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GEOLOGICAL ASSOCIATION OF CANADA
PALEONTOLOGY DIVISION

2022 Canadian Paleontology Conference

1st virtual conference

October 20-22, 2022

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Edited by Kimberley Bell and Meagan M. Gilbert

c/o Department of Earth Sciences
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St. John's, NL A1B 3X5 CANADA

Photo: Emily L. Bamforth
Cretaceous Frenchman Formation in southwestern Saskatchewan

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Introduction

Hello and welcome from the executive of the Geological Association of Canada's Paleontology Division (PD)!

After being unable to host a Canadian Paleontology Conference (CPC) for two years due to the COVID-19 pandemic, the PD is very happy to be hosting the 29th annual conference in a virtual format for the first time. While in-person conferences certainly have their merits, the pandemic has also demonstrated the benefits of meeting virtually. CPC 2022 was created with no registration cost and, as it does not require participants to pay for travel and accommodation, it has been accessible to a wider group of people, particularly students. This conference will showcase work from across Canada in a variety of different fields of paleontology, from the Cambrian to the Pleistocene.

As with previous CPCs, we will be awarding the Thomas E. Bolton Award to acknowledge excellence in paleontological research by a student through their paper presentation. This year, for the first time, we are also thrilled to be awarding the GAC-Paleo Division's first Avocational Paleontology Award, in recognition of outstanding action and/or achievement in the field of Canadian paleontology by a non-professional.

Despite paleontology being the study of long dead organisms, this is a science that is constantly changing and moving with the times. As a Paleontology Division, we are excited to support and recognize the amazing work that is being done throughout the country to further our understanding of life past, present, and future.

Have a wonderful conference!

Emily Bamforth
Chair, Geological Association of Canada's Paleontology Division

On behalf of the PD Executive Team.

Emily Bamforth, Chair
Marc Laflamme, Past Chair
Keith Dewing, Treasurer
Sandy McCracken, Publications Coordinator
Brittany Laing, Webmaster
Kimberley Bell, Councillor
Meagan Gilbert, Councillor

Land Acknowledgement and Inclusivity Statement

The Paleontology Division meets, works, and gathers across many traditional and treaty lands across Canada. We recognize the historical and systemic barriers encountered by many people in our society and welcome the inclusion of diverse voices.

Conference information

PLATFORMS

Oral presentation sessions and social events for CPC will be held via Zoom. Zoom is a free online teleconferencing platform that does not require participants to download anything to their personal computer. (For more information, see here: https://zoom.us/)

ZOOM LINK

If you are registered, you will receive a Zoom invitation via email on or before October 19th. Clicking this Zoom invitation link (see Zoom 101 Guide) will direct you to all of the oral presentations, the Icebreaker, AGM and Awards Ceremony.
If you DO NOT receive a Zoom link by Wednesday, October 19th, 2022 or have any other questions or concerns, please email cpc2022abstract@gmail.com.

ZOOM ETIQUETTE

When you 'arrive' in the session, you will be automatically muted. We ask that people remain muted while the presentations are taking place. At the end of each talk, there will be time for a few questions. During this time, you may either unmute yourself to ask the question, or type it into the textbox.
Do not record or take screen shots of presenter's talks or their slides.
If you wish to have a copy of anything in a presenter's talk or poster, you are encouraged to contact the author directly. Authors' contact information can be found in the abstract volume.

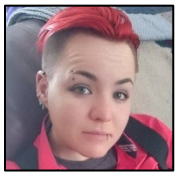
Meet the organizing committee

Emily Bamforth: Curator at the Philip J. Currie Dinosaur Museum in Wembley, AB. Research interests include Cretaceous vertebrate paleontology, paleobotany and paleoenvironemtal reconstruction, especially regarding paleoecological processes.

Kimberley Bell: Palynologist/ Canadian Business Developer at PetroStrat Ltd., with expertise in Devonian, Jurassic, Cretaceous and Paleocene palynology and stratigraphy from various regions of Canada, and the Miocene of Colombia. Especially interested in angiosperm pollen evolution.

Michael Cuggy: Senior Laboratory Coordinator at the University of Saskatchewan with expertise in Cambrian trilobites, eurypterids (sea scorpions), and Cambrian biostratigraphy.

Keith Dewing: Research Scientist at the Geological Survey of Canada, with expertise in Cambrian-Ordovician stratigraphy of the Canadian Arctic Islands. Especially interested in biostratigraphy and using fossils for thermal maturity, and a sentimental attachment to strophomenid brachiopods.



Meagan Gilbert: Petroleum Geologist at the Saskatchewan Geological Survey with expertise in Late Cretaceous to Paleogene vertebrate paleontology, stratigraphy, biostratigraphy and depositional systems.

Brittany Laing: Doctoral student at The University of Saskatchewan and Macquarie University. Researching the behavioural evolution and ecological impact of organisms through their trace fossils during the Ediacaran-Cambrian transition.

Marc Laflamme: Professor at the University of Toronto Mississauga. Interests lie in the classification and preservation of the Ediacaran biota, the oldest large and complex organisms in the rock record.

Sandy McCracken: Paleontologist, Volunteer Scientist with the Geological Survey of Canada (Calgary). Retired from the GSC in 2017 and now living in Victoria, BC. Expertise in Ordovician and Silurian conodonts and biostratigraphy, as well as some experience in Devonian.

If you need to contact the committee at any point, please email us at *cpc2022abstract@gmail.com*

Schedule

Pacific (PDT)	Mountian (MDT)	Central (CDT)	Eastern (EDT)	Atlantic (ADT)	Newfoundland (NDT)	THURSDAY, October 20		FRIDAY, October 21		SATURDAY, October 22
13:40	14:40	15:40	16:40	17:40	18:10	Tech test for presenters		Tech test for presenters		Tech test for presenters
14:00	15:00	16:00	17:00	18:00	18:30	Welcome		Welcome		Welcome
14:10	15:10	16:10	17:10	18:10	18:40	Chairs: Emily Bamforth+ Kimberley Bell	Technical Session	Chairs: Meagan Gilbert + Joseph Moysiuk	Technical Session	Chairs: Michael Cuggy+ Brittany Laing	Technical Session
14:25	15:25	16:25	17:25	18:25	18:55						
14:40	15:40	16:40	17:40	18:40	19:10						
14:55	15:55	16:55	17:55	18:55	19:25		BREAK				
15:10	16:10	17:10	18:10	19:10	19:40		Technical Session		Closing remarks and BREAK		Awards and closing remarks
15:25	16:25	17:25	18:25	19:25	19:55				Paleo Divisions Annual General Meeting		
15:40	16:40	17:40	18:40	19:40	20:10						
15:55	16:55	17:55	18:55	19:55	20:25		Closing remarks				
16:00	17:00	18:00	19:00	20:00	20:30	Organizers: Brittany Laing + Meagan Gilbert	Icebreaker				
16:15	17:15	18:15	19:15	20:15	20:45						
16:30	17:30	18:30	19:30	20:30	21:00						
16:45	17:45	18:45	19:45	20:45	21:15						

