A publication of the Rochester Academy of Science
FOSSIL SECTION

The FOSSILETTER

VOL. 38 Number 5 March 2021

March Meeting

The March section meeting is on Tuesday, March 2, at 7:30 PM. This meeting will be conducted as a virtual meeting on Zoom. Details on how to login in are in the accompanying email.

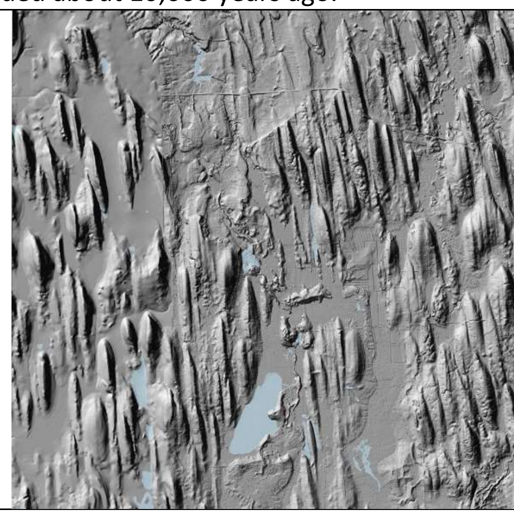
Dr. Dale Hess

Our March speaker is Dr. Dale Hess on "Drumlins of New York—What They Tell Us About Our Changing Climate." A drumlin is an oval or elongated hill formed as moving glaciers deposited till on outcroppings of bedrock or other obstacles in their paths. Till is the term for an unsorted and unstratified accumulation of glacial sediment. This is clay, sand, silt, rock, gravel, and soil scraped up by the glacier as it advances.

Classical drumlin with farm shown above it for scale

Dr. Hess provided the following, "Between 12,000 and 15,000 years ago, during retreat of the Laurentide Ice Sheet, most of what is now New York was covered by several thousands of meters of ice. Beneath that ice, glacial sediments amassed into fascinating glacial features known as drumlins. These streamlined bedforms vary in size and shape with some several hundred feet in width and a few hundred feet to several miles in length. This variability in size and shape tells an interesting story of the glacial past of New York State and provides an enhanced understanding of modern ice sheet behavior under a changing climate."

Drumlins are common in central New York between Lake Ontario and Cayuga Lake and were formed during the Wisconsin glaciation which ended about 10,000 years ago.



Digital elevation model showing glacial features of New York State. Note Duck Lake in bottom center, about 5 miles south by southeast of Victory, NY.

About our speaker: Dr. Hess received his Ph.D. in Geology from the University at Buffalo. After serving as a visiting scholar at University Centre in Svalbard (Norway), he was a member of the faculty at both Brock University and University of Rochester. Dr. Hess has spent the majority of his scientific career studying subglacial bedforms around the world, including the drumlins of New York State. An avid steward of our environment, Dr. Hess currently serves as Assistant Vice Provost at the University of Rochester.

President's Report by Dan Krisher

The Section's February meeting was held via ZOOM on 2/2. The meeting opened with a brief business portion in which the members were updated on COVID, the status of outreach events, and initial ideas around field trip plans. Trips will begin in April. The next portion of the meeting featured a talk by Dr. Emily Willoughby entitled "*The science and art of paleontological illustration*." Her talk gave an overview of the processes used to create "anatomically correct" artistic reconstructions and dealt primarily with avian dinosaurs.

February Meeting

President Dan's opening comments are largely covered in his above report. These were followed by an exciting meeting with Dr. Willoughby. Her work is frequently commissioned by paleontologists as illustrations for their papers on their fossils. She shared her scientific approach to recreating life scenes of extinct animals, including the subject, the background, and the depicted behavior, which has to be grounded in science. Examples include both the type and coloration of feathers. Over 110 people attended this talk.

