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FOSSIL SECTION

The FOSSILETTER

VOL. 41 Number 1 October 2023

October Meeting

The October section meeting is on Tuesday, October 3, at 7:00 PM. **Note the earlier than usual time.** This meeting will be at the Community Meeting Room at the NEQALS (North East Quadrant Advanced Life Support) building at 1030 Jackson Rd, Webster, 14580. From Route 104, take Holt Road exit south to end, turn left on Ridge Road, take first right at light onto Jackson Road, look for NEQALS on the left. This hybrid meeting will also be broadcast on Zoom. Details on how to login in are in the accompanying email.

Our speaker is Dr. Thomas Hegna, Associate Professor in the Department of Geology and Environmental Sciences at SUNY Fredonia.

Dr. Thomas Hegna, in the field

Dr. Hegna will speak on "*Tales Told by Trilobites*." He has sent the following: "Trilobites are one of the most charismatic representatives of the Paleozoic. They lived for over 250 million years all over the globe. But, can something dead for so long teach us anything meaningful and relevant today? In this talk, I will argue a resounding "yes." Trilobites are a part of the great experiment of life that has already been completed. After a brief introduction, I will highlight ways, all from current research, that trilobites have taught us new things about diversity, growth, fossilization, and yes, even technology. The studies I will relate contain anecdotes both from my own research, and the research of other paleontologists over the last two decades."

Dr. Hegna has his M.S. from the University of Iowa (2004), with his thesis being, "Systematics of late Cambrian (Sunwaptian) trilobites from the St. Charles Formation, southeastern Idaho." Although he has written several more papers on trilobites, his interests are more wide-ranging, principally extending to crustaceans of all kinds. He is a leading authority on branchipod crustaceans and a member of the Crustacean Society. Wikipeidea notes that, "Branchiopoda is a class of crustaceans. It comprises fairy shrimp, clam shrimp, Diplostraca (or Cladocera), Notostraca and the Devonian *Lepidocaris*. They are mostly small, freshwater animals that feed on plankton and detritus." Many of you may be familiar with brine shrimp, also known as 'Sea Monkeys' which were marketed in the 1960s and 70s to kids to raise from eggs.

He has his Ph.D. from Yale University (2006), with his thesis "Phylogeny and Fossil Record of Branchiopod Crustaceans: An Integrative Approach." He taught at Western Illinois University (2011 – 2019), earning the 2016 WIU Provost's Excellence Award for Teaching with Technology. He now teaches at SUNY Fredonia since 2019, and studies the fossil record of both trilobites and early crustaceans. In the spring of 2022, he was awarded the William T. and Charlotte N. Hagen Young Scholar/Artist award at SUNY Fredonia for his outstanding record of scholarship. He has over 40 published peer-reviewed papers and his work has been cited 882 times.

President's Report by Dan Krisher

The Section did not hold a section meeting in July, August, or September. We did have several field trips.

The Section's June meeting was on June 6th and featured our annual picnic at the Farash Center with the Mineral Section, with about a dozen Fossil and Mineral members attending. The picnic marked the end of the voting period for Section officers. The meeting also featured a review of the Year in Astronomy by Fossil Section and Astronomy Section member Dave Bishop.

Election Results of June 2023

A total of 14 votes were received, and the election results were tallied with the slate of nominated candidates winning unanimously.
President: *Daniel Krisher*
Vice President: *Michael Grenier*
Secretary: *Daniel Krisher*
Treasurer: *John Handley*
Director 3-year term*: Melanie Martin*
Director 2-year term: *Open*
Positions begin immediately.
Director whose term has not expired is Fred Haynes (2025).

We had a busy summer with a number of outreach events. In early June, two Section members worked as experts at the annual 'Dig with the Experts' at the Penn Dixie Fossil Park. The Section participated in the annual ADK Expo at Mendon Ponds Park on June 10th. The event was well attended, and the 3 participating members were kept quite busy. On June 22, the Section participated in an outreach event at the Burroughs Audubon Nature Club.