Technical Sessions

Thursday October 20th

17:00 EDT	WELCOME AND OPENING REMARKS
17:10 EDT	EVALUATING CHANGING BEHAVIOURS ACROSS THE EDIACARAN-CAMBRIAN TRANSITION Brittany A. Laing, Luis A. Buatois, M. Gabriela Mángano, Luke C. Strotz, Guy M. Narbonne & Glenn A. Brock
17:25 EDT	ONTOGENY AND MOULTING IN THE CAMBRIAN RADIODONT *STANLEYCARIS* Joseph Moysiak & Jean-Bernard Caron
17:40 EDT	THE CAMBRIAN ARTHROPOD TUZOIA REVISITED; TACKLING A 100-YEAR-OLD QUESTION Alejandro Izquierdo-López & Jean-Bernard Caron
17 :55 EDT	BREAK
18 :10 EDT	GROWTH PATTERNS IN A NEW GREGARIOUS POLYCHAETE WORM FROM THE CAMBRIAN BURGESS SHALE Hatena Osawa & Jean-Bernard Caron
18:25 EDT	A STEM GROUP MEDUSOID FROM THE CAMBRIAN BURGESS SHALE AND THE ORIGIN OF JELLYFISH REVISITED Justin Moon & Jean-Bernard Caron
18:40 EDT	A REVISION OF THE MID-CAMBRIAN (SERIES 3, GUZHANGIAN; MARJUMAN) TRILOBITE GENUS ARAPAHOIA FROM THE SULLIVAN FORMATION, SOUTHERN ROCKY MOUNTAINS, ALBERTA AND BRITISH COLUMBIA, CANADA Michael B. Cuggy
18:55 EDT	CLOSING REMARKS
19:00	CONFERENCE SOCIAL

Friday October 21st

17:00 EDT	WELCOME AND OPENING REMARKS
17:10 EDT	REFLECTIONS ON THE FIRST TWENTY YEARS OF RESEARCH IN THE SILURIAN ERAMOSA LAGERSTÄTTE OF SOUTHERN ONTARIO AND WHAT LIES AHEAD Anna F. Whitaker & Marc Laflamme
17:25 EDT	UNUSUAL TAPHONOMY AND DEPOSITIONAL SETTING OF A TRICERATOPS BONEBED FROM THE FRENCHMAN FORMATION, SOUTHERN SASKATCHEWAN Jack R. Milligan & Emily L. Bamforth
17:40 EDT	POLYCOTYLID PLESIOSAUR ONTOGENY: A GEOMETRIC MORPHOMETRIC CASE STUDY FROM LATE CRETACEOUS SASKATCHEWAN Mikayla J-A. Rychel, Colin D. Sproat, & Emily l. Bamforth 1, 2

17:55 EDT	ARCTIC MOLLUSC SUCCESSIONS IN LATE QUATERNARY POSTGLACIAL DEPOSITS: A CASE STUDY FROM EUREKA SOUND, NUNAVUT Jessica S.A. McLeod & Alec E. Aitken
18:10 EDT	CLOSING REMARKS AND BREAK
18:25 EDT	PALEO DIVISION AGM

Saturday October 22nd

17:00 EDT	WELCOME AND OPENING REMARKS
17:10 EDT	A NEW SPECIMEN OF THE LATE CRETACEOUS OCTOPOD ENCHOTEUTHIS FROM THE UPPER PEMBINA MEMBER OF THE PIERRE SHALE IN SOUTHERN MANITOBA Anita-Maria Hatcher & Joseph Hatcher
17:25 EDT	NEW PALEOFLORAL SITES FROM THE UPPER CRETACEOUS WAPITI FORMATION OF ALBERTA, CANADA: IMPLICATIONS FOR UNDERSTANDING THE PALEOECOLOGY OF NORTHERN DINOSAUR COMMUNITIES Emily L. Bamforth
17:40 EDT	EXPLORING CHANGES IN A TERRESTRIAL ECOSYSTEM IN WESTERN CANADA ACROSS THE CRETACEOUS-PALEOGENE BOUNDARY Robert D. Bourque, Peter M. J. Douglas, & Hans. C. E. Larsson
17:55 EDT	DEPOSITIONAL HISTORY AND PALEOECOLOGY OF THE CALF CREEK LOCALITY (CYPRESS HILLS FORMATION) IN SOUTHWESTERN SASKATCHEWAN, CANADA Meagan M. Gilbert & Frank H. McDougall
18:10 EDT	AWARDS AND CLOSE

New Paleofloral Sites from the Upper Cretaceous Wapiti Formation of Alberta, Canada: Implications for Understanding the Paleoecology of Northern Dinosaur Communities

Emily L. Bamforth[*1, 2]

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The Late Cretaceous aged (80 – 68 Ma) Wapiti Formation of northwestern Alberta and northeastern British Columbia spans an interval of time from the early Campanian to the late Maastrichtian. The formation is divided in five units, with Units 3 and 4 being the most fossiliferous. The dinosaur communities within these terrestrial units are significant because they fill the 'Bearpaw Gap', a time interval when southern Alberta was covered by the Western Interior Sea. Notable fossil localities from the Wapiti Formation include the Pipestone Creek *Pachyrhinosaurus lakusti* bonebed (one of the densest dinosaur bonebeds in North America), and numerous dinosaur footprint and trackway sites.

While the dinosaur fossils and trackways have been well studied, the abundant fossil plant deposits from the Wapiti Formation have received comparatively less attention. Plant fossils are significant in helping to recreate the paleoenvironment of past ecosystems and can also be an invaluable proxy for paleoclimate. During the 2022 field season, three new paleofloral sites were identified and collected from the Wapiti Formation near Grande Prairie, AB. The first, the Spring Creek Paleofloral site, contained fronds and cones of *Metasequoia* and *Parataxodium* in a finally laminated fine-grained siltstone, as well as the leaves of flowering trees, cycads, and three types of Gingkoes. The second site, the DC Bonebed Paleofloral Site, contained mainly broad-leaved angiosperm fossils in a fine-grained siltstone, as well as abundant deposits of amber in the overlying coal layer. The third site, Pipestone Creek Mouth Paleofloral, contained the fossils of angiosperm trees and Gingko, in a coarse-grained sandstone.