One of Dr. Willoughby's recreations of Microraptor gui *showing environment and hypothesized behavior.*

Some paleo art actually advances the science not only by forcing the paleontologists to think through their interpretations of the fossils but also in advancing new hypotheses based on the fossils. As an example, she discussed Charles William Beebe (1877-1962), an American explorer, naturalist, ornithologist, entomologist, marine biologist, and author. Along with his analysis of pheasant phylogeny and his studies of life in the Galápagos islands, Beebe regarded one of his most important contributions to the field of evolutionary biology to be his hypothesis that the ancestors of birds passed through what he referred to as a "Tetrapteryx stage", with wings on both their front and hind limbs. Beebe based this theory on his observation that the hatchlings and embryos of some modern birds possess long quill feathers on their legs, which he regarded as an atavism; he also noticed vestiges of leg-wings on one of the specimens of Archaeopteryx. Beebe described his idea in a 1915 paper titled "A Tetrapteryx Stage in the Ancestry of Birds". Never accepted while he lived, this turns out to be a dead ringer for the now well-known *Microraptor gui*.

Beebe's illustration of "Tetrapteryx" (from microecos. wordpress.com).

We recorded the talk at https://lb-sl-v1.meetingspace.cloud/playback/presentation/2.0/playback.html?meetingId=d7a3368216fb74b4c7451c3a6d2df6c388f1593e-1612310420368. Her talk starts at 8:35 minutes into the recording (following the RAS announcements and introduction) and runs to 78:40, the Q&A session then follows from 78:40 to 86:29. Carl Fechko's discussion (see following) covers the time between 87:18 to 91:35.

Fossil News

Nerepisacanthus denisoni

This small specimen (112mm, 4.4") of the Late Silurian acanthodian fish *Nerepisacanthus denisoni* is the first vertebrate fossil collected from the Bertie Formation Konservat-Lagerstätte of southern Ontario, Canada, a deposit well-known for its spectacular eurypterid fossils. The fish is the only nearly complete acanthodian from pre-Devonian strata worldwide. Published in 2014, it is newsworthy now as it is being included as a permanent display in the new Royal Ontario

Museum Willner Madge Gallery's Dawn of Life exhibit, set to open in November 2021.

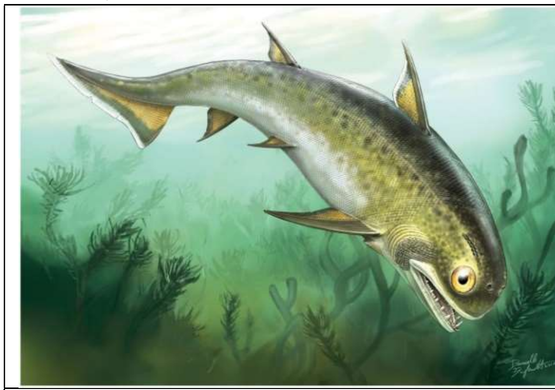
The spectacular fossil was found by amateur collector Carl Fechko, who discussed it with us at the February meeting. He frequently collects eurypterids at the Ridgemount Quarry in Fort Erie, Ontario. Here fossils are found by splitting and examining thin sheets of limestone. Carl explains, *"I had a neat little wall of smooth rock that was about 6 inches tall. It was not cracked anywhere. I randomly placed my chisel on that little wall, hit the chisel with my hammer, the rock split, and there was my fish. Because the fish was split out and because the actual fossil was so thin, if I had placed my chisel a millimeter or two higher or lower, I would never have found that fossil*."

Carl Fechko at finding of Nerepisacanthus denisoni

Carl donated the specimen to the ROM. *"Shortly after that, Dr. Rudkin asked Dr. Carole J. Burrow from the Queensland Museum in to study my fish. After she agreed, she asked that the fossil be shipped to Australia. The ROM told her that the fossil was too valuable and rare to ship it anywhere and if she wanted to study it, she would have to make the trip to Canada. She replied that if she was going to make the trip to Canada, she needed proof that her trip was worth making. So, the ROM compromised by lending her a tiny fragment that was shipped by a secure carrier. She eventually did make the trip to Canada to study my fossil. And then, after studying my fossil with a scanning electron microscope she declared that my find had already been discovered somewhere else. Even though my fossil was older and more complete, I did not get it named after me which was a small disappointment for about a day or so*."

