A publication of the Rochester Academy of Science FOSSIL SECTION

The FOSSILETTER

VOL. 38 Number 1 October 2020

October Meeting

The October section meeting is on Tuesday, October 6, at 7:30 PM. This meeting will be conducted as a virtual meeting on Zoom, which requires either a computer with sound (or with a telephone) or a Smart Phone. It is possible to use a telephone only, but you will have only audio and not see the slides for the talk. (Until at least February 2021, the Section will continue to meet monthly via ZOOM.)

Our speakers this month are Bill and Kris Parsons. They will speak on their work in the late Early Cretaceous of Montana. Besides dinosaurs, recent finds have included turtles, crocodiles, and mammals. Meeting will be held remotely via ZOOM.

Bill & Kris Parsons in the field in Montana (Editor's photo)

Bill sends the following notes: "Over the past thirty years or so, Kris and I and our family as well as a number of friends and volunteers have conducted a continuous faunal survey and excavation within a series of Early Cretaceous related sites in the Cloverly Formation of central Montana. Over that time our discoveries have included a number of dromaeosaurid "raptor" dinosaurs of the genus *Deinonychus*; at least three Mesozoic mammals, two of which are new to science; an enantiornithine bird, again new to science; a new nodosaurid, that we named *Tatankacephalus cooneyorum*; several juvenile and adult specimens of *Tenontosaurus*, and evidence of at least one large titanosaurid sauropod as well as several other interesting fossils such as impressions, footprints, and diagnostic plant materials that help to tell the tales of those times. In our presentation to the Rochester Academy of Science, we would like to present to you some of our latest discoveries and what they might imply.

To attend, you MUST register in advance, as only those registered will be sent the meeting information to log in and attend. Register by email to paleo@frontier.com).

President's Report by Dan Krisher

I would like to welcome you all back to our monthly meetings for the Fossil Section. Our last meeting was in June and in the intervening time we have all had to deal with the ongoing effects of COVID-19. When last we met, the Board hoped we could resume in-person meetings in the Fall but unfortunately, after assessing the situation and talking with the Brighton Town Hall, that has not proved possible. The Section meetings in May and June were held virtually via ZOOM and we will be continuing this practice at least until February.

Over the Summer our newly elected Vice-president, Michael Grenier, has been busy building a full slate of speakers for the season, and through his efforts, we will have a wide variety of high-quality presentations. The one advantage coming out of relying on ZOOM for our meetings is the ability to tap speakers from across the country who we would not ordinarily be able to present. This ability has proved so advantageous that, when we do return to in-person meetings, we intended to continue leveraging this ability in selected situations. Once again, welcome back and I hope to "see you" at our next meeting.

Election Results of June 2020

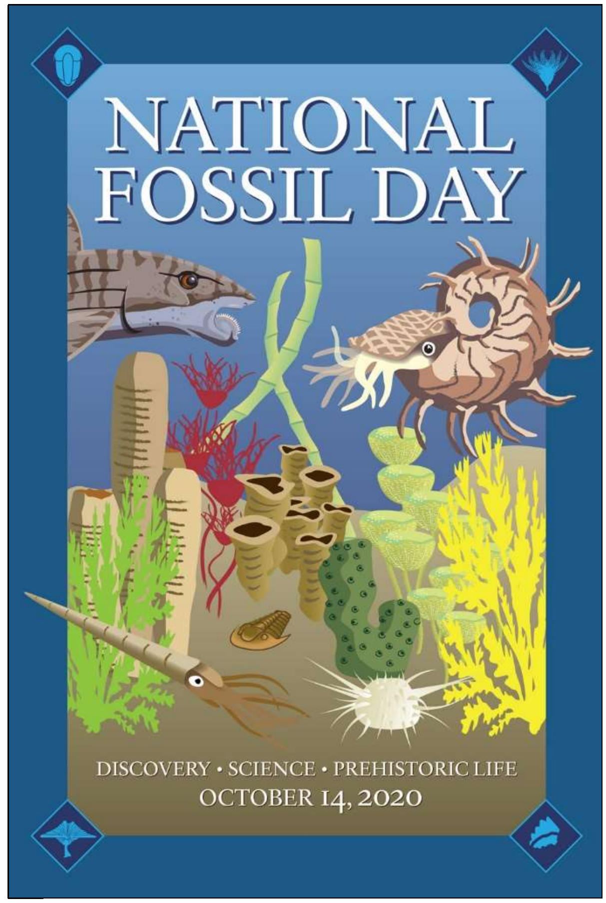
President: *Daniel Krisher*
Vice President: *Michael Grenier*
Secretary: *Daniel Krisher*
Treasurer: *John Handley*
Director 3-year term*: Melanie Martin*
Director 1-year term: *open*
Positions begin immediately.

