A publication of the Rochester Academy of Science FOSSIL SECTION

The FOSSILETTER

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December Meeting

The December section meeting is on Tuesday, December 3rd at the Brighton Town Hall basement meeting room, 2300 Elmwood Ave, Rochester, NY 14618 at 7:30 PM.

The meeting will feature our traditional "Shown-Tell" with pizza and drinks being provided by the section. Members are asked to bring their interesting finds and any specimens in need of identification. This is a great opportunity to show off your finds from the past year, or a part of your collection. Don't worry if what you have is not flashy, fossils rarely are. Whatever you have will be interesting to the rest of us. Many specimens which appear, at first glance, to be bland may actually turn out to be something rare or unusual. If (like me) you have nothing to show, come anyway for the joy of being with friends. If you have specimens which are defying identification bring them along. Between us all we usually have enough knowledge to put a name to something. Tables will be set up around the room and you can lay all your interesting specimens out for us to all enjoy and discuss.

If you have small fossils or fossils for which you would like a close-up view of details, bring them. Michael Grenier will again have a station set up with a 5MB digital microscope with 20X-200X magnification. Images of your fossil under magnification can be captured and transferred to your USB memory stick or SDHC card (SanDisk).

Bring a friend, visitors are welcome.

Membership Renewal Time

Unless you are a Life Member, note that your membership will expire on December 31, 2019. Please renew your membership at your earliest convenience. A membership form was sent with the November newsletter and appears in the current RAS newsletter, or you can get one at <u>rasny.org/mbform.pdf</u>, or you may renew your membership at the next Fossil Section meeting that you attend. Remember, on the form, you have to add the Rochester Academy of Science membership (\$10 individual) and Fossil Section membership (\$10 individual or family, \$5 student).

NO January Section Meeting

The Section will not hold a January meeting or issue a newsletter due to the holiday season. The next meeting will be Tuesday, February 4th, 2020 at the Brighton Town Hall basement meeting room at 7:30 PM.

President's Report

by Dan Krisher

The Fossil Section has committed to host high school and middle school 2020 Science Olympiad teams in an outreach program at our March 3rd meeting coaching them on fossils that will be included in the Olympiad competitions which will be held in mid-March. More information is on the following pages, including the new fossil list for this year's competition. I hope that many of you will be able to help with this. Section members have already begun pulling specimens together for this.

The November meeting for the Section was held on the second Tuesday (11/12) of the month as the first Tuesday was election day. The speaker for the evening was Ashley Pollock from the Niagara Peninsula Geological Society. Her talk was titled "The Late Heavy Bombardment and the Origin of Life". The talk provided an update on the new evidence for life in the Archean (4 bya to 2.5 bya) and new information on what has been termed the Late Heavy Bombardment phase of earth's history.



Ashley Pollack -- Precambrian Very Early Life on Earth

The Fossil Section was represented at the RAS Fall Paper Session by Sam Ciurca and with a poster on *Early Devonian Manlius Group: Eurypterids, Crinoids, Olney Limestone and a Drone.*

Outreach Event

An important function of the RAS is the promotion of science knowledge to the general public. Our principal means for this education are outreach events. Our next one will be the **Mendon Ponds WinterFest, Sunday 1/12/2020** from 11AM until 3PM. The Astronomy and Mineral Sections will be there also. This is an outreach program we do every year.

The Fossil Section sets up a couple of 8-foot tables with a variety of identified fossils from New York State and with other specimens from elsewhere across the globe. We have a number of handouts and a variety of fossils the children can look through to select a specimen to take.

Our tables are generally fairly busy so we try to have 2 -3 members on hand to answer questions the public may have. If you can please join us, even if only for an hour or two, or if you want more information, please contact Dan Krisher at 585-698-3147 or by email at <u>dlkfossil@gmail.com</u>.

Make A Donation, Win A Book!!

The gorgeous book, **A History of Life in 100 Fossils**, featured in the October newsletter, will be awarded at the December meeting in a special drawing. A few of the 30 tickets remain. The only



way to get a ticket is to make a \$2 donation to your very worthy Fossil Section to help with program expense. All such donations to the Fossil Section are tax-deductible. If you donate \$10, you will get 6 ticket—one extra for free.