Burrow & Rudkin (2014) Figure 2. A. Nerepisacanthus denisoni*, new specimen ROM64622.*

"It only took a minute for all the collectors to come running to see my fossil. One guy looked at the fish fossil and then turned to me and said, 'I have been collecting this quarry for 40 years and this is the most important fossil to ever come out of here.'" That turned out to have been our member, Sam Ciurca.



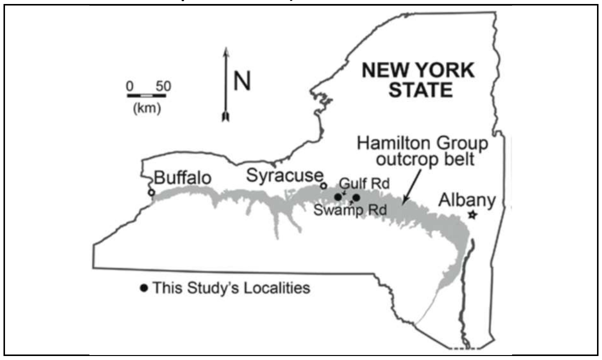
Recreation by Danielle Dufault, paleo artist at the Royal Ontario Museum and our last November speaker.

The original paper (Burrow, C.J. and Rudkin, D., 2014. **Oldest near-complete acanthodian: the first vertebrate from the Silurian Bertie Formation Konservat-Lagerstätte, Ontario**. *PloS one*, *9*(8), p.e104171) is available at:

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0104171

Long-term community stability in the lower Hamilton Group

It is no surprise to collectors that the life during the Middle Devonian, which we find as the fossils of the prolific lower Hamilton Group, were apparently stable for 4-6 million years until the extinctions so well covered by Dr. Over in our December meeting. A paper out of Syracuse University has now thoroughly examined that apparent stability with statistical analysis of populations from 81 sites with ~300 specimens from each. The team identified eight statistically and ecologically distinctive benthic communities that occur at these sites, in a vertical gradient from depleted deep-water dark shales below to species-rich shelf siltstones above. (These lower Hamilton communities, with two exceptions, do not have clear counterparts among upper Hamilton Group faunas.)



Two theories supposedly explaining the stasis were evaluated. The "ecological locking" (Morris et al., 1995) model views these marine communities as tightly structured and therefore, once established, resistant to large-scale taxonomic change. The "environmental tracking" model, in contrast, interprets stability as arising when faunas follow environments through time; during an interval of minimal environmental change, faunas will vary only minimally (Ivany, 1996). The "ecological locking" model proposed to explain the stability of Hamilton faunas is not supported by quantitative tests to date.

This paper, Newton, C.R., Newman, W.B. and Brower, J.C., 2020. Quantitative paleoecology of marine faunas in the lower Hamilton Group (Middle Devonian, central New York): **Significance for probing models of long-term community stability**, is at https://pubs.geoscienceworld.org/books/book/2216/chapter/126999749

Modern Birds of the Mesozoic, Part 2

Bird Mass-Extinction Survivors

by Michael Grenier

There are over 10,000 species of birds alive today. Imagine, if you will, an environmental crisis so severe that when it is over only a half dozen or so of these species have survived. These might include a landfowl or two, perhaps small numbers of prairie chickens and grouse. There might be a couple of ducks, such as silver and cinnamon teal. Maybe the kiwi makes it through and some song birds might survive, maybe a few juncos and hermit thrush. Shorebirds, all gone, except one or two, such as a sandpiper or a dunlin. All such survivors would have a number of things in common—very small size, generalist diets, and ground-dwelling with no reliance on trees. In short, they would mirror what passed through the last major extinction.