Analysis of these new paleofloral sites will contribute to the understanding of the paleoenvironment of the Late Cretaceous paleoecosystems at relatively high latitudes. Understanding the seasonal nature of the forests and floodplains the dinosaurs lived on may help to determine inferred behaviors such as herding and migration and may provide clues as to the environmental tolerances of these animals.

Figure 1. Angiosperm leaf from the Spring Creek Paleofloral Site. (E. Bamforth, 2022)

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Exploring changes in a terrestrial ecosystem in Western Canada across the Cretaceous-Paleogene boundary

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Understanding the effects of the Cretaceous-Paleogene (K-Pg) mass extinction has been an ongoing endeavor that has employed a variety of methods and extended across many areas of research. One method that we have used on sediments from two localities in southern Saskatchewan near the town of Shaunavon looked at stable carbon and hydrogen isotopes preserved in plant wax n-alkanes (straight-chain alkanes) that can be used to infer climatic changes over the K-Pg boundary. While initial results found evidence for a sudden disturbance in the carbon cycle that quickly recovered above the K-Pg boundary, we have since found a correlation between the isotope signatures and a shift in the primary contributors to the plant wax record. Isotopic data shows that waxes below the boundary are primarily derived from aquatic plants while at the boundary there is a disturbance in the n-alkane record, followed by waxes primarily derived from terrestrial plants. Initially aquatic plants were the largest contributor to the waxes preserved in sediments before the disturbance in the n-alkane record during the K-Pg extinction event. Waxes then indicate a stabilization occurred with a larger contribution from terrestrial plants, which we interpret to be linked to the extinction of herbivorous megafauna. A more thorough examination of the contribution of n-alkanes to bulk carbon suggests that the contribution of different sources of carbon to the bulk record is not even and these can wildly affect the bulk carbon measurements if not considered. These methods showcase a novel way of studying changes in the ancient past and allow for a better understanding the effects of mass extinctions.

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A revision of the Mid-Cambrian (Series 3, Guzhangian; Marjuman) trilobite genus *Arapahoia* from the Sullivan Formation, southern Rocky Mountains, Alberta and British Columbia, Canada

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The systematics of the trilobites from the Sullivan Formation of the Southern Rockies of Canada have been briefly described by Walcott, and were then treated in more detail by Resser who was perhaps the most notorious 'splitter' in Cambrian palaeontology. Consequently, numerous species have been named but many are likely to be synonyms. Since this previous work was based on relatively few, small collections with little stratigraphic control, a great deal of systematic description and revision is still needed. One such taxa is *Arapahoia*, an abundant and species-rich genus that is poorly known from across Laurentia, but is especially species rich in the Sullivan Formation. The placement of *Arapahoia* within the Ptychopariida trilobites is unresolved, typically it is placed within the Plethopeltidae based on superficial similarities of its effaced cranidium. New collections of *Arapahoia* from the Sullivan Formation allow the species within this genus to be evaluated, new characteristics to be identified and for the first time allow the genus to be placed within a phylogenetic framework. The diversity and high rate of turnover seen in *Arapahoia* in the Sullivan Formation makes it an ideal taxa for biostratigraphy.

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Depositional History and Paleoecology of the Calf Creek Locality (Cypress Hills Formation) in southwestern Saskatchewan, Canada

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The Eocene to Miocene Cypress Hills Formation (CHF) spans 28 million years, forming the conglomeratic caprock of the Cypress Hills plateau in southwestern Saskatchewan. The formation records one of the last significant sedimentation events in the western plains of North America at a time of major global climate fluctuations. The CHF contains the only high latitude, non-polar mammalian fossil assemblage known in Canada, spanning the Late Eocene to Early Miocene (Uintan to Hemingfordian land mammal ages). The Late Eocene (Chadronian 2) Calf Creek Locality is the most prolific Paleogene multitaxonomic bonebed in Canada, with numerous field campaigns producing a robust collection of approximately 60 fossil vertebrate families. This includes various carnivores and creodonts (ie. *Hyaenodon horridus, Hesperocyon regarius,* and *Daphoenus* sp.), early horses and tapirs (*Mesohippus westoni, Mesohippus propinquus, Miohippus grandis, Colodon occidentalis*), small rhinos and deer (*Hyracodon priscidens, Leptomeryx* sp.), various "insectivores", brontotheres (*Megacerops coloradensis*, *M.* kuwagatarninus), and numerous freshwater fish, amphibians, and reptiles. Presented is a detailed sedimentologic and paleoenvironmental profile of the Calf Creek Locality, serving as a foundation for further studies that may be conducted utilizing the sites extensive collections. A paleoenvironmental reconstruction is accomplished using cenograms, a graphic plot of mammalian body size of each species in a community excluding chiroptera and carnivora. The resulting shape of the cenogram can be interpreted based on their slope and continuity, providing insight into paleoclimate and paleoenvironment. This study is part of a larger ongoing work to establish a detailed regional stratigraphic and environmental framework to unravel the notorious complexity of the CHF deposits, which host one of the most significant Cenozoic mammalian faunas in Canada.

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A New Specimen of the Late Cretaceous Octopod *Enchoteuthis* from the Upper Pembina Member of the Pierre Shale in Southern Manitoba

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A new specimen of *Enchoteuthis* was discovered from the Pembina Member of the Pierre Shale in Southern Manitoba along the banks of a tributary of the Pembina River. The in-situ specimen is an incomplete free rachis, exhibiting the characteristic selenite encrustation typical to fossils of the Pembina Member. This specimen is highly fragmented and poorly preserved. However, its stratigraphic position expands the range of the Enchoteuthids of Manitoba to the upper unit of the Pembina Member from previously being only known from the lower unit of the same. Although the gladius is absent, the preservation is poor and the remains are fragmented, the specimen clearly exhibits the characteristics of the genus *Enchoteuthis* to classify it to the genus level.

The rachis fragments are large enough to distinguish a dorsal and ventral surface. The dorsal surface is rounded while the ventral surface exhibits a ventral furrow, ventral ridges, and lateral ridges. Visible only in the large fragments is the dorsolateral furrow. Rod-like structures and poorly defined lamellae are evident in cross-section. There is evidence the rachis has a complex cross-section. These findings, combined with the in-situ stratigraphic occurrence of the specimen, are consistent with the genus *Enchoteuthis*.