The election results were tallied with the nominated slate of candidates winning unanimously. Multiple write-in votes were recorded for Melanie Martin to be a director and she accepted the position. Fred Haynes has two years remaining on a three-year term as Director and was not up for election.

National Fossil Day

We celebrate the eleventh annual National Fossil Day on Wednesday October 14, 2020.

The 2020 National Fossil Day Logo is inspired by the rich diversity of Permian marine fossils found at the Guadalupe Mountains and Glass Mountains of west Texas and New Mexico. The Permian Period (299 to 252 million years ago) represents the last geologic period of the Paleozoic Era, which ended with a massive extinction event at the boundary marking the end of the Permian and the beginning of the Triassic Period and the Mesozoic Era. During this extinction event approximately 96% of marine species and 70% of terrestrial vertebrate species went extinct. However, the Permian rocks and fossils preserved at Guadalupe Mountains National Park predate this extinction event and shows that a rich tropical reef system once occurred in west Texas and southeastern New Mexico approximately 270 million years ago.



Guadalupe Mountains National Park was established on September 30th, 1972 and incorporates 86,367 acres near El Paso, Texas. The park's name comes from the Guadalupe Mountains, which are found in western Texas and southeastern New Mexico, and also contain Carlsbad Cavern National Park. Guadalupe Mountains National Park includes Guadalupe Peak, which at 8749 feet in height is the highest point in the state of Texas, and El Capitan, an important geographical feature for travelers of the Butterfield Overland Mail stagecoach line during the late 1800s. These features of the Guadalupe Mountains are composed primarily of fossil-rich Permian limestones. In fact, there are so many fossils in the mountains that the middle part of the Permian is called the Guadalupian.

For more information on the fossils of the Permian reef, visit: https://www.nps.gov/articles/fossils-of-the-2020-national-fossil-day-artwork.htm.

El Capitan, Guadalupe National Park, Texas.
NPS photo by Vincent Santucci, October 2018.

For more information on National Fossil Day: **www.nps.gov/subjects/fossilday/index.htm**

June Meeting Recap

In lieu of our traditional June picnic our June 2 meeting was held via ZOOM. After a brief business session, the remainder of the meeting consisted of a fascinating presentation by Dr. Ben Dattilo, Associate Professor at Indiana University—Purdue University at Fort Wayne. His talk was entitled "The Hidden Functions of Crinoid Columnals" and was well attended, including by members too far away to come to our usual meetings. A few key points of the talk follow. Dr. Datillo was an excellent speaker and we will want him to return.

The crinoid column (also called a stem or stalk) is made from disc-shaped pieces of endoskeleton (internal) which are stacked upon each other and are hollow in the middle. These stems are made of discs called ossicles. Ossicles are also small calcareous elements embedded in the dermis of the body wall of echinoderms. They form part of the endoskeleton and provide rigidity and protection. The ossicles are the only parts of the animal likely to be fossilized after a crinoid (or other echinoderm) dies. They are held together by ligaments which decomposed rapidly after death.

The ossicles are constructed from calcium carbonate crystals in a sponge-like microstructure. This three-dimensional microstructure is called *stereom*. (Your vocabulary word for the day.) Ossicles are held together by collagenous ligaments and are covered by epidermis. The ligaments hold the ossicles together and provide a variety of postures for the organism without using extra muscular energy. The musculature gives additional support and flexes the column, arms, and other movable parts. This is so strong it actually enables a stalked crinoid to crawl rapidly (www.youtube.com/watch?v=cZcomBnNKXg for a video of this). Though covered by tissue, the ossicles of echinoderms have the function of an exoskeleton.

