A publication of the Rochester Academy of Science FOSSIL SECTION

The FOSSILETTER

VOL. 38 Number 4 February 2021

February Meeting

The February section meeting is on Tuesday, February 2, at 7:30 PM. This meeting will be conducted as a virtual meeting on Exputo's BigBlueButton (not Zoom). Details on how to login in are in the accompanying email.

Our February speaker is Dr. Emily Willoughby, "The science and art of paleontological illustration."

We have the following from Dr. Willoughby, "Paleontological illustration, or paleoart, is a specific genre of naturalistic visual art that focuses uniquely on life that lived and died before human prehistory. It shares many of its principles with any genre of naturalistic visual art, such as the importance of accuracy, composition, perspective, color and light. Paleoart, however, is unique across one important dimension: the fact that we cannot passively observe Mesozoic birds and other dinosaurs as they were, or capture their appearance and behavior with photography, means that we need to apply principles of scientific inference to our visual representations of them instead.

Illustration from Dr. Willoughby's soon to be published paleoart book

"The process of creating paleoart is one that starts with the discovery of a fossil, and proceeds through a series of interacting steps of scientific understanding and artistic interpretation. I will cover how the paleoartist must understand and interpret information from research in order to represent the form and function of the subjects to be painted, and the life appearance, behavior, and environment most realistic to the evidence at this time. With examples from descriptions of new Mesozoic birds and other dinosaurs, phylogenetic interpretation, biomechanical studies, and ichnological studies, we will explore how a conscientious paleoartist can strive to represent dinosaurs as they were, not as movie monsters or mysterious creatures, but as real animals, full of beauty and life."

Dr. Willoughby recently received her Ph.D. in Behavior Genetics. As a scientist studying human

behavior, she is working at the intersection of evolutionary biology and psychology. Although she has several important (i.e., cited by others) papers and awards in this field, paleoart is almost a parallel career.

Dr. Emily Willoughby, University of Minnesota Twin Cities

An avid birder with long-standing interest in fossils and with artistic talent, she has become a noted and sought-after artist for paleontological scientific publications. Her gorgeous illustrations of Mesozoic birds and other dinosaurs bring these avocations together.

Dr. Willoughby has a web site dedicated to both her behavior genetics and to her art at emilywilloughby.com. Not surprisingly, she does the illustrations for her own professional papers and for those of her peers in her field.

Membership Renewal Time

We are still awaiting many of our members to make their renewal of membership (which expired 12/31/2020). If you have not, please renew at your earliest convenience. A membership form is attached to the cover email, or you can get one at **rasny.org/mbform.pdf**.

President's Report by Dan Krisher

The Fossil Section calendar is typically quiet for the months of December and January and with the ongoing COVID restrictions it has been particularly so this year. The Section's December meeting was held via ZOOM on 12/1 and featured a talk by Dr. D. Jeffery Over from SUNY Geneseo. Dr. Over's talk dealt with ongoing research into the world-wide Devonian mass extinctions and the evidence for them in the Devonian rocks of New York.

As is tradition, the Section did not have a January meeting. Typically, the Section has one or two outreach events scheduled for December and January but these have been cancelled due to the virus.

The Devonian Globe

dinosaurpictures.org/ancient-earth#400

This is a great web site for viewing how the earth has changed through time. It was created by Ian Webster, a software engineer in California with a focus on data analysis and visualization. At this link, #400, you are presented with the Earth as we understand it to have looked 400 million years ago in the Early Devonian. The view is a spinning globe so it looks as though it would have from space, except that modern landmass outlines are shown so you can know where you are.

From this you can move back to 430 Mya (Late Silurian), or deeper in time. You can move forward to 370 Mya (Late Devonian) or more close in time. This greatly aids our ability to visualize the motion of the tectonic plates, as we can see how they move through time. There are twenty-six time views to select, ranging from 750 Mya (Cryogenian Period – "Snowball Earth") to today's view. Note that for the Cryogenian Period, they do not show the Earth as covered in ice, as then you would not be able to see where the continents are located.