On July 30 through August 1, several members participated in the International Commission on Stratigraphy's Subcommission for Devonian Stratigraphy meeting which was held at SUNY Geneseo. This was an international meeting that brought stratigraphers and paleontologists from around the world together to share and discuss the latest findings in Devonian stratigraphy. Aside from participating in the talks and field trips the Section also presented 2 posters as well as a large fossil display.

On August 12 and 13, members of the Section attended the 2-day annual symposium at the Paleontological Research Institute in Ithaca where George McIntosh delivered a talk on Devonian crinoids and Dan Krisher spoke on the Paleozoic corals of New York. George also made this presentation at the Devonian Stratigraphy meeting and will present it at the April 2, 2024 Fossil Section meeting.

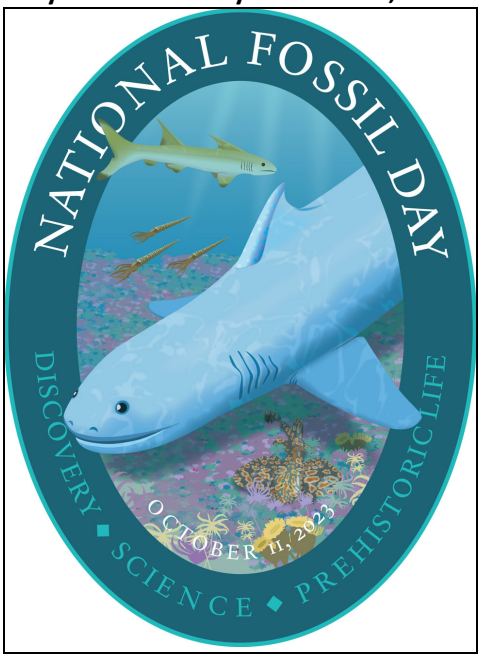
We conducted several field trips during the warm weather, but others had to be cancelled due to weather or illness. On 5/27 the Section held a field trip to road cuts near Waverly, New York and Almond, New York to collect in Upper Devonian sandstones and siltstones. Two Section members attended and spent about 5 hours collecting a variety of brachiopods, bivalves, corals, hydrozoa, and sponges. On 7/8/23 the Section visited a couple of road cuts on route 20 near Richfield Springs which expose the Onondaga Formation. The road cut site near Pompey Center was then visited on the return trip. Two members attended.

On 7/22/23 the Section was scheduled to visit the Jaycox Run site located between Geneseo and Avon but unfortunately, due to an injury, the trip was postponed. This field trip will be rescheduled.

The Section will hold its first meeting for the 2023-2024 session on October 3rd. At least two Section members will be attending the annual Geological Society of America meeting in Pittsburg and at least one member will be attending the annual Society for Vertebrate Paleontology in Cincinnati in mid-October.

National Fossil Day

We celebrate the fourteenth annual National Fossil Day on Wednesday October 11, 2023.



The following material from the National Park Service site is only a small part of the information on the website. You can learn more at: **www.nps.gov/subjects/fossilday/index.htm**.

The 2023 National Fossil Day Logo is inspired by the Mississippian shark fossils and other fossils inside Mammoth Cave in the National Park there.

The cave-forming rocks represent the Mississippian period (359-323 mya) and include, from oldest to youngest the St. Louis Formation, Ste. Genevieve Formation, Girkin Formation, and Big Clifty Sandstone. Outside of the Mammoth Cave system, Mammoth Cave National Park also includes rocks representing the very end of the Mississippian period and the beginning of the Pennsylvanian period. The combination of the Mississippian and Pennsylvanian geologic periods is also referred to as the Carboniferous period, so named from the massive coal beds found worldwide dating to these geologic horizons.