As we saw last month, birds were found everywhere in the late Cretaceous, and most of these were enantiornithean birds—toothed, with clawed hands and long bony tails. Over 80 species of these have been named, but many researchers believe that their diversity actually approached that of modern birds and that they filled all the niches of modern birds. Most were perching birds and most had teeth evidencing carnivory, with prey from insects and crustaceans to fish and other vertebrates. Although a couple without teeth are known, they appear to be fish eaters. No seed-eating enantiornitheans have been found yet and it may be that there were none. Exceptionally well-preserved enantiornithean soft tissue fossils show no evidence of a crop or gizzard for grinding seed material. The claws of most enantiornitheans show that they were perching birds. These are factors which can explain why none survived the mass extinction.

Chicxulub bolide impact (from dreevoo.com)

The Cretaceous-Paleogene (K-Pg) extinction was coincident with the Chicxulub asteroid impact (66.02 Ma). Of course, the impact itself would have destroyed life in Central America and in much of North and South America. Even Africa, much closer then to the impact site, may have had immediate damage. Non-avian dinosaurs and pterosaurs became extinct, and major extinctions also occurred among mammals, reptiles, insects, and plants. The effects on marine life were similar.

It is estimated that 75% or more of all species on Earth vanished.

Evidence has been found worldwide of major destructive events right at the K-Pg boundary and contemporaneous with the impact. We find corroboration for the impact and for other near-term and long-range ecological catastrophe after-effects in the boundary rock layers. (There was also massive volcanism in India which may have contributed.) There is a layer of clay from fine particle matter settling out of the atmosphere, found at over 100 locations world-wide. It is 30 cm thick or more in Haiti and other near-to-impact locations. The clay can be as thin as 1 mm in some locations but still found everywhere the boundary is located. Even at the type section in Italy the clay is 17 cm thick. This is where Walter Alvarez first found it and the world-wide iridium anomaly proof of extra-terrestrial source (Alvarez et al. 1980).

Walter Alvarez (right) with father and co-author Luis Alvarez at a limestone outcropping near Gubbio, Italy, where they found high concentrations of iridium. Walter's right hand is touching the top of the Cretaceous limestone, at the K-T boundary. (Image: Lawrence Berkeley National Laboratory)

Iridium is very rare in our crust as being very heavy most has settled to the core. It is common in meteorites and with a constant background falling of meteorite dust, it is used to measure how rapidly sedimentary rocks were laid down. This is what Alvarez was doing when he found the extraordinary concentration of it.

This fine clay material ejected from the crater and suspended in air would have blocked light for years, eliminating photosynthesis and plunging earth temperatures (Vellekoop et al. 2014). At the bottom of the layer are tektites and other ejecta (Smit 1999) that would have fallen red-hot and started forest fires, evidenced by charcoal deposits world-wide (Tschudy et al. 1984).

Also below the clay are tsunami deposits. Recent models show that every ocean was affected (Range et al. 2018).

Below the clay, fossil pollen is prolific. Above the clay is a layer, everywhere, in which pollen is rare, but fern spores are dense. This has been called the "fern spike—evidence for the return of low light from no light, creating an ecology in which ferns could thrive, but not other plants (Vajda et al. 2001). Establishment of the fern spike occurred within a century of the Chicxulub impact and the fern community flora persisted on the order of 1,000 years (Claramunt & Cracraft 2015).

Ferns sprouting up in a fire-damaged forest. (Regan Dunn / The Field Museum)

The impact inundated Earth's atmosphere with sulfur trioxide, from sulfate-rich marine rocks vaporized by the blast, that rapidly transformed into sulfuric acid, generating massive amounts of acid rain within a few days of the impact (Ohno et al. 2014). Eventually, pollens returned, but different from those before, showing that plants, too, suffered mass extinction (Field et al. 2018). In the many-year-long darkness, herbivores starved, as did their predators and even scavengers.