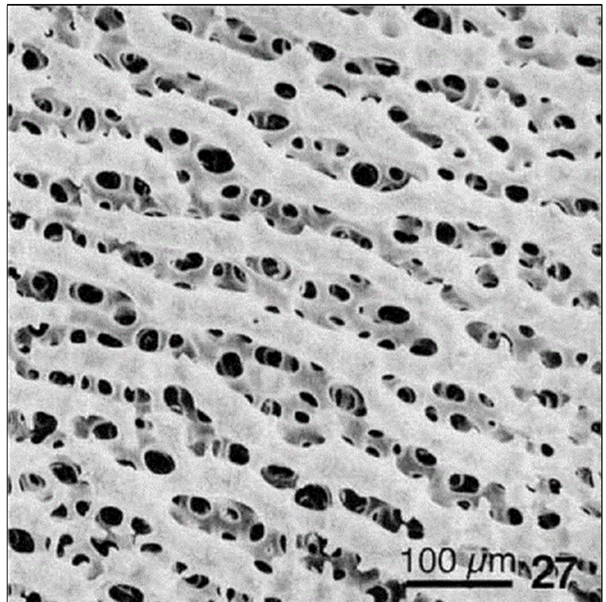


Fig. 27 Scanning electron micrograph of an arm ossicle of Tropiometra afra. This detail shows the underlying irregular stereom visible between the thick ridges. (Birenheide, R. and Motokawa, T., 1997. Morphology of skeletal cortex in the arms of crinoids (Echinodermata: Crinoidea). Zoological science, 14(5), pp.753-761.)

Field Trip Report

8/22/20 Lockport Rochester Shale: A Section field trip was planned for mid-July but had to be postponed until August 22nd. This field trip to collect in the Rochester Shale Lewiston Member (Middle Silurian) at an exposure in Lockport was attended by seven members—Fred Haynes, Daniel Krisher, Laura Marsh and her son Camden, Melanie Martin, Joseph Sullivan, and Michael Grenier. All attendees met at the site (no car-pooling) and social distancing was maintained. Attendees were required to have a mask in the event it was needed. The site, a moderately sized railroad cut, had sufficient space to maintain the required distancing.

The site is just off the road a short distance west of Lockport. This was something of a change for the Section as most of our trips are to Devonian exposures. Fossils at this site are very common but are typically small (1/2 inch) although larger material is also found. The site lends itself to just sitting down on the hillside and picking up the small brachiopods, bryozoa, and the occasional/rare coral and cystoid which are scattered across the surface. The site does not require tools, just a few small bags to collect your finds. We met at the site at 10:00 and collected for about four hours.

A long exposure only 140 feet from parking, this Lockport site is prolific, though fossils tend to run small. Photo by Fred Haynes.

A fieldtrip planned for September 19th was cancelled due to too few members expressing interest—likely it was attempted too late in the season.

RAS Fall Scientific Paper Session

Due to most colleges having extraordinarily challenging Fall semesters, the RAS has decided to forego the annual Fall Scientific Paper Session and is planning its next one for 2021.

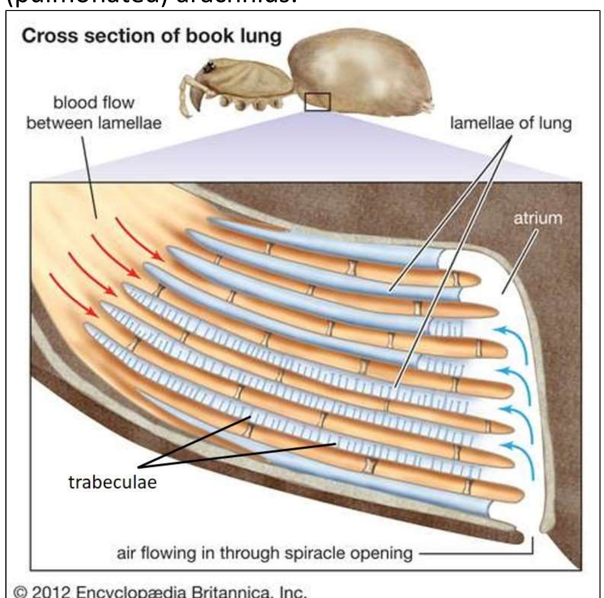
Fossil News

Air Breathing in an Exceptionally Preserved 340-Million-Year-Old Sea Scorpion

So, where is the best place to look for important fossils unknown to science? Actually, it is in museums, which have case after case, shelf after shelf full of fossils acquired but never analyzed or published. Some paleontologists have scores of papers describing new species found in their searches through museum collections. Another such has provided big news recently.