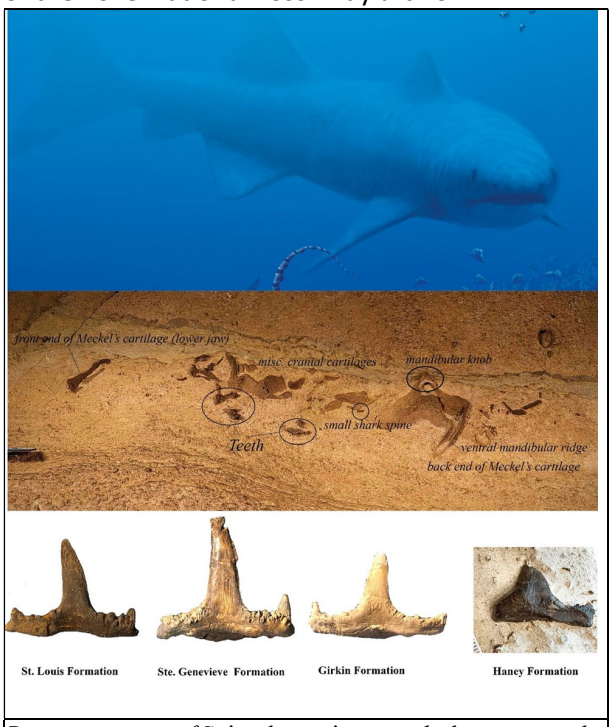
Until recently, the most recognized paleontological highlights from Mammoth Cave were somewhat limited to fossils of Pleistocene animals. These fossils include evidence of a wide variety of bats (such as the extinct Stock's vampire bat), saber-toothed cat, short-face bear, peccary, tapir, and mastodon. Early cave explorers did note the amazingly preserved Mississippian invertebrates which include a diversity of articulated crinoids, brachiopods, blastoids, horn corals, and nautiloid cephalopods. However, it is the recent research into the Mississippian fossil shark record of Mammoth Cave that inspired the 2023 National Fossil Day artwork. In a short period of time, paleontologists have identified more than 100 species of ancient cartilaginous fishes (from the class Chondrichthyes) from nearly every geologic horizon that forms Mammoth Cave, among them one of the largest sharks to have lived during the Mississippian period as well as a number of new shark species found only at Mammoth Cave National Park!

The unique cave environment within Mammoth Cave allows for extraordinary preservation of fossils of ancient sharks. The over 100 species identified so far from Mammoth Cave have been found in four of the five geologic horizons that make up the cave systems within the park. The older, Middle Mississippian St. Louis and Ste. Genevieve Formations presently have the greatest diversity of sharks, which may in part be due to these rocks representing deeper marine waters just prior to the formation of Pangea. By the Late Mississippian, represented by the Girkin and Haney Formations, Pangea had more or less formed and these rocks were deposited in shallower marine waters. Only a few sharks have been found within them to date.

Several new species have been identified from Mammoth Cave. One of these new shark species was found by Mammoth Cave National Park Superintendent Barclay Trimble. Referred here as "Trimble's shark", this new species is a member of the ctenacanth shark family, a group of sharks that first appeared during the Devonian period (approximately 400 million years ago); this group went extinct at the end of the Permian period (252 mya). The name "ctenacanth" translates to "comb-spine", which is derived from the prominent dorsal fin spines that bear comb-like denticles on the back of the spines, near the apex. "Trimble's shark" is unique in having a tooth crown that is more like some modern sharks with complex ridges and smaller cusps between the middle and side cusps but the tooth base/root still retains features seen in older ctenacanths. Based on the tooth dimensions, "Trimble's shark" would have been 6-7 feet in length. You can see "Trimble's shark" in the upper left corner of the 2023 National Fossil Day artwork.

Reconstruction of "Trimble's Shark". https://www.nps.gov/articles/000/fossils-of-the-2023-national-fossil-day-artwork.htm.

Another new chondrichthyan identified from Mammoth Cave is a species of *Janassa*. *Janassa* is found almost worldwide from the Mississippian period to the Permian period. Complete skeletons with body impressions of *Janassa* have found in Permian rocks in Germany and England, suggesting this fish had a body design similar to modern skates although more closely related to modern ratfish. The fossil of *Janassa* found in the Ste. Genevieve Formation at Mammoth Cave represent a species which has teeth with a larger number of fine ridges and a more rounded cusps compared to other *Janassa* species found within the same time period. The Mammoth Cave *Janassa* would have been approximately 1-2 feet long, and based on the gut contents of the more complete skeletons, fed on brachiopods ("lamp shells"), snails, and bryozoans ("moss animals"). You can see our new *Janassa* species feeding on invertebrates in the lower right of the 2023 National Fossil Day artwork.