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The Cambrian arthropod *Tuzoia* revisited; tackling a 100-year-old question

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The Canadian Burgess Shale site has been key to our understanding of the Cambrian (Wuliuan) period for over 100 years. Despite its long history of research, species like the bivalved arthropod *Tuzoia* have remained largely unknown. *Tuzoia* was of the most widespread genera of the era, with at least a dozen species recognized worldwide. Yet, only the carapace, eyes and potential antennae have been recovered since its first description. Here, we describe new specimens of *Tuzoia* from the Burgess Shale, showcasing exceptionally preserved soft tissues, allowing for the first comprehensive reconstruction of its anatomy, ecology and evolutionary affinities. The head bears antennae and differentiated cephalic appendages. The body is divided into a cephalothorax and a homonomous trunk bearing ca. 10 pairs of legs with heptopodomerous endopods and differentiated basipods, and two pairs of caudal rami form a tail fan. These traits suggest that *Tuzoia* was an active swimmer, but could also have also used its spinose legs to predate or handle carcasses on the seafloor. Based on its morphology and phylogenetic analysis, *Tuzoia* is interpreted as an early mandibulate arthropod, although other traits, probably convergent, are similar to the stem-euarthropod isoxyids. The position of *Tuzoia* as a mandibulate brings new questions about the early evolution of this group and its diversification in the aftermath of the Cambrian Explosion.

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Evaluating changing behaviours across the Ediacaran-Cambrian transition

Brittany A. Laing*[1,4], Luis A. Buatois[1], M. Gabriela Mángano[1], Luke C. Strotz[2], Guy M. Narbonne[1,3], & Glenn A. Brock[2,4]

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[3] Queen's University, Kingston, Ontario, Canada
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Just as physiologic adaptations can offer a species a selective advantage in their environment, so can behavioural adaptations. The elucidation of these adaptations and the evolutionary basis driving them is pivotal to our understanding of life on earth. As the fossil evidence of organism behaviour, trace fossils are a key data source in the reconstruction of behavioural adaptations through time. However, systems for characterizing behavioural adaptations (i.e. "complexity") as shown through trace fossils vary among researchers. This variability hampers our ability to compare behaviour through geologic time. A potential solution might lie in the theoretical framework of the Movement Ecology Paradigm ("MEP"). MEP describes the movement path of an organism as the product of four factors: (1) internal state (2) navigation capacity, (3) motion capacity, and (4) external factors. As the expression of these factors change, so will the resulting optimal movement path. We hypothesize that the application of MEP to horizontal foraging paths in the Ediacaran-Cambrian transition may offer insight into behavioural changes at this moment in time. Our proposal focuses on the analysis of horizontal foraging trace fossils where it is assumed that the tracemakers motivation to move (i.e. internal state) is finding food. Simulations and studies of similar paths in extant organisms have examined the efficacy (or optimality) of certain search strategies as the resource distribution style, mortality risk, energy reserves, and perceptual range of the foraging organism varies. They suggest that deterministic strategies may be more optimal than stochastic ones under conditions with low mortality risks and high energy reserves. In turn, when perceptual range is low and information on foraging targets decreases, stochastic strategies have been shown to be more effective than deterministic ones. Deterministic and stochastic search strategies are distinguishable via the collection of key statistics (e.g. mean location, mean squared displacement, mean dispersal distance, and variance). Our study seeks to apply these statistical analyses to the trace fossil record in the Ediacaran-Cambrian transition to quantitatively evaluate changes in behaviour at this pivotal moment in geologic history.

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Arctic mollusc successions in Late Quaternary postglacial deposits: A case study from Eureka Sound, Nunavut

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This case study uses mollusc ecology to assess environmental change during glacial retreat following the Last Glacial Maximum (LGM) ~25000 years ago. The glacier that covered the Canadian Arctic Archipelago during the Pleistocene began receding 10000-8000 years ago and caused shifts in oceanographic properties (salinity, temperature) and sediment load. These changes influenced benthic community composition, giving rise to several stages of repopulation as deglaciation continued. This study focused on benthic macrofauna from well-preserved mid-to-late Holocene postglacial deposits of Eureka Sound, Nunavut. Diversity and relative abundance of the most commonly preserved shells - infaunal bivalves (clams, cockles) and other epifaunal molluscs (mussels, gastropods) - were evaluated and eventually categorized into assemblages of similar living styles. These mollusc assemblages can be organized into ecological successions and integrated with previous ecological and environmental studies. Arctic benthos is extremely sensitive to environmental changes; therefore, ranges of paleoenvironmental conditions can be achieved by considering the known tolerances of modern mollusc species. The ultimate goal is to continue integrating paleoecological studies with biostratigraphic data and radiocarbon dating, which will help resolve a timeline of the Late Quaternary deglaciation and subsequent Arctic benthic marine repopulation. Furthermore, the results of Late Quaternary studies contribute to the understanding of modern benthic communities during a rapidly changing Arctic.

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Unusual taphonomy and depositional setting of a *Triceratops* bonebed from the Frenchman Formation, southern Saskatchewan

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Ceratopsid bonebeds, particularly those of centrosaurines from Alberta such as *Pachyrhinosaurus lakustai*, *Centrosaurus apertus*, and *Styracosaurus albertensis* have provided insight into gregarious behaviour and habitat preference. These inferences are based on large sample sizes across all ontogenetic stages and the lithology of these assemblages. Chasmosaurine bonebeds are rarer and have led to assumptions that they preferred different environments than centrosaurines. Bonebeds for the chasmosaurine Triceratops have been previously reported in low energy depositional settings from the Hell Creek Formation of Montana and Wyoming, yielding interesting paleobiological and taphonomic implications regarding post-depositional processes and social structure. Herein we provide an update on the ongoing excavation of a Triceratops bonebed from the Frenchman Formation in the East Block of Grasslands National Park in southern Saskatchewan. The sedimentology of the bonebed is a medium-grained sandstone with trough crossbedding, interpreted as a high energy river channel environment. The current minimum number of individuals of Triceratops in this bonebed is two, comprising a large adult and a juvenile. Initial indications seem to suggest the larger Triceratops is one individual that is semi articulated, including a left hind limb, vertebrae, and pelvic elements. The juvenile is represented by a right pubis. Furthermore, the bonebed contains a single crocodile caudal vertebra and an articulated partial carapace from a baenid turtle cf. *Neurankylus* sp.. The presence of both a semi articulated adult Triceratops along with a juvenile within a river channel sandstone indicates a low level of transport and could provide evidence of parental behaviour in Triceratops.