This one was found in the Hunterian Museum of the University of Glasgow. It is a small eurypterid in a phosphate nodule approximately 71 mm (2.8 inches) long and 55 mm (2.2 inches) wide. The nodule had been split and the dorsal (back) side of the specimen is visible. Almost the entire eurypterid is preserved, with the exception of the telson (the tail-end segment). This nodule is from the Lower Carboniferous Formation of the Montagne Noire region, France and is about 340 million years old. This area produces many of these nodules, which contain exceptionally preserved, permineralized, often three-dimensional fossils (of which this is one). The fossils in the Lydiennes phosphatic nodules include cephalopods, arthropods, and plants.

Modern scorpions and many spiders breathe using what are called "book lungs" because they are made up of sheets of stacked tissue similar to the pages of a book. Unlike book pages, the sheets of tissue (called lamellae) have to be held apart by struts so that air can flow between them. These struts are called trabeculae. Book lungs and trabeculae are only found in air-breathing (pulmonated) arachnids.



Book lung of spider (legs not shown). Your editor added the identification of the trabeculae.

This three-dimensionally preserved eurypterid is a new species, *Adelophthalmus pyrrhae*, and the authors provide a formal description of it. Not wanting to damage the fossil by attempting to remove it from the nodule, they used micro computed tomography (μ-CT) imaging to digitally reconstruct the entire specimen in three dimensional images including its internal structure. Among other features, they found four pairs of book gills preserved with trabeculae. (False color added to scanned images to emphasize structures.)

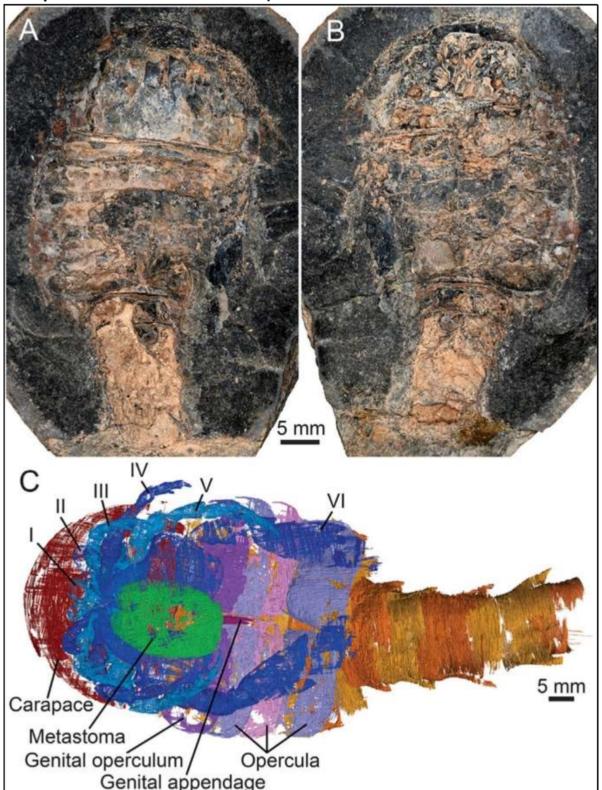
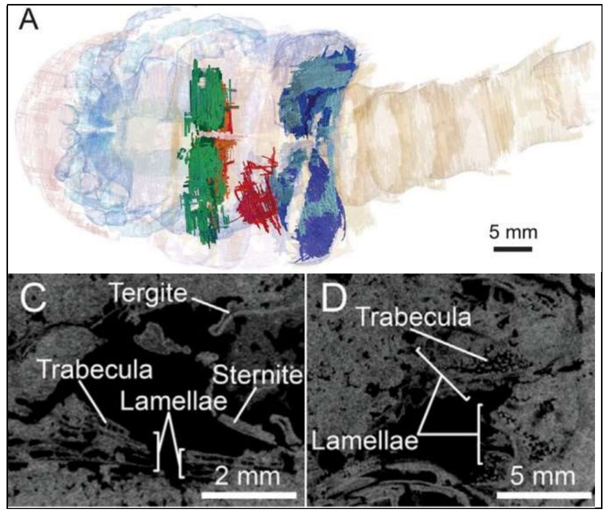