Reconstruction of Saivodus striatus *with the preserved partial cranium and lower jaw and teeth from the Middle to Late Mississippian formations at Mammoth Cave National Park.*

One of the largest sharks to have swam the ancient Mississippian seas was *Saivodus striatus*, which is featured prominently in the 2023 National Fossil Day artwork. Until recently, much of what we knew about this large ctenacanth shark was only from isolated teeth that have been found in Europe and North America. However, at Mammoth Cave National Park, a partial skull of *Saivodus* was found in one of the side passages with a nearly complete lower jaw that was almost a half meter long (2 feet) with teeth about 2.5 centimeter (1 inch) wide! The dimensions of this fossils suggest this particular individual was at least as large as the average sized living white shark (*Carcharodon carcharias*) which is today's largest predatory fish at 4 to 5 meters (15-16 feet) in length. However, larger teeth of *Saivodus striatus* have been found throughout Mammoth Cave National Park, from the oldest St. Louis Formation to the youngest Haney Formation, suggesting these sharks exceeded the largest white shark recorded with estimated body lengths between 8-10 meters (20-26 feet) in length. Even larger teeth of *Saivodus* found in Ireland suggest it could have reached possibly 11 meters (36 feet) in length!

November Meeting

Save the date—November 14, 2023, for our next meeting which will feature Dr. D. Jeffrey Over of SUNY Geneseo, one of the three editors of the mammoth three-volume, 12-chapter, 906-page treatise the *Devonian of New York* which revises the stratigraphy of the Devonian. Learn about the multi-year project and the results.

Fossil News **by Michael Grenier**

Trilobites arose in Cambrian not Ediacaran with no long cryptic history.

This study concludes that trilobites must have arisen in the Cambrian and that there is no reason to assume a long evolution in the Ediacaran (Holmes, J.D. and Budd, G.E., 2022. Reassessing a cryptic history of early trilobite evolution. *Communications Biology*, *5*(1), p.1177).

Trilobites are an iconic group of biomineralizing marine euarthropods that appear abruptly in the fossil record (c. 521 million years ago) during the Cambrian 'explosion'. ("Euarthropods" are "true" arthropods and exclude the tardigrades.) They are one of the largest and most successful Paleozoic groups, persisting for some 270 million years, and represented by over 22,000 described species. Their sudden appearance has proven controversial ever since Darwin puzzled over the lack of pre-trilobitic fossils in the Origin of Species, and it has

generally been assumed that trilobites must have an unobserved cryptic evolutionary history reaching back into the Precambrian.

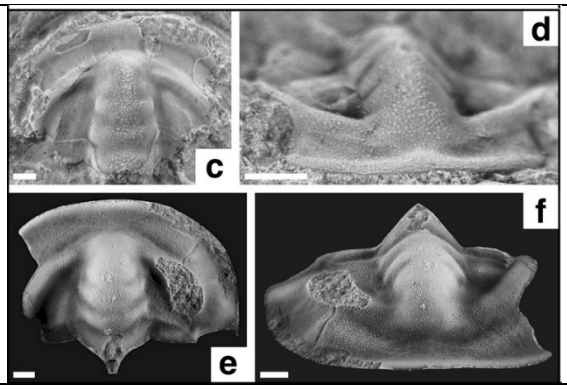
There are many issues with this conventional view. Such a cryptic history assumes that an unlikely widespread multiplicity of trilobite taxa acquired biomineralized structures suddenly, simultaneously, and independently; that geographic separation of these taxa (vicariance) existed due to the breakup of the supercontinent Rodinia, and despite that such vicariance is inconsistent with factors controlling extant marine invertebrate distributions. Holmes ad Budd conclude that the group's appearance at c. 521 Ma closely reflects their evolutionary origins.

Early divergence dates estimated by molecular clocks suggested trilobite origin deep in the Ediacaran. Recently, more refined molecular divergence estimates have come closer in-line with the fossil record.