Tickets will be sold at our December 3rd meeting, cash or check. You can also buy a ticket via PayPal. (Just send \$2 for each ticket you want to <u>mgrenier@frontiernet.net</u>, friend-to-friend). If you win and you are out of town, I will send you the book, at no extra charge.

Science Olympiad 2020 Fossil List

(Note: Taxa marked by an asterisk (*) are for State and National Tournaments only. We will not cover these at our session. Also, additions since last year are in red.)

KINGDOM PROTOZOA Phylum Foraminifera (Forams) * order Fusulinida (Fusulinids)* order Rotaliida* genus Nummulites* **KINGDOM ANIMALIA SPONGES (Phylum Porifera)** genus Astraeospongia (calcareous sponge) genus Hydnoceras (glass sponge)* **BRYOZOANS (Phylum Bryozoa)** (Growth forms: branching, massive, fenestrate) genus Archimedes genus Rhombopora **GRAPTOLITES (Phylum Hemichordata)*** order Dendroidea (benthic graptolites) order Graptoloidea (planktic graptolites) **CORALS (Phylum Cnidaria)** order Tabulata (tabulate corals) genus Favosites

genus Halysites* order Rugosa (rugose corals)

genus *Heliophyllum* (horn coral) genus *Hexagonaria*

order Scleratinia (stony corals) genus Septastrea **ARTHROPODS (Phylum Arthropoda)** SubPhylum Crustacea (shrimp, lobster, crabs, barnacles, ostracods)* Sub Phylum Chelicerata Order Eurypterida (Eurypterids) Class Insecta (Insects) Class Trilobita (Trilobites) genus Cryptolithus genus Calymene genus Elrathia genus Isotelus* genus Eldredgeops (formerly Phacops) **BRACHIOPODS (Phylum Brachiopoda) Class Inarticulata** genus Lingula **Class Articulata** genus Atrypa genus Composita genus Juresania* genus Leptaena genus Mucrospirifer genus Platystrophia genus Rafinesquina order Rhynchonellida **MOLLUSKS (Phylum Mollusca)** Class Bivalvia (clams, oysters, mussels) genus Exogyra genus Gryphaea genus Pecten genus Glycymeris genus Astarte genus Nucula **Class** Cephalopoda order Goniatitida (goniatites)* order Ceratitida (ceratites)* order Ammonitida (ammonites) genus Baculites genus Dactylioceras order Belemnitida (Belemnites) genus Belemnitella order Nautilida (Chambered Nautilus) order Orthocerida ("Orthoceras") Class Gastropoda (Snails) genus Conus genus Cypraea genus Platyceras

genus Turritella genus Worthenia **ECHINODERMS (Phylum Echinodermata)** Class Asteroidea (Starfish)* **Class Blastoidea** genus Pentremites Class Crinoidea (stems, columns, calyxes) Class Echinoidea (regular or irregular echinoids including sea urchins, sand dollars and heart urchins) Class Ophiuroidea (brittle stars)* **VERTEBRATES (Phylum Chordata)** Superclass Agnatha (Jawless Fish) (Ostracoderms)* Class Placodermi (Armored Jawed Fish) genus Bothriolepis genus Dunkleosteus Class Chondrichthyes (Cartilaginous Fish) Superorder Selachimorpha (Sharks) genus **Otodus** genus Carcharocles (formerly Carcharodon) species C. megalodon Superorder Batoidea (Rays)* Superclass Osteichthyes (Bony Fish) Class Actinopterygii (ray-finned) genus Knightia genus Xiphactinus* Class Sarcopterygii (lobe-finned) genus Eusthenopteron genus Latimeria (Coelacanth) genus *Tiktaalik* Class Amphibia (Amphibians) genus Acanthostega genus Eryops genus Diplocaulus Class Reptilia (Reptiles) order Crocodilia (crocodiles)* order Testudines (turtles)* order Ichthyosauria (Ichthyosaurs) order Squamata Family Mosasauridae (Mosasaurs) order Plesiosauria (Plesiosaurs & Pliosaurs) order Pterosauria (Pterosaurs) Clade Dinosauria (Dinosaurs) order Saurischia (lizard-hipped) Suborder Theropoda genus Allosaurus genus Coelophysis