Figure 1. (A and B) Photograph of the part (A) and counterpart (B) of the phosphatic nodule containing Adelophthalmus pyrrhae*. (C) Digital segmentation of* Adelophthalmus pyrrhae *specimen in ventral view. Labels show major aspects of the morphology, with Roman numerals indicating the prosomal appendage pair.*

They report, "The trabeculae exhibit regular spacing and possess a morphology comparable to the trabeculae found in arachnids, which comprise a conical base extending into a narrow pillar. The occurrence of trabeculae on the book gills indicates that these too were active respiratory organs in air and confirms that eurypterids were fully capable of persisting in terrestrial environments for extended periods."

There have been prior discoveries of subaerial trackways attributed to eurypterids (though not proven) and these have led to the suggestion that eurypterids were able to venture on land and possibly breathe air. However, modern horseshoe crabs undertake amphibious excursions onto land to reproduce and they cannot breathe while out of water. The trace fossil evidence is inconclusive.



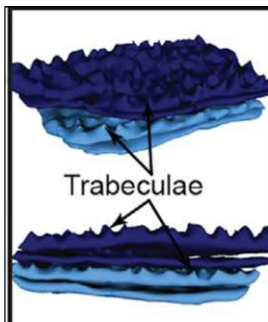


Figure 2 (A) Digital segmentation showing the location of preserved Adelophthalmus pyrrhae *gill lamellae (green, red, blue). (C & D) Scan images showing lamellae with trabeculae of the 6th body segment in lateral view (C) and lamellae located on the 4th and 6th body segments in dorsal view (D). (Bottom) Digital segmentation showing the trabeculae on two book gill lamellae of 6th body segment.*

This paper is the first published on the specimen, but more will follow as analysis is done on other parts of the anatomy. The authors are currently working on the leg structures, including back legs which expand into a paddle shape (possibly for swimming), spikes on the bases of the legs that may have ground up food to be maneuvered into their mouths, and the leg joints which would determine how they walked.

This paper, (James C. Lamsdell, Victoria E. McCoy, Opal A. Perron-Feller, Melanie J. Hopkins. Air Breathing in an Exceptionally Preserved 340-Million-Year-Old Sea Scorpion. Current Biology, 2020; DOI: 10.1016/j.cub.2020.08.034) does not appear to be available for free download, but a copy can be had from the editor.

Artistic reconstruction of* Adelophthalmus pyrrhae.* *Individuals of* Adelophthalmus pyrrhae *undertake amphibious excursions around freshwater pools in a Carboniferous forest. While the respiratory organs indicate that eurypterids were capable of respiring on land, the external morphology, including the expanded swimming paddle, indicates a predominantly aquatic mode of life.*

New fossil challenges shark evolution theories

The existing paradigm for shark evolution is that the first fish had cartilage skeletons, that sharks and their relatives descend from these, and that a different branch developed bony skeletons and they led to today's bony fish and tetrapods (including us). A new find calls that into question. First, let's review shark and other fishes evolution, as known from the fossil record.

According to the Natural History Museum, the earliest known fossil evidence for sharks or their ancestors are a few scales dating to 450 million years ago (MYA), during the Late Ordovician Period. Emma Bernard, a curator of fossil fish at the Museum, says, "Shark-like scales from the Late Ordovician have been found, but no teeth. If these were from sharks it would suggest that the earliest forms could have been toothless. Scientists are still debating if these were true sharks or shark-like animals." The earliest teeth fossils we have come from an Early Devonian (410 MYA) fossil belonging to an ancient fish called *Doliodus problematicus*. (The species name, *problematicus,* rather says it all.) Described as the "least shark-like shark", it is thought to have risen from within a group of fish known as acanthodians or spiny sharks. "Acanthodians are not at all shark-like in shape, for example they have diamond-shaped scales and spines in front of all the fins," says Emma. "But they do have a cartilage skeleton, a shark-like skull and jaw, and at least some shark-like teeth, which were often fused together." (www.nhm.ac.uk).