The authors assert that the sudden appearance of trilobites worldwide in the fossil record is more likely due to rapid dispersal and speciation rather than to the assumed divergence all of major trilobite lineages sometime during the earlier period which then all independently evolved a calcite exoskeleton at ~521 Ma or shortly thereafter. The latter implies eleven independent convergent acquisitions of a calcified exoskeleton and associated eye structures, and seven acquisitions of dorsal facial sutures. Additional, if trilobites really did evolve these traits independently, this implies the presence of a large number of non-mineralized trilobite sister groups at this time, and one would expect to see some of these in the various early Cambrian Lagerstätten. Yet, there are none. Also, no trilobite has been found in the earlier stage despite the presence of diverse shelly faunas.

The authors also note that though trilobites are classified as the Olenellidae order in the Laurentia and Baltica region (figure 3e and 3f) and the Redlichiida order in Gondwana (figure 3c and 3d), despite key character differences, there are many similarities between the two indicating being close to a common last ancestor.

This open access paper is available for free download at:
https://www.nature.com/articles/s42003-022-04146-6.



Comparison between the early redlichiine bigotinid Bigotina bivallata *(c, d) and the early olenelline* Profallotaspis tyusserica *(e, f). These show considerable morphological similarities, supporting close relationship of these groups.*

Early Cretaceous Fossil Shows Rare Evidence of a mammal attacking a dinosaur

Thanks to David Bishop for this one.

Canadian Museum of Nature press release issued July 18, 2023.
https://nature.ca/en/about-the-museum/media-centre/fossil-mammal-attacks-dinosaur/ for more.

Canadian and Chinese scientists have described an unusual fossil from around 125 million years ago that shows a dramatic moment in time when a carnivorous mammal attacked a larger plant-eating dinosaur. "The two animals are locked in mortal combat, intimately intertwined, and it's among the first evidence to show actual predatory behavior by a mammal on a dinosaur," explains Dr. Jordan Mallon, of the Canadian Museum of Nature.

The fossil's presence challenges the view that dinosaurs had few threats from their mammal contemporaries during the Cretaceous, when dinosaurs were the dominant animals. The rare fossil is now in the collections of the Weihai Ziguang Shi Yan School Museum.

The dinosaur in the well-preserved fossil is identified as a species of *Psittacosaurus*. Plant-eating psittacosaurs are among the earliest known horned dinosaurs and lived in Asia during the Early Cretaceous, from around 125 to 105 Ma. The mammal in the fossil pair is a badger-like animal, called *Repenomamus robustus*. It was among the largest mammals during the Cretaceous.

Prior to this discovery, paleontologists knew that *Repenomamus* preyed on dinosaurs including *Psittacosaurus* because of fossilized baby bones of the herbivore found in another specimen's

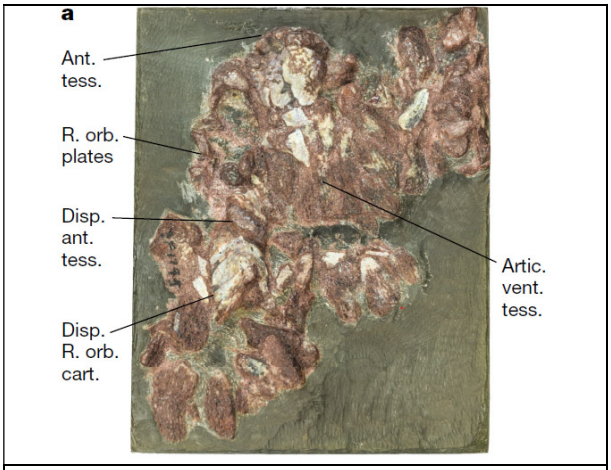
Fossil with skeletons of mammal Repenomamus *and ceratopsian dinosaur* Psittacosaurus*, with three circles highlighting features of the attack underway. Scale bar equals 10 cm. Photo: Canadian Museum of Nature © Gang Han*

stomach. The fossil was collected in China's Liaoning Province in 2012 and both skeletons are nearly complete. Their completeness is due to the fact that they were buried suddenly by mudslide and debris following volcanic eruption. "The weight of the evidence suggests that an active attack was underway," says Dr. Mallon.