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A stem group medusoid from the Cambrian Burgess Shale and the origin of jellyfish revisited

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Medusozoan cnidarians represent a group of morphologically diverse and ecologically important metazoans that are ubiquitous in our modern oceans and freshwater ecosystems. The earliest purported medusozoan fossils from Late Ediacaran deposits remain controversial, while putative medusozoan macrofossils from early Palaeozoic deposits are primarily based on traces or imprints, with little medusozoan synapmorphies preserved. Here we describe unambiguous body fossils of a medusoid jellyfish based on over 100 exceptionally well-preserved specimens from the middle (Wuliuan) Cambrian Burgess Shale (Raymond Quarry, British Columbia, Canada). This medusoid possesses characters known from several extant medusozoan groups and the largest specimens reach ca. 20 cm in height. The umbrella is tetraradial and resembles modern cubozoans. Over 90 tentacles encircle the entire ventral margin of the bell, reaching the maximum length of one-fifth the height of the umbrella. Internal structures such as a stomach cavity, a manubrium, up to four putative gonads, and a marginal canal are also preserved. We interpret this Burgess Shale medusoid as a stem group of the Acraspeda, a monophyletic group containing the Staurozoa, Scyphozoa, and Cubozoa. The overall morphology of this medusoid suggests that it may have been an efficient pelagic predator in the Burgess Shale palaeocommunity. Clusters of well-preserved specimens suggest mass mortality events, with many specimens living along the benthos, which might indicate a nektobenthic lifestyle. This Burgess Shale medusoid provides bona fide evidence of the evolution of swimming medusozoa by the Cambrian Period, and further supports later divergence times of major medusozoan clades.

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Ontogeny and moulting in the Cambrian radiodont *Stanleycaris*

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Radiodonta is a clade of stem euarthropods of central importance to our understanding of the evolution of this phylum. Radiodonts are iconic in part for their size, with many species representing some of the largest animals from the Cambrian Period, however very little is known about their ontogeny due to a dearth of smaller specimens. Here we present an analysis of ontogeny in the radiodont *Stanleycaris* based on 268 specimens from the mid-Cambrian Burgess Shale. Ranging in size from 10 to 83 mm, this collection constitutes the most complete radiodont ontogenetic series known. Segment number increases with size from 12 up to 17, after which growth continues without segment addition. The presence of this hemianamorphic developmental mode in a radiodont is consistent with the hypothesis that this mode is ancestral for arthropods. As size increases, the H-element and neck become relatively broader, while the trunk and flaps become longer. The eyes of *Stanleycaris* exhibit negative allometry, indicating precocious development and thus an important role for visual processing in juveniles. In addition to reconstructing ontogenetic changes in morphology, we find evidence for moulting. Using a novel discrete character morphospace approach to evaluate taphonomic variation between specimens, we show that putative carcasses and exuviae can be quantitatively distinguished. Based on patterns of presence and association of body elements we propose that *Stanleycaris*, and probably other radiodonts, moulted via a suture near the anterior of the trunk. Similar anterior moulting strategies are shared with some Cambrian euarthropods and therefore likely represent the ancestral condition.

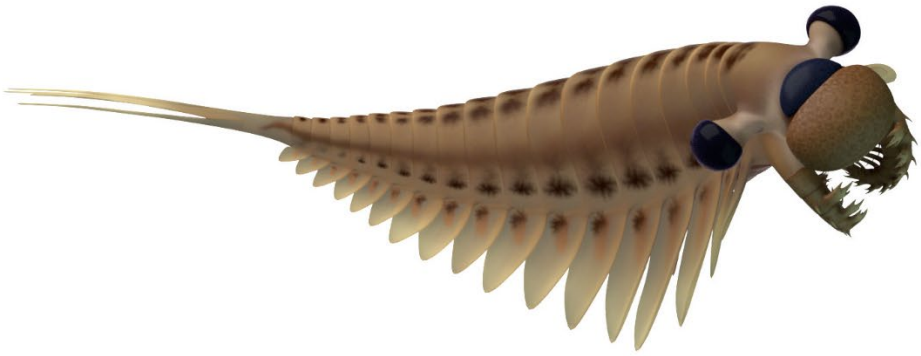

Figure 1. Artistic reconstruction of *Stanleycaris hirpex* by Sabrina Cappelli © Royal Ontario Museum

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Growth patterns in a new gregarious polychaete worm from the Cambrian Burgess Shale

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The roots of the Kingdom Annelida can be traced to the Cambrian explosion thanks to a limited number of well-preserved specimens from Cambrian Burgess Shale-type Lagerstätten. Here we introduce a new fossil polychaete from a sub-locality of the Burgess Shale along Tokumm Creek in Kootenay National Park, British Columbia. Known from hundreds of specimens, this new species is about 3–15 mm long and has 8–10 body segments with biramous parapodia and long capillary chaetae. The sixth to ninth segments uniquely bear up to five extra-long dorsal chaetae per bundle.

This new species was recovered as a stem-group annelid in our Bayesian phylogenetic inference, in a polytomy with other Cambrian polychaetes. It is reconstructed as an epibenthic deposit feeder that used its neurochaetae mainly for locomoting on the seafloor. The notochaetae, including the longer posterior ones, are suggested to be used for protection from predators. This new polychaete is often found in densely packed clusters of up to 30 specimens, which we interpret to result from behaviour rather than taphonomy.

The number of segments in this new polychaete is strikingly reduced. The range of sizes of specimens recovered with ten segments suggests that the addition of segments terminates during juvenile or early adult stages, which is uncommon in modern polychaetes. This study provides the oldest example of preserved growth patterns in Annelida and suggests that growth in the ancestral polychaete may have relied less on segmental additions and more on continuous somatic growth.

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Polycotylid plesiosaur ontogeny: A geometric morphometric case study from Late Cretaceous Saskatchewan

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It is rarer to find juvenile plesiosaurs than adult specimens in the fossil record, likely due to their smaller size and more fragile skeleton. It is especially rare to find a large number of juveniles at a single fossil locality. Isolated propodial elements of the fore- and hindlimbs of the short-necked polycotylid plesiosaurs were found in abundance at the Herschel Marine Bonebed (HMB), at varying stages of ontogenetic development. The HMB is an exceptional multi-taxic site with interesting lithology, containing micro- and macro-vertebrate, invertebrate and trace fossils dating to the Campanian (Upper Cretaceous, ~76-70 Ma). Qualitative and quantitative analyses of the propodials were conducted to study the differences between juvenile specimens and adults, and to interpret osteological ontogenetic changes. Principal Component Analysis (PCA) of linear measurements and outline data demonstrates significant differences in size and shape of propodials in adult and juvenile specimens. Reduced major axis regression revealed a linear growth sequence. An outline-based approach to geometric morphometric analysis, with thin-plate spline deformations and relative warps, visually represents the change in morphology resulting from ontogenesis. The propodials increase in size, and change shape at both the proximal and distal articular ends, especially the latter as it pertains to articulation with epipodial elements of the paddle. The results of this study quantify the variation in morphology of the Late Cretaceous polycotylid plesiosaurs found at the HMB, with implications furthering our understanding of propodial ontogeny, juvenile ecology, and of the morphological and functional differences between adult and juvenile plesiosaurs.