By the middle of the Devonian (380 million years ago), the genus *Cladoselache* had evolved. This is the first group that we might recognize as sharks today, but it may well have been part of the chimaera branch, and so technically not a shark. As active predators they had torpedo-shaped bodies, forked tails and dorsal fins. So, no unambiguous shark fossils until 380 MYA.

Fish arose during the Cambrian explosion about 530 million years ago. These were jawless but had skulls, a vertebral column, and skeletons of cartilage. They are a vertebrate superclass known as Agnatha, with lampreys and hagfish their living representatives. Early examples include *Haikouichthys* (525 MYA, China).

The earliest jawed vertebrates (gnathostomes) appear in the fossil record in the Silurian (though may have evolved in the late Ordovician). Two extinct groups are found—the acanthodians (~444 MYA) and the armored fish known as placoderms (~433 MYA). The jawed fish that are still extant in modern days also appeared during the late Silurian: the Chondrichthyes (or cartilaginous fish, ~430 MYA) and the Osteichthyes (or bony fish, 419 MYA). We have not found a common ancestor of any pair of these four groups. The bony fish evolved into two separate groups: the Actinopterygii (or ray-finned fish) and Sarcopterygii (which includes the lobe-finned fish and tetrapods).

The new paper by an international team from Imperial College London, the Natural History Museum, and researchers in Mongolia was led by Dr Martin Brazeau (Department of Life Sciences at Imperial College) and described a new 'placoderm'-like species from an exceptional partial skull roof and braincase discovered in Early Devonian (Pragian, 410 MYA) strata of western Mongolia. The species has been named *Minjinia turgenensis.* The authors suggest that the anatomical details found using x-ray computed microtomography (XR-µCT) provide strong evidence for placement in the gnathostome stem group. *Minjinia turgenensis* presents an unexpected discovery of extensive endochondral bone in a 'placoderm'-grade fish. Previously, no placoderm had been found with endochondral bone, but the skull fragments of *M. turgenensis* were "wall-to-wall endochondral."

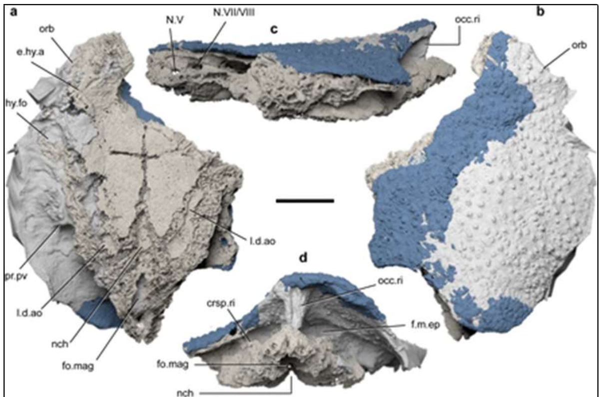
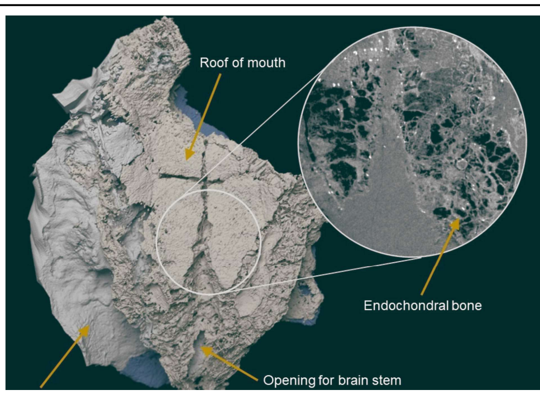