Illustration showing Repenomamus robustus *as it attacks* Psittacosaurus lujiatunensis *before a volcanic debris flow buries them. Art: Canadian Museum of Nature © Michael W. Skrepnick 2023*

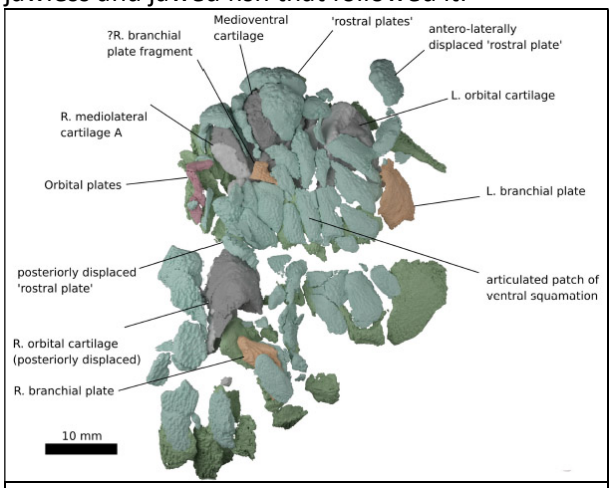
This paper (Han, Gang, et al. "An extraordinary fossil captures the struggle for existence during the Mesozoic." Scientific Reports 13.1 (2023): 11221.), is available for free download at: https://www.nature.com/articles/s41598-023-37545-8.

Prehistoric fish fills 100-million-year gap in evolution of the skull. University of Birmingham press release issued September 20, 2023. https://www.birmingham.ac.uk/news/2023/prehistoric-fish-fills-100-million-year-gap-in-evolution-of-the-skull. for more.



***Eriptychius americanus* PF 1795. Fig. 1a** *Photograph of the skull cartilage pieces, which had the split face set in epoxy and was manually prepared.*

Scientists made a detailed 3D representation of the skull of *Eriptychius americanus,* a 455-million-year-old fossil jawless fish which was collected in the 1940s and is housed in the Field Museum of Natural History, Chicago. This ancient fish had separated, independent cartilages encasing the brain, unlike that of any other known vertebrate, rather than the solid bone or cartilage structure of jawless and jawed fish that followed it.



This computed tomography (CT) scan shows earliest-known example of internal cartilage skull and provides new information on how vertebrates evolved to protect their brains.

Dr. Ivan Sansom, senior author of the paper at the University of Birmingham said: "These are

tremendously exciting results that may reveal the early evolutionary history of how primitive vertebrates protected their brains. *Eriptychius americanus* appears to be the first evidence for a series of cartilages separating the brain from the rest of the head." Dr. Richard Dearden, said: "On the face of it *Eriptychius* is not the most beautiful of fossils. However, we were able to show that it preserves something unique: the oldest three-dimensionally preserved vertebrate head in the fossil record."

This paper (Dearden, Richard P., et al. "The oldest three-dimensionally preserved vertebrate neurocranium." *Nature* (2023): 1-6.) is available for free download at:
https://www.nature.com/articles/s41586-023-06538-y.

Fossil discovery reveals that trilobites had clasper-like limbs used for mating

Geological Society of America press release issued May 10, 2022.
https://www.geosociety.org/GSA/GSA/News/pr/2022/22-27.aspx for more.

Thanks to their easily fossilized exoskeleton, trilobites largely dominate the fossil record of early complex animal life. However, trilobite appendages and the anatomy of the underside of their body are typically not well preserved, which makes it difficult to infer their mating and reproductive behaviors.

Until now, modern arthropods have been heavily used as an analog to infer the mating behavior of trilobites, but a study published in *Geology* described the discovery of a specialized limb in a mature male trilobite species that sheds light on trilobite's mating behaviors.

Detailed study of a fossil specimen of the trilobite species *Olenoides serratus* revealed two sets of peculiarly reduced appendages in the middle of its body. Each of these appendages is interpreted to be a clasper-like limb, which mature males would use to grasp females during mating to ensure that the male is in the best position for external fertilization of the eggs.