genus Dilophosaurus genus Spinosaurus* genus Tyrannosaurus genus Velociraptor Suborder Sauropodomorpha genus Brachiosaurus genus Diplodocus genus Patagotitan* genus Plateosaurus order Ornithischia (bird-hipped) Infraorder Ankylosauria genus Ankylosaurus Infraorder Ceratopsia genus Triceratops genus Protoceratops* Infraorder Ornithopoda genus Iquanodon genus Parasaurolophus genus Maiasaura Infraorder Pachycephalosauria genus Dracorex Infraorder Stegosauria genus Stegosaurus Class Aves (Birds) genus Archaeopteryx genus Titanis (Terror Bird) genus Ichthyornis* Clade Synapsida Mammal-like Reptiles genus *Dimetrodon* (pelycosaurs) genus Lystrosaurus (therapsids) Class Mammalia (Mammals) genus Basilosaurus (prehistoric whale) genus *Equus* (modern horse) genus Australopithecus (hominin)* genus *Homo* (hominin) species H. neanderthalensis species H. erectus* species H. sapiens genus *Mammut* (Mastodon) genus Mammuthus (Mammoth) species M. primigenius (Wooly Mammoth) genus Megacerops (Brontothere) genus *Mesohippus* (three-toed horse) genus Smilodon (saber-toothed cat) **KINGDOM PLANTAE**

FLOWERING PLANTS (Phylum Anthophyta)

genus Acer (Maple)

genus *Populus* (Aspen & Poplar) genus Platanus (Sycamore) **GINKGOS (Phylum Ginkgophyta)** genus Ginkgo CLUB MOSSES (Phylum Lycopodiophyta) genus Lepidodendron (scale tree) **CONIFERS (Phylum Pinophyta)** genus Metasequoia HORSETAILS (Phylum Sphenophyta) genus Calamites (form leaf genus: Annularia) **SEED FERNS (Phylum Pteridospermatophyta** genus Glossopteris TRUE FERNS (Phylum Pteridophyta) genus Psaronius (form leaf genus: Pecopteris) ADDITIONAL EARTH MATERIALS **Trace Fossils** Trails, Tracks, Trackways, Borings, Burrows, Tubes Predation marks, Repair scars, Coprolites Stromatolites Amber/copal Petrified wood Sedimentary Rocks Coquina Limestone (Chalk/Fossil limestone) Sandstone Shale Chert

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Fossil News

The crust could have formed and supported life when Earth was just 350 million years old (University of Chicago Press Release) (https://www.sciencedaily.com/releases/2018/06 /180605154122.htm) Ashley Pollack gave an exciting talk on the origins of life in the Precambrian. Due to the interest among our members, I will report on recent studies in this topic for the next few months. According to several recent studies using differing methods, the age of the Earth is estimated to be 4.54 ± 0.05 billion years (Wikipedia). Illustrations and captions following are provided by your FossiLetter (FL) editor.]

The early Earth might have been habitable much earlier than thought, according to research from a group led by University of Chicago scientists. Counting strontium atoms in rocks from the Nuvvuagittuq Greenstone Belt (NBG) of northern Canada, they found evidence that the Earth's continental crust could have formed hundreds of millions of years earlier than previously thought. Continental crust is richer in essential minerals than younger volcanic rock, which would have made it significantly friendlier to supporting life.



Two papers dating the age of the Nuvvuagittuq Greenstone Belt have been published. One paper gave an age of ca. 3,750 million years ago (mya), while the more recent gave an age of ca. 4,388 mya. So far, the age of the Nuvvuagittuq Greenstone Belt is still unresolved.

"Our evidence, which squares with emerging evidence including rocks in western Australia, suggests that the early Earth was capable of forming continental crust within 350 million years of the formation of the solar system," said Patrick Boehnke, a Postdoctoral Fellow in the Department of Geophysical Sciences and the first author on the paper. "This alters the classic view, that the crust was hot, dry and hellish for more than half a billion years after it formed."

One of the open questions in geology is how and when some of the crust -- originally all younger volcanic rock -- changed into the continental crust we know and love, which is lighter and richer in silica. This task is made harder because the evidence keeps getting melted and reformed over millions of years. One of the few places on Earth where you can find bits of crust from the very earliest epochs of Earth is in tiny flecks of apatite imbedded in younger rocks.

Luckily for scientists, some of these "younger" minerals (still about 3.9 billion years old) are zircons -- very hard, weather-resistant minerals somewhat similar to diamonds. "Zircons are a geologist's favorite because these are the only record of the first three to four hundred million years of Earth. Diamonds aren't forever -- zircons are," Boehnke said.