It gets better. In the upper left, if you enter your nearby city (e.g., Rochester, NY) or any other location, they highlight that location. The only flaw is that on the list of nearby fossils, they only show dinosaur fossils—but it is a feature within a site dedicated to those critters.

Mendon Ponds Park WinterFest

As of press time, it is unclear whether Monroe County will go ahead with their annual WinterFest or not. It is likely to be cancelled, in your editor's opinion. Regardless, the RAS Board of Directors has already decided that it is not yet sufficiently

safe for us to have members at our usual indoors facility, and if the event is held out-of-doors only, it would not be conducive to the outreach displays we set up. Hence, the RAS has already cancelled our participation, even if the event goes on. If they do hold it, members are welcome to make their own decisions as to whether to go and enjoy the other planned activities.

monroecounty.gov/parks-winterfest

December Meeting

Dr. Over reviewed the nature of mass extinction, reviewing the five major ones (end-Ordovician, late-Devonian, end-Permian, end-Triassic, and end-Cretaceous) before focusing on that of the Devonian. The Devonian was a major mass extinction (Kellwasser events–ending ~376.1 Ma) between the Frasnian and Famennian stages, with smaller extinctions added in at the Middle Devonian (Eifelian-Givetian boundary) and at the end-Devonian. The first two are found throughout NY state, and the late Devonian is in Pennsylvania, so most members do not have to go far to find each of these in the strata. The best preserved strata in the world for the Frasnian-Famennian extinction is in the deltaic black shale and carbonate deposits of the Hanover shale in western NY. 60-70% of the fauna became extinct and reefs ended with the extinction of Stromataporoid sponges and most rugose corals.

Hanover shale on Silver Creek. Courtesy Jeff Over

He presented evidence that causes of these extinctions were climate changes and sea level rises and falls, driven by forest development and erosion rate change.

The strata in the above photograph ranges from the Lower Kellwasser event at bottom to the Upper Kellwasser event near top, with 30 meters of thickness between them—much more than the 1 to 1 ½ meter thick deposits in Germany and Morocco. There was 800,000 years between the lower and upper Kellwasser events. Every thin black shale deposit lines up with a Milankovitch 20,000-year cycle. With an average of about 250 years' accumulation per centimeter, Dr. Over and associates have already found sub-cycles with 2000 and 350 year periodicities, and may be able to get to annual.

~~Book~~ *Video* Review

Prehistoric Road Trip, Emily Grassley, PBS, DVD (2020) $24.99.

Emily Grassley (right) with Danielle Dufault of the Royal Ontario Museum, our speaker this past November.

Imagine taking a nine-week-long, 6,000-mile road trip throughout the northern Great Plains of the U.S., visiting every fossil museum you can find in the Dakotas, Montana, Wyoming and Nebraska. Imagine that you have a knowledgeable professional tour guide to take you through these museums. Imagine that your highly entertaining tour guide is well-connected and knows all of the museum directors and other personalities

involved and will introduce you for discussions on their research projects. Imagine that she gets you full access to the back rooms and storage areas of each of these museums. Imagine that she knows not only the museums but all of the nearby field collecting sites and the teams and team leaders working at each of those quarries and takes you to more than thirty of them. Now imagine that all of that has to be crammed into three hours. That is what you get with this fun and engaging video of the PBS series "Prehistoric Road Trip." Your tour guide is Emily Grassley, "Chief Curiosity Correspondent" staff member of the renowned Field Museum of Natural History in Chicago. Emily and Ally Gimbel are also the Executive Producers of the series, which took three years to complete.