"There's about 20,000 described trilobite species, but less than 40 species have preserved appendages. This is the first time that significant appendage specialization is seen in trilobites. The discovery teaches us about trilobite behavior and shows that this type of complex mating behavior already existed by the mid-Cambrian," said Sarah Losso, lead author of the study.

The *O. serratus* specimen is approximately 500 million years old from the Cambrian Period and was originally collected from the Burgess Shale in British Columbia, Canada, which is a world-renowned fossil deposit for its soft-bodied preservation of Cambrian organisms. The fossil specimen is currently housed at the Royal Ontario Museum in Toronto, Canada. Until now, this special clasper-like appendage was otherwise unknown for *O. serratus* or other trilobite species.

Losso & Ortega-Hernández (2022) Figure 1A. Specialized trunk appendages in the trilobite Olenoides serratus from the Cambrian (Wuliuan) Burgess Shale (British Columbia, Canada). Specimen ROMIP 66299 part photographed under cross-polarized light. Abbreviations: en—endopodite; ex—exopodite.

The discovery of this clasper-like limb in trilobites reveals that the complex mating behaviors that are observed in modern arthropods originated during the Cambrian Explosion over 500 million years ago. It is the earliest record of an appendage of this type used for reproduction and represents a degree of limb specialization for a non-feeding function.

This paper (Losso, S.R. and Ortega-Hernández, J., 2022. Claspers in the mid-Cambrian *Olenoides serratus* indicate horseshoe crab–like mating in trilobites. *Geology*, *50*(8), pp.897-901.) is available for free download at:
https://pubs.geoscienceworld.org/gsa/geology/article-pdf/50/8/897/5655070/g49872.1.pdf.

CALENDAR OF EVENTS

October

Tuesday October 3, FOSSIL MEETING 7:00 PM. LOCATION: NEQALS Community Meeting Room, 1030 Jackson Rd, Webster, 14580. Speaker is Dr. Thomas Hegna on "Tales Told by Trilobites." Visitors are welcome.

November

Saturday November 4, RAS 49TH ANNUAL FALL SCIENTIFIC PAPER SESSION & ANNUAL LARRY KING MEMORIAL LECTURE 9 AM to 3 PM. LOCATION: Rochester Institute of Technology Thomas Gosnell Hall. Speakers are Dr. Roger Easton, Jr. and Dr. Jeyhan Kartaltepe on "Astronomical Images – the Oldest and the Newest".

Tuesday November 14, FOSSIL MEETING 7:30 PM. LOCATION: NEQALS Community Meeting Room, 1030 Jackson Rd, Webster, 14580. Speaker is Dr. D. Jeffrey Over of SUNY Geneseo on the "Devonian of New York". NOTE 2nd Tuesday date due to elections.

Visitors are welcome to all Fossil Section meetings! For more information and the latest updates check the RAS Website (**www.RASNY.org**). You can also contact Dan Krisher at DLKFossil@gmail.com or John Handley at jhandley@rochester.rr.com for further information.

ROCHESTER ACADEMY OF SCIENCE FOSSIL SECTION

Monthly meetings are now held as hybrid meetings, live but also broadcast on Zoom. Meetings are held the first Tuesday of each month from October to December and from February to May at 7:30 pm. In person meetings are now held at the NEQALS Community Meeting Room, 1030 Jackson Rd, Webster, NY 14580 unless otherwise listed.

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The FossiLetter is published before each meeting month of the year. Please send submissions to mgrenier@frontiernet.net or by U.S. Postal Service mail to 692 Maple Drive, Webster, NY 14580. Deadline for submissions to the Fossiletter is the 15th of the month.

For scheduling changes and the latest updates please check the RAS Website (www.rasny.org) and click on the Fossil Section link. Last minute updates can also be found on the *General Announcements* page of the Academy Website.

Warning: *Trilobite Pornography.*
Reconstruction of mating position in Olenoides serratus. *Art by Holly Sullivan, Copyright © 2023 by Sullivan Scientific*