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Reflections on the first twenty years of research in the Silurian Eramosa Lagerstätte of southern Ontario and what lies ahead

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The Silurian Period represents the first major terrestrial colonization by multi-cellular life, and evidence of this transition is preserved in shallow-marine environments. The Silurian contains several non-concretionary Lagerstätten (sites of exceptional preservation), however these preservational settings are unusual, as "traditional" Paleozoic Lagerstätten (e.g., Burgess Shale-type) are fine-grained siliclastic deposits, while several North American Silurian Lagerstätten are shallow water, carbonate deposits. The middle Silurian (Wenlock Epoch; Sheinwoodian Age) Eramosa Formation (Ontario, Canada) was first formally published as a Konservat-Lagerstätte in 2002, and the two decades following have seen extraordinary collections from the formation. The diverse biota contains both biomineralized and soft-bodied taxa, including chordates (articulated conodonts, tolypelepid heterostracan and corvaspid fish), arthropods (phyllocarids, ostracode crustaceans, xiphosuran chelicerates, eurypterids, scorpions, trilobites), annelids (polychaetes, annulated vermiforms), echinoderms (lepidocentrid echinoids, ophiuroids, crinoids), demosponges, conularid cnidarians, algae, articulate and inarticulate brachiopods, bivalves, gastropods, and cephalopods. While the systematics of several taxa have been resolved, there are dozens more awaiting attention. Advancements in the taphonomy and preservation of the biota are analyzed through scanning electron microscopy (SEM) and integrated energy dispersive X-ray spectrometry (EDS), and opportunities for future research avenues and comparison to other Lagerstätten are discussed.

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CANADIAN PALEONTOLOGY CONFERENCE AND ITS PREDECESSORS

(*a.k.a.* Biostratigraphy Seminar, Eastern Canadian Biostratigraphy Conference, Canadian Paleontology & Biostratigraphy Seminar)

Y / M / D	TYPE	VENUE	CITY	No.	CONVENOR	THEME/MEETING
1965/4/2	BS	McGill Univ.	Montreal	46	C.W. Stearn	Paleoecology
1965/11/10	BS	Queen's Univ.	Kingston	?	J.L. Usher, R.G. Greggs	Biostratigraphy
1967/3/14	BS	Ottawa Univ.	Ottawa	?	?	
1968/3/21	BS	Western	London	?	A.C.Lenz, C.G. Winder	
1968/11/29	BS	Univ. Montreal	Montreal	?	P.J. Lesperance, B.L.L. Mamet	
1969/10/31	BS	Carleton Univ.	Ottawa	?	K. Hooper	
1970/10/9-10	BS	Laurentian Univ.	Sudbury	?	P. Copper	Precambrian Fossils
1971/10/8-9	BS	Memorial Univ.	St. John's	?	M.M. Anderson	Cambrian of Newfoundland
1973/9/29-30	BS	Bruce Peninsula	Field trip	?	B.A. Liberty	
1974/12/6-7	BS	McGill Univ.	Montreal	?	C.W. Stearn	Evolution and Paleontology
1975/11/21-22	BS	R.O.M.	Toronto	?	P.H. von Bitter, G. Norris	
1976/10/22-23	ECBC	Univ. Windsor	Windsor	125	R.K. Jull	
1977/10/21-22	ECBC	Univ. Waterloo	Waterloo	100	C.R. Barnes	
1978/9/20-25	ECBC	Memorial Univ.	St. John's	?	Skevington, James, Stevens	
1979/9/22-26	CPBS	Univ. Alberta	Edmonton	?	B.D.E. Chatterton, B. Jones	
1980/9/27-30	CPBS	Univ. N.B.	Fredericton	40	R.K. Pickerill	
1981/9/26-29	CPBS	Manitoulin Isd.	Little Current	52	P.G. Telford	Field Meeting
1982/9/18-22	CPBS	Univ. Calgary	Calgary	28	R.L. Hall	
1983/9/23-25	CPBS	Univ. Toronto	Toronto	80	R. Ludvigsen	
1984/9/28-30	CPBS	Univ. Ottawa	Ottawa	120	G.S. Nowlan	
1985/9/27-29	CPBS	Laval Univ.	Quebec	80	J. Riva	
1986/9/26-27	CPBS	N.Y. Geol. Surv.	Albany	105	E. Landing	N.Y. State Geol. Survey 150th Anniv.
1987/9/26-27	CPBS	Univ. W. Ontario	London	60	A.C. Lenz	
1988/9/23-25	CPBS	Univ. Manitoba	Winnipeg	33	R.J. Elias, E. Leith, G. Lammers	
1989/9/29-1	CPBS	AGC-BIO	Dartmouth	40	G.L. Williams, R. Fensome	
1990/9/28-1	CPBS	Queen's Univ.	Kingston	103	G.M. Narbonne, N.P. James	Precambrian-Cambrian Transition
1991/8/18-27	CPC-	Univ. Brit.	Vancouver	105	P.L. Smith, M.J. Orchard	Pander Society Joint