With the bolide impact shockwaves knocking down trees immediately after the impact, wild fires and acid rain directly eliminating forest habitats, and reduced light levels and associated global cooling delaying forest recovery, life forms had to deal with long-term ecological stress. The protracted recovery of climax vegetation likely lasted for less than 5000 years (Renne et al. 2012) and more likely about 1000 years (Field et al. 2018). (*I will expand this apocalyptic summary with a more detailed article in the near future on how the events of this whole catastrophe have been determined*.)

Several recent papers show that a consensus hypothesis is emerging in which surviving birds are thought to have had a suite of features that enabled them to survive the extinction event. For surviving birds, these included having a relatively small body size (this limits metabolic requirements), flying ability, no dependence on trees (Claramunt & Cracraft 2015), an advanced digestive system, and dietary flexibility to capitalize on sparse resources that likely included small insects and seeds (Field et al. 2018).

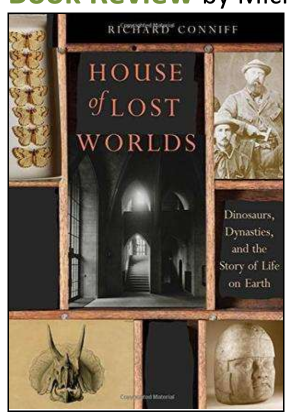
Terrestrial food webs that relied on photosynthesis would have collapsed. However, seed banks derived from plants, including relatively abundant angiosperms, could have been a common, nutrient-rich resource that would have persisted among the detritus, which also has been suggested as a key food source for species survival across the boundary (Larson 2016). This pattern is observed in modern fire succession communities, where seed-eating (granivorous) birds are the first to re-occupy disturbed habitats due to food resource accessibility. A persistent seed bank, which can remain viable for more than 50 years in modern temperate forests, most likely outlasted the catastrophic ecosystem collapse caused by a bolide impact and associated infrared thermal pulse, acid rain, darkness, and impact winter.

The recovery is marked by the re-emergence of canopy vegetation. The earliest Paleocene marks a change in forest community compared to the Cretaceous (Claramunt & Cracraft 2015).

Recent fossil finds and phylogenetic analyses have shown that the scenario outlined in the opening paragraph is likely what actually happened. As noted last month, landfowl (chickens, quail and the like) evolved in the Cretaceous as did the closely related waterfowl (ducks, etc.). Ratites (ostiches, emus, etc.) had diverged even earlier, and it is likely that the flamingo/grebe clade (Mirandornithes) also split from other Neoaves before the K-Pg extinction. The finding of Field et al. (2018) are that a landfowl species (possibly more than one) survived, as did one or more waterfowl, ratites, mirandornithines, and Neoaves ancestor(s).

All were small, seed/insect-eating, ground dwelling or water birds. This is consistent with the survival pattern in small mammals, amphibians, other reptiles and fish. Surviving birds would have been flyers to give them large ranges to find scarce food, so even the ratites that passed through would have been more like today's flight-capable tinamous than like kiwis, with the large flightless emus and others evolving later. All the hundreds (or likely thousands) of other Cretaceous bird species did not live through the K-Pg extinction catastrophe.

Book Review by Michael Grenier



House of Lost Worlds: Dinosaurs, Dynasties, and the Story of Life on Earth. By Richard Conniff. New Haven (Connecticut): Yale University Press. $35.00. 352 pages, 97 color illustrations. 2016.