This video's three episodes cover 2.5 billion years of life on earth. Episode 1, "Welcome to Fossil Country," covers the Precambrian and Paleozoic, up through the end-Permian mass extinction and to the end of the Jurassic. Emily introduces us to some of Earth's earliest life forms, primitive bacteria preserved as fossils, and which created the atmospheric oxygen that kick-started animal and higher plant evolution. Looking at a slab of these fossils, she exclaims, "*So this is how life started on earth! In the bacteria*!" She slices through time and rock strata to explore that evolution, stopping to look at many of the fascinating creatures that preceded us. In Episode 2, "We Dig Dinosaurs," we cruise with Emily into the 80 million-year long Cretaceous Period, when astonishing creatures dominated the planet. She explores what happened to these tremendous animals and how other life forms survived an apocalyptic asteroid crash into Earth 66 million years ago. Episode 3 "Tiny Teeth, Fearsome Beasts" continues her adventure into the most recent 66-million years, the Age of Mammals. For me, this delightful program has been a joy to watch. It has an easy-going feel to it, with riding-in-the-car scenes between sites of interest. Conversational in format, it was very much like riding along on an actual road trip.

Emily Grassley (left) with Melissa Connely, Tate Geological Museum Curator, examining a pterosaur trackway. (Editor's Disclaimer: This image capture was not selected at random. I worked with Melissa for several field seasons in the 90's.)

If on your own, you might have overlooked small museums such as the Tate Geological Museum in Casper, WY; the Great Plains Dinosaur Museum in Malta, MT; and the Standing Rock Institute of Natural History. For the latter, Emily takes us there to meet Sioux Paleontologists Ben Eagle and Sonya White Mountain, who discuss the abundant fossil remains found on their tribal lands and the museum built to hold them after their people were the first tribe in the U.S. to enact their own fossil management code.

Grassley goes out of her way to not be portrayed as an expert, rather serves as questioning interviewer to a range of experts with whom she engages. When necessary, she explains more about what she "learned" to the rest of us. Make no mistake, she has expertise, and she could not have done this if she didn't, but she is careful not to encroach on the stories of the people she lined up to showcase their museums and their work. She says that she interviewed more than 50 people and traveled (with the PBS crew) about 6000 miles. Extensive planning went into this ahead of time and most of the filming was done over an eight-week period in the summer of 2019. ("*We talked with landowners. We talked with two different tribal communities. We talked with universities, community colleges, amateurs — just paleo nerds, illustrators, artists. We talked with anybody who we could find to ask them how paleontology and studying the fossil record had shaped them and their identity — because that's kind of what the show is about, how my identity has been shaped by my proximity to this part of the world*.")

This show is easy to watch and follow, but you will learn a lot without making much effort at it. I highly recommend this video. So much so that I

added it to my gift list and my loving wife accommodated me. It can be had at prices well below retail at several on-line stores. I searched the Monroe County library system and found it at only one library, but it is worth asking your library to bring it in on inter-library loan. If you subscribe to Amazon Prime Video, the series is available for streaming there. If all else fails and you are close enough to me, I will lend you my copy.

Modern Birds of the Mesozoic, Part 1

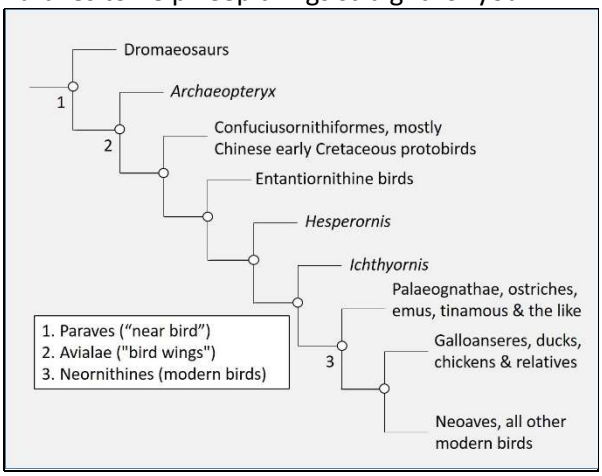
In our May 2020 issue, we reviewed the publication of *Asteriornis maastrichtensis,* a late Cretaceous modern Aves (synonym Neornithes, also called crown birds). All modern birds, over 10,000 species of them, are Neornithine birds. But this article you are now reading could have been really short. Although there are lots of birds known from the Mesozoic, there are only two generally accepted well-supported modern birds among them—*A. maastrichtensis* and *Vegavis iaai*, and both of these are found from just before the mass extinction. More on both these to follow, but first, why only these two?

