River area Devonian fossils

Photos by Pete Truch and Geoff Barrett. Many thanks go out to Geoff for his photos and for his help in identification of other fossils.

Figure 39. *Phillipsastrea* sp., a common colonial rugose coral. Photo by Pete Truch. Centimetre scale.

Figure 40. Brachiopod, likely *Atrypa* sp. Photo by Pete Truch.

Figure 41. Branching tabulate coral *Thamnopora* sp. in matrix. Branches about 1 cm thick. Photo by Pete Truch.

Figure 42. Brachiopod, *Cyrtospirifer* sp. Photo by Pete Truch.

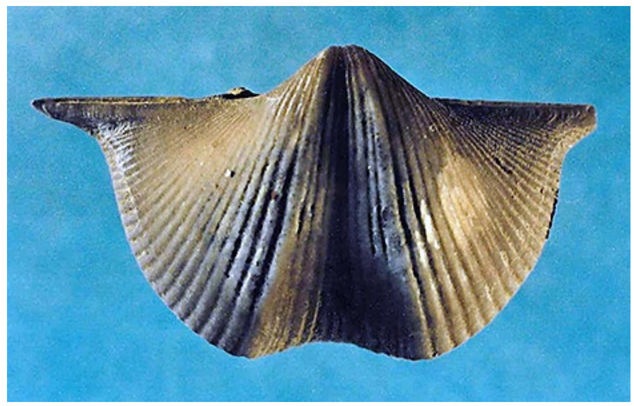


Figure 43. Brachiopod, *Cyrtospirifer* sp. Width about 4 cm. Photo by Geoff Barrett.

Figure 44. Brachiopods, *Spinatrypa* sp. Photo by Geoff Barrett, who says this is the most common brachiopod found in the area. Width of each specimen about 2 cm.

Figure 45. Brachiopod, *Atrypa* sp. Ventral (pedicle) view of the second most commonly found brachiopod. With about 3 cm. Photo by Geoff Barrett.

Figure 46. Posterior view of *Atrypa* showing ventral and dorsal valves Photo by Geoff Barrett.

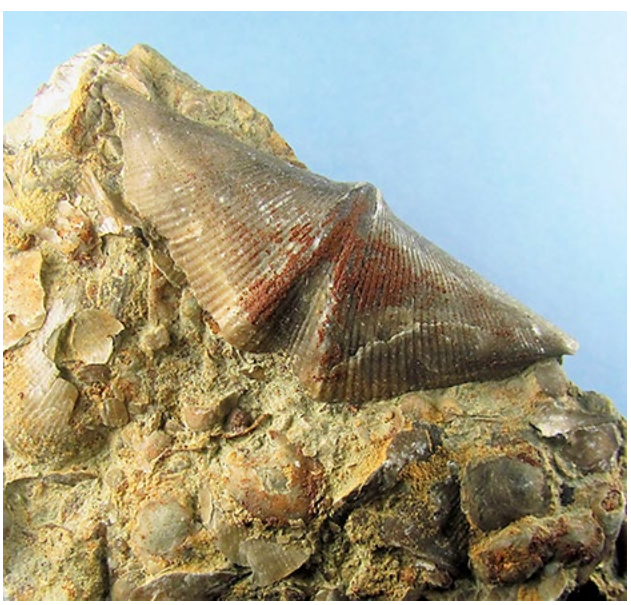


Figure 47. *Cyrtospirifer* in matrix. Width of specimen about 4 cm. Photo by Geoff Barrett.

Figure 48. Dorsal view of *Schizophoria*. Width of specimen about 3 cm. Photo by Geoff Barrett.

Figure 49. Posterior view of *Schizophoria* sp. showing ventral and dorsal valves. Photo by Geoff Barrett.

Figure 50. Another *Cyrtospirifer* to show the range in variation. Width about 4 cm. Photo by Geoff Barrett.

Figure 51. *Cyrtospirifer*. Photo by Geoff Barrett

Figure 52. *Coenites*, another common tabulate coral but usually only found as fragments, this is an exceptional specimen. Photo by Geoff Barrett.

Figure 53. Typical solitary rugose coral, very common, would need cross-sectioning to positively identify. Photo by Geoff Barrett.

Figure 54. *Cystiphyllum*, another common rugose coral. Photo by Geoff Barrett.

Appendix 2. Selected minerals and rocks from the Pine Point mine

All photos by Pete Truch.

Figure 55. Galena samples—lead sulphide (no, not the graphite that goes into "lead" pencils). Two views of crystals that I found in one core.