	1	Col.				Meeting
1992/9/25-27	CPC-II	GSC/CMN	Ottawa	105	A.D. McCracken	Earth's Historians
1993/10/1-3	CPC-III	Ont. Geo. Survey	Sudbury	110	P. Copper	CSRG Joint Meeting
1994/9/23-25	CPC-IV	Brock Univ.	St. Catharines	60	S.R. Westrop	
1995/9/29-10/2	CPC-V	Royal Tyrrell Museum	Drumheller	91	P. Johnston	Intl. Symp. Paleobiology & Evol.
1996/9/28-30	CPC-VI	Memorial Univ.	Corner Brook	30	S.H. Williams, E. Burden	Economic & Applied Paleontology
1997/9/27-29	CPC-VII	Univ. Sask	Saskatoon	40	Basinger, Kotyk, McIver & Pratt	
1998/10/22-25	CPC-VIII	Roy. Ont. Mus.	Collingwood	45	D.M. Rudkin, J. Waddington	In Memory of Thomas E. Bolton
1999/8/20-21	CPC-IX	Univ. Calgary	Calgary	100	A.D. McCracken	Intl. Congr. Carb. & Perm.; Pander Soc.
2000/8/18-20	CPC-X	St. F. Xavier U.	Antigonish	35	M.J. Melchin	
2001/9/22-24	CPC-2001	Univ. W. Ontario	London	60	Jin, Tsujita, Lenz & Caldwell	
2002/9/28-30	CPC-2002	Geol. Surv. Cda.	Ottawa	52	B.J. Dougherty	National Museum & GSC Collections
2003/9/19-24	CPC-2003	Univ. Alberta	Edmonton	107	B.D.E. Chatterton, M.W. Caldwell	
2004/9/23-26	CPC-2004	H.M.S.C	St. Andrews	47	J.B. Caron, M. Best	Bay Fundy: Modern/Ancient Settings
2005/8/24-30	CPC-2005	Exploration Plc.	Prince George		R. Campbell	6th BC Paleontological Symposium
2006/10/13-16	CPC-2006	Redpath Museum	Montreal	60	V. Millien, M. Best, B. Carroll, M. Chartier, M. Cournoyer, M. Dubreuil, H. Hoffman, H. Larsson	Musée de Paleontologie et de l'Évolution and McGill University
2007/9/20	CPC-2007	Memorial Univ.	St. John's	50	E.T. Burden, E.N. Edinger, D. McIlroy	
2008/9/19-21	CPC-2008	The Manitoba Museum	Winnipeg	60	G.A. Young, R.J. Elias, A. Janzic	Field Trip: Upper Ordovician Rocks and Fossils, Southern Manitoba
2009/9/10-13	CPC-2009	Laurentian Univ. Ont. Geo. Survey	Sudbury	27	F.R. Brunton, E. Turner, D. Armstrong	Field Trip: Paleozoic of Manitoulin Island, Bruce Peninsula
2010/09-29 – 2010/10/02	CPC-2010	Geol. Surv. Cda.	Dartmouth		R. Fensome, G. Williams	Joint with AASP
2011/8/19-22	CPC-2011	Univ. Brit. Col.	Vancouver		P.L. Smith, J.W. Haggart	E.T. Tozer Triassic Special Session
2012/9/21-23	CPC-2012	UofT-ROM	Toronto	>40	L. O'Brien, C. Brown, K. Brink	ROM collections theme
2013/8-29 to 9-1	CPC-2013	UofA Vertebrate Paleo lab	Edmonton	>50	M. Vavrek, K. Bramble, V. Arbour, G. Funston, A. Torices, M.I Caldwell	Sternberg 50th Anniversary of Vertebrate Paleontology Lab at UofA

2014/8-28-31	CPC-2014	Redpath - McGill	Montreal	60	H. Larsen, C. Cameron, M. Chartier, M. Cournoyer	Joint Invertebrate / Vertebrate Paleontology Conference
2015		No CPC held				
2016/8/26-28	CPC-2016	Cape Breton	Sydney	37	Jason Loxton, Melissa Grey	Hist./Geology Cabot Trail
2017/9/30-2017/10/1	CPC-2017	Geol. Surv. Cda.	Calgary	49	R. MacNaughton, L. Tingley, S. Gouwy, K. Bell, K. Dewing, B. Richards, B. Medioli, C. Morgan, C. Gross, P. Johnston	
2018/9/21-24	CPC-2018	Univ of Sask	Saskatoon	40	M. Cuggy, G. Mangano	
2019/8/23-25	CPC-2019	UTM	Mississauga	50	M. Laflamme	
2020	-	-	-	-	-	-
2021	-	-	-	-	-	-
2022/10/20-21	CPC-2022	Online	-	-	Kimberley Bell, Emily Bamforth, Meagan Gilbert, Brittany Laing	-

Note: There was no Biostrat Seminar in 1972 because it conflicted with International Geological Congress in Montreal

The Bolton Award

The Paleontology Division of the Geological Association of Canada gives an award to acknowledge excellence in paleontological research by a student through his or her paper presentation at the Canadian Paleontology Conference. Beginning in 1998, the award has been named in honour of Tom Bolton. The first of the Thomas E. Bolton Awards was presented at the Eighth Canadian Paleontology Conference in Collingwood, Ontario.

Past Recipients of the Bolton Award

1998 Christopher Rancourt (University of Toronto) A shallow-water versus deep-water origin for the Collingwood Member of the Lindsay Formation

1999 Paul E. McNeil (University of Calgary) Late Pleistocene fauna from the St. Mary Reservoir, southwestern Alberta

2000 Jennifer Russel-Houston (Dalhousie University) Graptoloid concentration beds from the Cape Phillips Formation, Nunavut, Canada

2001 Matthew Clapham (Queen's University) Community ecology of Ediacaran fossil assemblages at Mistaken Point, Newfoundland

2002 Catherine Boisvert (Redpath Museum, McGill University) Vertebral development and its evolution in modern salamanders

2003 Louise Longridge (University of British Columbia) The Jurassic ammonite *Badouxia* from the Taseko Lakes map area, British Columbia

2004 Tim Fedak (Dalhousie University) New Early Jurassic dinosaurs from Nova Scotia

2005 Stephan Little (University of Alberta) A developmental study of Middle Eocene Princeton Chert: aquatic adaptation of *Decodon allenbyensis* and a new type of bark

2006 Nadia Fröbish (McGill University) Metamorphosis and neoteny – alternative pathways in the life history of branchiosaurids (Temnospondyli)

2007 Emily Bamforth (Queen's University) Network rangids: an early experiment in multicellular life from the Ediacaran of Newfoundland

2008 Pengfei Chen (University of Western Ontario) Functional morphology and evolution of Late Ordovician – Early Devonian orthide brachiopod *Dicoelosia*

2009 Martin Smith (Dept. of Palaeobiology, Royal Ontario Museum & University of Toronto) A redescription of the Burgess Shale animal *Nectocaris*

2010 Matt Stimson (Saint Mary's University) Evidence of fossil horseshoe crabs from Joggins, Nova Scotia: paleoichnology and paleoenvironmental implications

Emily Bamforth (Redpath Museum, McGill University) Ecosystems in stone: determining terrestrial biodiversity drivers in the latest Cretaceous of central North America

2011 Andrew Caruthers (Dept. of Earth & Ocean Sciences, University of British Columbia) The Early Toarcian marine extinction in western North America

2012 Aaron LeBlanc (Dept. of Ecology and Evolutionary Biology, University of Toronto) Histological examination of the dental replacement pattern in the Early Permian reptile *Captorhinus aguti*

2013 Karma Nanglu (Dept. of Ecology and Evolutionary Biology, University of Toronto & Dept. of Palaeobiology, Royal Ontario Museum) Reconstructing the early evolution of enteropneusts in the light of new fossil finds from the Burgess Shale and modern decay experiments.

2014 Trina Du (Redpath Museum, McGill University) Simulated and observed patterns of theropod cranial disparity and chronomorphic evolution reveals lineage-specific shape novelties.