Apart from birds, all major groups of extant tetrapods—amphibians, snakes and lizards, turtles, mammals and crocodilians—are well-known from pre-Cenozoic crown-group fossils. We know from multiple DNA-based phylogenetic studies (Jarvis et al 2014, Claramunt & Cracraft 2015, Prum et al 2015, Kimball et al 2019, and others) that among living birds, the ratites (ostriches and relatives) split first from the avian tree and then the Galloanserae ancestors of ducks and chickens before those two lineages split in turn. The remaining 95% of extant modern birds form a group named Neoaves. We know from time-calibrated studies and rare early Cenozoic fossils that Neoaves itself underwent an explosive radiation close to the K-Pg boundary. Whether before or after is not yet known due to lack of fossil evidence. It is possible (Kimball 2019) that the first split within Neoaves (one lineage that led to the flamingos, grebes, sandgrouse, doves and pigeons and a second lineage leading to all other Neoaves) may have been in late Cretaceous.

As is now well-known, paleontologists have determined that Neornithes is the only surviving type of Theropod dinosaur. Specifically, it is a maniraptoran theropod, which excludes beasts like *T. rex* and *Allosaurus* but which includes Dromaeosaurs (*Deinonychus, Velociraptor,* and their relatives and *Oviraptor* and its relatives).

Included within Maniraptora is the group Paraves ("near bird") which includes Dromaeosaurs and Avialae—this latter the Neornithines and their close extinct relatives. Paravians generally have long, winged forelimbs, though these have become smaller in many flightless species and some extinct lineages that evolved before flight. The wings usually bore three large, flexible fingers, with claws in early forms.

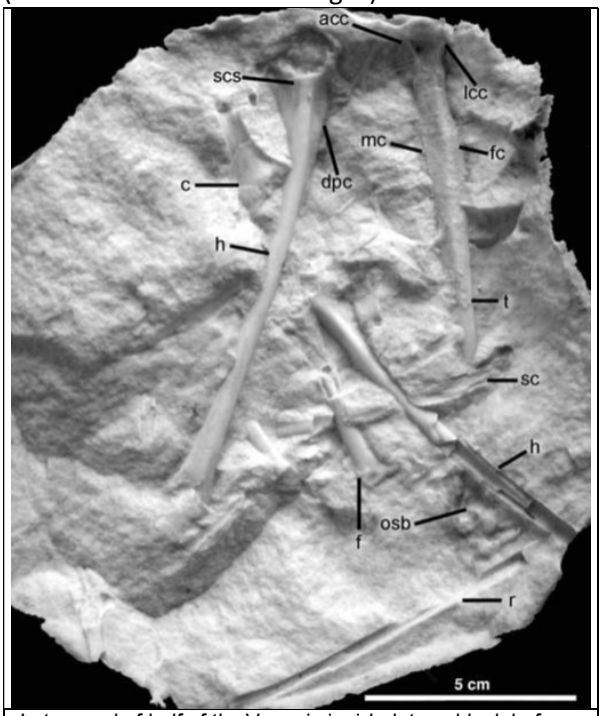
Phylogeny (history of a group's evolution, with descent and relationships) can be confusing, so here's a greatly simplified bird family tree for Paraves to help keep things straight for you.



Archaeopteryx, from the Late Jurassic (~150 MYA) is still generally accepted as the oldest known bird (with some contention). There are a number of other proto-birds, but by the time of the late Cretaceous, most of the known birds are either Hesperornithines (flightless diving birds, 28 species) or Enantiornithines ("opposite birds", over 80 species). But very few Neornithines are found before the Cretaceous-Paleogene (K-Pg) extinction.