Figure 56. Zebra dolomite: two specimens showing dolomite that crystallized in alternating light and dark layers.

Figure 57. Left: "Saddle" dolomite, so-named for the curved crystal surfaces. **Right**: A piece of core with a calcite crystal-lined *vug*—a geological term that simply means a hollow where crystals can grow, often looking very cave-like: almost usable in a sci-fi movie.

Figure 58. Calcite crystals. **Left**: rhombs on "saddle" dolomite. Right a very large single crystal of the form called "dogtooth spar."

What’s up?

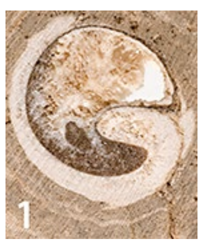
By Howard Allen, Editor

A geologist joke I saw on the internet recently speaks for a lot of amateur rockhounds and, as it turns out, is relevant to the June *Bulletin*’s cover photo. The joke is a rhetorical one-liner: “Why is it, whenever I ask a geologist to identify a rock, I end up with three different answers and a broken rock?”

In the photo caption I asked readers if the core slab on the cover was right way up, and how you could tell. There are many lines of evidence, called *geopetal* indicators that geologists can use to determine the “upness” of rock beds, an important skill that’s drilled into geology students.

The response to my quiz was underwhelming. Only one person offered a guess, by researching the stratigraphic position of the Methy Formation relative to under- and overlying formations and supposing that our little slab contained a formation contact. A valiant try, but a house-of-cards conclusion built on too many assumptions. The only valid evidence (if there is any) must come entirely from the rock itself.

Looking at our specimen I can see four lines of evidence—there may well be more—that could be used as clues.



1. Most obvious is the lovely big snail shell in the middle. The once-hollow shell has fine-grained, dark sediment at the bottom and pale, coarse crystals and empty space at the top. Loose stuff in a container will always settle to the bottom thanks to gravity. Empty space at the top can later fill with crystals (*e.g.* calcite) grown from mineralized water. Interpretation: the slab is right-way up.

2. Another possible clue (probably the weakest) is the way the darker sediment lies against the big oncoid in the middle. The dark sediment on the right side of the photo appears to have built up in wedges that overlap progressively toward the oncoid. This pattern of *onlap* (geo-jargon) is what you’d expect to occur on the top of an object, due to settling under gravity, but wouldn’t happen on the bottom. Interpretation: the slab is right way up.

3. In the upper right corner of the photo is a pale, stick-shaped object, probably a fossil fragment. Its lower end seems abruptly chopped off (*truncated*, in geo-jargon) against a dark hair-line streak. This can happen when a sedimentary bed is eroded at some stage in its formation, wearing away the exposed end of the fragment. In all but a very few circumstances erosion works on rocks from the top down. Later deposition then piles more sediment onto the eroded surface, a process termed *scour-and-fill*. Interpretation: the slab is upside-down.

4. The overall disposition of the darker, finer sediment relative to the lighter, coarser sediment is also a potential clue. Sediment accumulation in marine environments typically results in *normally graded* beds (more jargon). This is what happens when you shake a jar full of gravelly/sandy/silty/muddy water and let it stand. The gravel sinks first, then the sand, the silt and finally the mud settles on top. Here, the finer, dark sediment sits on top of the coarser, pale sediment. Interpretation: the slab is right-way up.

But here’s where the geologist joke comes true.

1. The snail shell’s sediment indicator is great, but how do we know the shell didn’t rotate *after* its sediment fill hardened? The fact that it’s in a round oncoid means it may have rolled around on the seafloor prior to becoming buried by more sediment.

2. The sediment “onlapping” the sides of the oncoid could be just a result of compaction from the weight of overlying sediment pressing the squishy mud against the hard oncoid. This could occur from the top down and/or from the bottom up.

3. The truncation of the stick-like fragment is very likely due to “pressure solution”: carbonate rocks (limestone or dolostone, which this is) commonly dissolve under pressure—think of an ice cube pressed onto a hotplate—along surfaces called “stylolites”; that’s likely what the black hairline streak is; it can happen from the bottom, the top, or both.

4. Though “normally graded” sediment profiles can be useful, here we only have two grain sizes to work with: fine and coarse. The coarse could easily have been dumped on top of the fine in a subsea sediment gravity flow, or washed onto the finer muds during a high-energy storm event.

So, the slab could be right side up, upside down, or maybe there’s just not enough evidence. Three different answers. At least I didn’t have to break the rock! ❏