2016 Greer Strothers (Sheridan College) Trends, tropes and speculation in paleoart

2017 Brittany Cheung (Dept. of Ecology and Evolutionary Biology, University of Toronto) Redescription of the Middle Cambrian *Amiskwia sagittiformis* as a stem lophotrochozoan

2018 Brittany Laing (Dept. of Geological Sciences, University of Saskatchewan) The Fortunian fuse for the CambrianExplosion: An ichnologic ecospace analysis of the Treptichnus pedum ichnofossil assemblage zone at the Ediacaran-Cambrian GSSP

2019 Joseph Moysiuk (Dept. of Ecology and Evolutionary Biology, University of Toronto) A new hurdiid radiodont from the Burgess Shale evinces the exploitation of Cambrian infaunal food sources

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Past Recipients of Billings Medal

Year	Recipient
2017	S. George Pemberton
2015	Paul Smith
2013	Godfrey Nowlan
2011	Graham L. Williams
2009	Guy Narbonne
2007	Brian Chatterton
2005	Christopher R. Barnes
2003	Brian Norford
2001	P. Copper
1999	R.C. Fox
1997	T. Bolton
1995	G.E.G. Westermann
1993	A.C. Lenz
1991	R.L. Carroll
1989	E.T.Tozer
1987	C.S. Stearn
1984	L.S. Russell
1980	H.J. Hofmann
1978	G. Jeletzky

Past Recipients of the Pikaia Award

The Pikaia Award is named after Pikaia, an early cephalochordate known from the Burgess Shale. The Pikaia Award is awarded biennially in even-numbered years by the Paleontology Division. It is awarded in recognition of a recent contribution to research on any aspect of Canadian paleontology, or by a Canadian to paleontology that is judged to constitute an outstanding accomplishment in the field. The outstanding accomplishment may be a single paper or monograph or a series of closely related papers. The award will normally go to an individual who is no more than 15 years past their last degree.

Year	Recipient
2018	Ryan McKellar
2016	Marc Laflamme
2014	Not awarded
2012	Howard Falcon-Lang
2010	Jean-Bernard Caron
2008	Michael W. Caldwell
2006	Nick Butterfield
2005	Not awarded
2004	Jonathan Adrain
2003	Jisuo Jin

Recipient of the Avocational Paleontologist Award

Great discoveries are made, and great things are done, by people who have no formal training in paleontology but who are passionate about ancient life, fossils, and the preservation of fossil sites. Whether it is donating a fossil collection to an institution, protecting and/or maintaining a site of paleontological importance, volunteering in fossil prep or outreach, or fundraising to build a fossil museum, avocational palaeontologists play a huge role in the Canadian palaeontology community.

The PD Division has created a new award to recognizes the role of avocational paleontology in Canada. This new, yet unnamed, award will recognize and celebrate the contributions of non-professional paleontologists to the field, helping to send the message that avocational palaeologists of are all ages are important and valued. The awards will be offered in a three-year cycle, excepting the Bolton Award which will be awarded annually at CPC. This year's inaugural recipient for 2022 is **Charles Helm** who's work at Tumbler Ridge has helped advance our paleontologic understanding of the region.

Charles Helm, known as "Dr. Dino" by locals of Tumbler Ridge, British Columbia, is a recently retired medical doctor whose passion for paleontology spans three decades. He is deserving of the Avocational Palaeontologist Award for making significant advances in paleontology and for his dedication, contributions, and ongoing inspiration within the community and the Tumbler Ridge Global Geopark.

Charles is enthusiastic, passionate, and thoughtful in everything he does. His considerable efforts over the years have increased understanding of the scientific, heritage, and educational values of fossils by the public and industry. Discoveries by Charles include world-class crocodile and dinosaur tracks, fish, marine reptile, plant, and invertebrate fossils. His recent contributions to research on giant crocodile swim tracks are featured in the Museum gallery. Charles has been involved in the research of diverse dinosaur trackways that fills the gap in knowledge where dinosaur bones are scarce. He has also been instrumental in raising awareness of the importance of fossil resources in B.C., through public education and outreach. He is engaged with paleontological education, such as leading nighttime lantern tours to view the dinosaur trackways along creekbeds.

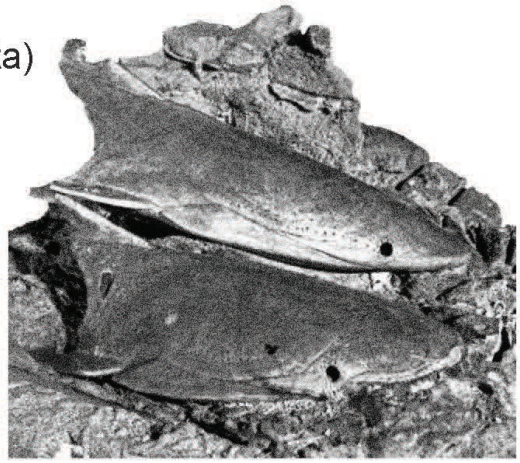
Charles played a key part in getting the UNESCO designation for the Tumbler Ridge Global Geopark in 2014. Charles has been involved in sustaining the town's economy related to tourism in the Geopark, where he designs, builds, and maintains trails.

Dr. Helm is a founding member of the Tumbler Ridge Museum, an organization committed to researching, preserving and displaying fossils. The Museum houses remarkable fossil discoveries that are a major tourist draw and works closely with the Geopark. The Museum celebrated its twentieth anniversary this year and has survived the ups and downs of the local economy tied to coal mining.

Charles' life-long contribution to science and promotion and preservation of fossils is very well deserving of this award.

PALAEONTOGRAPHICA CANADIANA No. 40

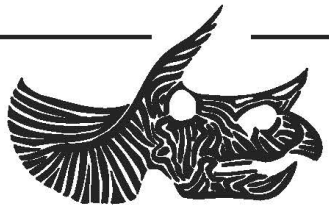
Silurian and Devonian Heterostraci (Vertebrata) of the Canadian Arctic Archipelago



R. Thorsteinsson
and
D.K. Elliott

2022

CANADIAN SOCIETY OF PETROLEUM GEOLOGISTS
GEOLOGICAL ASSOCIATION OF CANADA



PALAEONTOGRAPHICA CANADIANA

No. 24 Bashforth, A.R. 2005. Upper Carboniferous (Bolsovian) macroflora from the Barachois Group, Bay St. George Basin southwestern Newfoundland, Canada. 123 pp., 20 pls. ISBN 1-897095-07-4
No. 25 Chatterton, B., Fortey, R., Brett, K., Gibb, S., and McKellar, R. 2006. Trilobites from the upper Lower to Middle Devonian Timrhanrhart Formation, Jbel Gara el Zguilma, southern Morocco. 177 pp., 54 pls. ISBN 1-897095-15-5 [Out of Print]
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