In 2005, Dr. Julia Clarke, one of the foremost bird paleontologists, led a team that described a partial skeleton of the first Cretaceous fossil definitively placed within the extant bird radiation. The team performed several phylogenetic analyses supported by independent histological data that demonstrated that *Vegavis iaai* was both

a new species and is a part of Anseriformes (waterfowl) and is most closely related to Anatidae, which includes true ducks. They noted that *Vegavis* showed that a minimum of seven surviving and still extant avian lineages had to have diverged before the K-Pg boundary—that of the ratites(1), of the landfowl(2) from waterfowl(3), and of the ancestors of the screamers(4), the magpie geese(5), and true ducks and geese(6). No inferences regarding Neoaves can be made from this fossil, though, except that at least one ancestral species(7) escaped the K-Pg extinction. Although Neorithine birds were likely very rare in the Cretaceous, at least seven species (one for each of these lineages) survived.



Latex peel of half of the Vegavis iaai *holotype block before original preparation. The coracoid, right humerus and tibia are all present, as were all pelvic bones, 7 vertebrae, left scapula, right ulna, right and left fibulae, a tarsometatarsal shaft proximal left humerus, right coracoid, femora, left tibiotarsus, distal right radius, sacrum, distal left tarsometatarsus, proximal right tarsometatarsus and more than six dorsal ribs. No skull was found.*

Because *Vegavis* was found in Antarctica, and all other early Neornithine fossils are from there or other southern Gondwana locales, some have theorized by that all modern birds are descended from shorebirds in a Gondwanan refuge where they survived the extinction impact. Found in Upper Maastrichtian (~66–68 Ma) strata, *Vegavis* lived just before the extinction. Clarke et al published a second partial but substantial specimen of *Vegavis iaai* from the same location was by in 2016. This specimen also lacks a skull.

Published in 2020, *Asteriornis maastrichtensis* is the other well-supported crown bird from the Mesozoic and the first Mesozoic crown bird with a skull. Character-based phylogenetic analysis (no DNA to use) shows it as a sister taxon to the common ancestor of Galliformes (landfowl) and Anseriformes (waterfowl), with characteristics of both groups—not surprising when closely related to the unknown common ancestor. The fossil is 66.8 to 66.7 million years old—the oldest unambiguous crown bird fossil yet discovered.

Asteriornis provides conclusive Mesozoic evidence of Neornithes in the Northern Hemisphere undercutting claims that Gondwana was the origin point of modern birds. *Asteriornis* also provides a firm calibration point for the minimum age of divergence (66.7 Ma) of the major bird clades Galloanserae and Neoaves.

A large *Ichthyornis*-like archaic bird fossil was found in the same quarry horizon as *Asteriornis* (hence same approximate age). This provides evidence (also found elsewhere) that modern birds and avialan stem birds were in the same environment in the immediate lead-up to the K–Pg mass extinction.

Other birds referred to Neornithines are based on scrappy material. *Polarornis* is known from a few bones including humerus, femur, and proximal end of the tibia and *Neogaeornis* only by one non-diagnostic tarsometatarsus leg bone. Both have been claimed (with the Paleocene *Australornis)* to be in the same family as *Vegavis,* or to be stem-loons, or to not be modern birds at all. *Teviornis* is known only from a few pieces of a crushed right forelimb in Mongolia. Described as an Anseriformes, a more recent study found that it cannot be conclusively assigned to Neornithes.

Palaeotringa was found by O. C. Marsh in the Hornerstown Formation of New Jersey, which straddles the Cretaceous and the Paleocene. Originally thought to be latest Cretaceous, but more likely from the Paleocene, the scant fossils are so fragmentary that they cannot be assigned to any family. Known Hornerstown Cretaceous shark, fish, and ammonite fossils appear to be

reworked and likely not contemporaneous with other fossils there. Named birds include *Tytthostonyx* (from a single, partial bone), *Anatalavis*, *Telmatornis* (from distal end of right humerus), and *Laornis* (from a single tibiotarsus leg bone). Although these fossils are informative, they do not tell us enough. None are conclusively from the Mesozoic.