Here's the Yale Peabody Museum press release on this book: "*A gripping tale of 150 years of scientific adventure, research, and discovery at the Yale Peabody Museum. This fascinating book tells the story of how one museum changed ideas on dinosaurs, dynasties, and even the story of life on earth. The Yale Peabody Museum of Natural History, now celebrating its 150th anniversary, has remade the way we see the world. Delving into the museum's storied and colorful past, award-winning author Richard Conniff introduces a cast of roughneck bone hunters, bold explorers, and visionary scientists. Some became famous for wresting Brontosaurus, Triceratops, and other dinosaurs from the earth, others pioneered introduction of science education in North America, and still others rediscovered the long-buried glory of Machu Picchu.*

"In this lively tale of events, achievements, and scandals from throughout the museum's history. Readers will encounter renowned paleontologist O. C. Marsh who engaged in ferocious combat with his "Bone Wars" rival Edward Drinker Cope, as well as dozens of other intriguing characters. Nearly 100 color images portray important figures in the Peabody's history and special objects from the museum's 13-million-item collections. For anyone with an interest in exploring, under-standing, and protecting the natural world, this book will deliver abundant delights."

This is not just publisher's marketing poof. I found it to be an excellent non-technical read with good science. In his introduction, prize-winning science writer and journalist Coniff writes that, "Five overarching stories or themes run through the book and sometimes overlap. . . . for the first ten chapters, the museum does not exist, at least not as a physical structure." So, the first theme is the founding of a great museum. The remaining four themes are the dominating personality and science of the great paleontologist and museum curator Othniel Charles Marsh, all the early Yale scientists (James Dwight Dana, Addison Emory Verrill, George Bird Grinnell, Charles E. Beecher, Charles Schucheet, and others) and the great collections (many of which have nothing to do with dinosaurs), the often tattered relationship between the Peabody Museum and its parent institution Yale University, and the museum's major research areas of paleontology, anthropology and zoology.


Left, Othniel Charles Marsh. Right, George Peabody

The museum was the brainchild of O.C. Marsh. The local angle is that Marsh was born in 1831 in Lockport, NY. Several of us searched for his family's home after our field trip to Lockport last August, thanks to member Joe Sullivan. Although his immediate family were of modest means, his mother's older brother was the wealthy banker and philanthropist George Peabody. His uncle put him through college with both a BA and an MA from Yale. After three more year's study in Germany, he returned and secured a Yale faculty position in 1866 as the first professor of paleontology in the United States (thanks again, Uncle George). That same year he asked his uncle to fund a museum and George gave Yale $150,000 to found the Yale Peabody Museum. (He funded Harvard's Peabody Museum two weeks earlier).

Chapter 4 is a very welcome biography of the astounding George Peabody. Born poor, he made his fortune in dry goods and banking. Incredibly generous to education and housing for the poor, he is known as the "father of modern philanthropy", spending over $8 million during his lifetime. When he died in 1869, he left an estate of $16 million, mostly to his foundations and charities, many of which are still operating. That is the equivalent of over $300 million today, based on inflation. The city of Peabody, MA (formerly South Danvers, where he was born) was renamed in his honor a year before he died.

Although much of the book is rightfully about O.C. Marsh and his dinosaurs, YPM is a natural history museum, so we also meet folks like famed geologist James Dwight Dana (Chaper 5), whose standard college textbook *Manual of Mineralogy* is still in publication (23rd edition). The great zoologist and conservationist George Bird Grinnell, founder of the Audubon Society, merits all of chapter 10. Hiram Bingham III (discoverer of Machu Picchu) get chapter 17. Others, who deserve much more, such as Yale's first female Ph.D. in zoology Katherine J. Bush, a specialist in marine invertebrates get only passing mention (pp 120–122 in Bush's case). Other chapters are dedicated to the collections, such as chapter 15, which gives a third to trilobites.

The 97 "color illustrations" are well-selected and a real treat, though most are old photographs reproduced in sepia tone, which is hardly "color". Regardless, this book is well worth reading.

CALENDAR OF EVENTS

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

April
Tuesday April 6, FOSSIL MEETING 7:30 PM **Virtual Meeting on Zoom** Speaker is Dr. William Ausich, "Extreme Crinoids." 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.

The asteroid didn't just wipe out the dinosaurs—it wiped out the forests. Which meant anything that lived had to learn to live on the ground. From Smithsonian Magazine. (Illustration by Phillip M. Krzeminski)