I could not locate a photo of a NGB zircon—none is included in the paper, so I offer this example, about the size of a dust mite. It is the oldest one known dated at 4.4 billion years old from the Jack Hills of Western Australia.

Plus, the zircons themselves can be dated. "They're like labeled time capsules," said Prof. Andrew Davis, chair of the Department of Geophysical Sciences and a coauthor.

Scientists look at the variants of elements, called isotopes, to tell a story about these rocks. They wanted to use strontium, which offers clues to how much silica was around at the time it formed. The only problem is that these flecks are absolutely tiny -- about five microns across, the diameter of a strand of spider silk -- and you have to count the strontium atoms one by one.

This was a task for a unique instrument that came online last year: the CHicago Instrument for Laser Ionization, or CHILI. This detector uses lasers that can be tuned to selectively pick out and ionize strontium. When they used CHILI to count strontium isotopes in rocks from the NBG, they found the isotope ratio suggested plenty of silica was present when it formed. This is important because the makeup of the crust directly affects the atmosphere, the composition of seawater, and nutrients available to any budding life hoping to thrive on planet Earth. It also may imply there were fewer meteorites than thought pummeling the Earth at this time, which would have made it hard for continental crust to form.

"Having continental crust that early changes the picture of early Earth in a number of ways," said Davis. "Now we need a way for the geologic processes that make the continents to happen much faster; you probably need water and magma that's about 600 degrees Fahrenheit less hot." This paper (Boehnke, Patrick, Elizabeth A. Bell, Thomas Stephan, Reto Trappitsch, C. Brenhin Keller, Olivia S. Pardo, Andrew M. Davis, T. Mark Harrison, and Michael J. Pellin. "Potassic, highsilica Hadean crust." *Proceedings of the National Academy of Sciences* 115, no. 25 (2018): 6353-6356.) is available on request.

New Evidence for the Affinity of the Mazon Creek Problematicum *Tullimonstrum gregarium*

It has been over two years since Tullimonstrum *gregarium* has made the news. This creature lived in shallow tropical coastal waters of muddy estuaries of the Pennsylvanian period, about 300 million years ago. A single species, T. gregarium, is known. Examples have been found only in the Mazon Creek fossil beds of Illinois. In the FossiLetter of April and May 2016, we reported first that a Yale-led team determined that the 300million-year-old animal - which grew to only a foot long – was a vertebrate, with gills and a stiffened rod (or notochord) that supported its body and that it is part of the same lineage as the modern lamprey. Then, a University of Leicester team also identified the ancient 'Tully Monster' as a vertebrate -- due to the unique characteristics of its eyes. They identified a lens for the first time and found fossil melanosomes of two shapes "conclusively proving that Tullimonstrum had eyes on stalks". Only vertebrates have two different shapes of melanosome. A third report (FL March 2017), challenged that, noting that the eye was a non-vertebrate "cup shape" and that other important vertebrate characters were missing,

such as otic capsules (components of the ear that allow animals to balance) and a lateral line (a sensory structure that enables fishes to orient themselves in space).



By PaleoEquii--Own work, CC BY-SA 4.0, https:// commons.wikimedia.org/w/index.php?curid=79612004

In October, a large team of paleontologists led by Dr. Victoria McCoy of the U. of Wisconsin presented additional evidence that *T. gregarium* is a vertebrate at the Society for Vertebrate Paleontology (SVP) conference in Brisbane, Australia. (No, your editor was not there.) This report is not yet in publication. They note that chordates, annelids, arthropods, and mollusks differ in the composition of their tissues specifically teeth and mouthparts. They undertook a biomolecular analysis, since the composition of the teeth of Tullimonstrum would enable them to distinguish between the two best supported morphological hypotheses: chordates have teeth composed of keratin, a protein, and mollusks have radula teeth composed of chitin.

They used Raman microspectroscopy to determine the composition of *Tullimonstrum* teeth using and compared them to those in other Mazon Creek animals: chordates and annelids (jaws) to represent proteinaceous tissues; and arthropods, annelids (setae) and a mollusk to represent chitinous tissues. The whole Raman band spectra were compared using principle components analysis (PCA) to determine if the teeth of *Tullimonstrum* are more similar to fossilized proteinaceous material, or fossilized chitinous material.