(Next month: The end-Cretaceous extinction and how modern birds made it through.)

Kimball, R.T., et al., 2019. A phylogenomic supertree of birds. *Diversity*, *11*(7), p.109.

Longrich, N.R., et al., 2011. Mass extinction of birds at the Cretaceous–Paleogene (K–Pg) boundary. *Proceedings of the National Academy of Sciences*, *108*(37), pp.15253-15257.

Clarke, J.A., et al., 2005. Definitive fossil evidence for the extant avian radiation in the Cretaceous. *Nature*, *433*(7023), pp.305-308.

Claramunt, S. and Cracraft, J., 2015. A new time tree reveals Earth history's imprint on the evolution of modern birds. *Science advances*, *1*(11)

Prum, R.O., et al., 2015. A comprehensive phylogeny of birds (Aves) using targeted next-generation DNA sequencing. *Nature*, *526*(7574), pp.569-573.

Jarvis, E.D., et al., 2014. Whole-genome analyses resolve early branches in the tree of life of modern birds. *Science*, *346*(6215), pp.1320-1331.

Field, D.J., et al., 2020. Late Cretaceous neornithine from Europe illuminates the origins of crown birds. *Nature*, *579*(7799), pp.397-401.

Fossil News

Ice Age Woolly rhinoceros collected from Siberian Permafrost *(suggested by Fred Haynes)*

In news released just this past December, Russian researchers announced that an Ice Age-era woolly rhinoceros was unearthed in eastern Siberian permafrost in August 2020 on the banks of the Tirekhtyakh river in the Abyisky region of Yakutia. This may be the best-preserved woolly rhino yet found, according to Dr. Valerii Plotnikov at the Russian Academy of Sciences. He said that much of the rhino's soft tissue was still visible, and that the rhino was between three and four years old when it died, probably from drowning. The rhino is believed to have lived in the late Pleistocene era, anywhere between 20,000 and 50,000 years ago. The beast will reportedly be moved to a lab in the city of Yakutsk, where scientists will take samples and carry out radiocarbon analyses, and then to a lab in Sweden for further analysis. There were traces of wear on the horn, suggesting the rhino "was actively using it for food", she said.

A carcass of a juvenile woolly rhinoceros, found in permafrost in August 2020. image copyright Reuters

The woolly rhino specimen includes all four limbs, its nasal horn, some of its woolly coat, and likely even internal organs. Dr. Plotnikov said that wear marks on the horn suggest the creature may have used its horn to gather food, perhaps scraping away snow to reach tender greenery underneath. The site is close to where another young woolly rhino was recovered in 2014 which was estimated to be 34,000 years old.

Horizontal image of the woolly rhino's full body (Valery Plotnikov / Courtesy of the Siberian Times)

Discoveries of this kind are becoming more frequent as global warming melts the permafrost across vast areas of Russia's extreme north and eastern regions. For more, see
https://www.youtube.com/watch?v=XNPaPbg9Qkw
https://www.smithsonianmag.com/smart-news/melting-russian-permafrost-yields-new-woolly-rhino-specimen-180976664/
https://www.bbc.com/news/world-europe-55490037

CALENDAR OF EVENTS

February
Tuesday February 2, FOSSIL MEETING 7:30 PM Brighton Virtual Meeting on BigBlueButton Speaker is Dr. Emily Willoughby, "The science and art of paleontological illustration." Visitors welcome.

March
Tuesday March 2, FOSSIL MEETING 7:30 PM Brighton Virtual Meeting on Zoom. Speaker is Dr. Dale Hess on the Ice Age Drumlins of New York. Visitors welcome.

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 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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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.

Ice Age rhino horn from the new Siberian specimen