Fig. 1 *A 'placoderm' skull roof and braincase from the Early Devonian of Mongolia. a, Ventral view. b, Dorsal view. c, Left lateral view. d, Posterior view. Taupe: endoskeleton; grey: mold; blue: exoskeleton. Features:* ***crsp.ri,*** *cranio-spinal ridge;* ***e.hy.a,*** *sulcus for the efferent hyoid artery;* ***f.m.ep****, epaxial muscle fossa;* ***fo.mag****., foramen magnum;* ***hy.fo****, hyodean fossa;* ***l.d.ao****, sulcus for the lateral dorsal aorta;* ***N.V****, trigeminal nerve canal;* ***N.VII****, facial nerve canal;* ***N.VIII****, acoustic nerve canal;* ***nch****, notochordal canal;* ***occ.ri****, occipital ridge;* ***orb****, orbit;* ***pr.pv****, paravagal process. Scale bar, 10 mm.*

This endochondral bone is the key discovery. It is the main internal skeletal tissue of nearly all osteichthyans—as noted, the 60,000 living



species of bony fishes and all tetrapods. The prevailing hypothesis has been that endochondral bone is an osteichthyan character not shared with other lines. Even the group name reflects this— "oste" (bone) "ichthys" (fish). Finding it in a placoderm means that placoderms and osteichthyans must have it from a common ancestor, which would have been much earlier than the common ancestor of bony fish and sharks. The shark lineage should have inherited this bony material, but does not have it now. *The dermal bone must have been secondarily lost in early chondrichthyans.* The lighter skeletons of sharks may have evolved from bony ancestors, rather than the other way around. This has revived uncertainty about the true phylogenetic timing of the origin of endochondral bone. *Minjinia* provides direct corroboration for a more ancient origin.

Minjinia does not represent the first report of endochondral bone outside of Osteichthyes. However, it is by far the most extensive and unequivocal example and raises explicit questions in light of the proximity of *Minjinia* to the gnathostome crown.

Dr Brazeau was quoted in the Imperial College press release as saying: "If sharks had bony skeletons and lost it, it could be an evolutionary adaptation. Sharks don't have swim bladders, which evolved later in bony fish, but a lighter skeleton would have helped them be more mobile in the water and swim at different depths. This may be what helped sharks to be one of the first global fish species, spreading out into oceans around the world 400 million years ago."

Imperial College London has provided a one-minute YouTube video on the study results.
https://www.youtube.com/watch?v=bqz-BHXXG74

This paper, (Brazeau, M.D., Giles, S., Dearden, R.P. et al. **Endochondral bone in an Early Devonian 'placoderm' from Mongolia**. *Nat Ecol Evol*, 2020 DOI: 10.1038/s41559-020-01290-2) does not appear to be available for free download, but a copy can be had from the editor.

CALENDAR OF EVENTS

October
Tuesday October 6, FOSSIL MEETING 7:30 PM Virtual Meeting on Zoom. Advance registration required. Speakers Bill and Kris Parsons, ***"On their work in the late Early Cretaceous of Montana."*** **RAS members only.** Contact Michael Grenier at paleo@frontier.com.

November
Tuesday November 10 (NOTE 2nd Tuesday, not 1st Tuesday, due to election), FOSSIL MEETING 7:30 PM Virtual Meeting on Zoom. Advance registration required. Speaker: Danielle Dufault, Research Associate and Staff Artist at the Royal Ontario Museum on **"Art Work in the Service of Science."** RAS members and guests welcome. Contact Michael Grenier at paleo@frontier.com.

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 will be held on Zoom until at least February 2021. Meetings are held the first Tuesday of each month from October to December and from March to May at 7:30 pm. In person meetings, when they can be held again, are at the Brighton Town Hall, Community Meeting Room, 2300 Elmwood Avenue, Rochester, NY unless otherwise listed.

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Director (one-year-term): ***Open***		
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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.


Acanthodian fish fossils are generally just loose batches of scales and spines, as the cartilage skeleton quickly decomposes. We would know little if that is all we had. Fortunately, we occasional find specimens preserved as complete carbonized imprints, as with this Middle Devonian *Rhadinacanthus (Diplacanthus) longispinus*,