The *Tullimonstrum* samples overlap with the proteinaceous group but not the chitinous group.

Therefore, *Tullimonstrum* teeth were similar in composition to the keratin/collagen tissues of chordates and annelid jaws and differ from the chitinous tissues in the mouthparts of arthropods and mollusks and the setae of annelids. This supports a chordate identity for *Tullimonstrum*.

Exceptional 3d Preservation of Soft Tissues and Organs in the Vertebrate Fauna from the Late Devonian Gogo Formation

John A. Long and Kate Trinajstic, with several co-authors, made two interesting presentations at the SVP Conference in October. Dr. Long is the author of *The Rise of Fishes: 500 Million Years of Evolution*, 2010, which we featured in FL May 2016, and which is available to be borrowed.

The Gogo Formation of Western Australia is renowned for its exceptional 3D preservation of both bone and soft tissue in fossil fishes that inhabited an ancient reef environment. It is also one of the most diverse vertebrate assemblages of this age (Frasnian) with over 50 species of placoderms, osteichthyans (bony fishes) and rare sharks and acanthodians ("stem sharks") that once inhabited the algal-stromatoporoid sponge reef environment. More significant is the wellpreserved soft tissue, embryos and sexual organs in certain groups of placoderms.

The Gogo Formation has long been recognized for the exceptional 3D preservation of original bone in a diverse vertebrate and invertebrate fauna that once inhabited this reef environment. Fossils were first collected in the late 1960s; however, it was not until 2000 that the first soft tissues were recognized. The first soft tissues recovered from vertebrates were small patches of muscle in placoderms (basal jawed vertebrates) which had been removed from carbonate nodules by acetic acid. Recent collecting has shown soft tissue in varying amounts and preservation styles in all taxa from the Gogo Formation.

To date the most extensive amounts of vertebrate soft tissue have been recovered from placoderms where large blocks of muscles allow

for the complete musculature of the neck and body to be determined. The segmented body musculature has also been recovered from a sole acanthodian specimen, a yet to be described chondrichthyan (sharks, skates, rays, etc.) and actinopterygians (ray-finned bony fishes, the most common fishes). The extensive amount of muscle present from multiple taxa has enabled the history of vertebrate evolutionary the musculature to be determined. In addition to muscle preservation several taxa preserve organs, including the heart and liver, and the skin with its lateral line is preserved in the chondrichthyan.



A 380-million-year-old fossil of the predatory placoderm fish Eastmanosteus from the Gogo Fm. Preserved muscle fibers found from this species were used in a new study.

Soft tissue preservation also confirms the earliest evidence of live birth by the presence of a mineralized umbilical cord in a placoderm, the embryo still within the abdominal cavity of the adult. The presence of the umbilical cord indicates that these fishes were viviparous. Soft tissue is not particularly decay resistant. The preservation of soft tissue in the Gogo Formation appears to be the result of the combination of bacterial sulfate reduction and rapid burial in a low oxygen environment. Mineralization was rapid enough for high fidelity preservation of some of the muscle fibers, and some organic molecular breakdown products within the fish scales. These discoveries represent the oldest 3D preservation of vertebrate muscle and organs known to date.

CALENDAR OF EVENTS

December

Tuesday December 3, FOSSIL MEETING 7:30 PM Brighton Town Hall Auditorium 2300 Elmwood Ave. Our traditional Show-and-Tell with pizza and drinks provided by the section. This is a great opportunity to show off your finds from the past year. Visitors welcome.

January NO MEETING

February

Tuesday February 4, FOSSIL MEETING 7:30 PM Brighton Town Hall Auditorium 2300 Elmwood Ave. Michael Grenier will present a slide-show talk on "Dinosaur Research in 2019." Visitors welcome.

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

ROCHESTER ACADEMY OF SCIENCE FOSSIL SECTION

Monthly meetings are held the first Tuesday of each month from October to December and from February to May at 7:30 pm at the Brighton Town Hall, Community Meeting Room, 2300 Elmwood Avenue, Rochester, NY unless otherwise listed.

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The FossiLetter is published before each meeting month of the year. Please send submissions to <u>mgrenier@frontiernet.net</u> 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.



Your very own plush Tully Monster from the Paleontological Research Institute, only \$12. https://www.priweb.org/index.php/ppals-store/tullymonster-detail