North America Research Group

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Hundreds Attend Newport FossilFest

Early on February 11, Dan O'Loughlin and some of his family drove-up to the front doors of the Hatfield Marine Science Center in Newport, OR before it was open to the public. Other NARG members arrived and helped carry in fossil displays, tablecloths, pamphlets, t-shirts, and everything else needed to put together the Newport FossilFest.

Dan O'Loughlin hosting the NARG table

Bill Harvey (right) answering questions

Greg Carr put up a nice display showing results from the NARG field trip to a site north of Madras where multiple saber-tooth salmon were excavated. He later gave a good talk about the discoveries in the Science Center's auditorium.

Dr. Bill Orr and Mike Full also made presentations. Dr. Bill Orr, professor emeritus of paleontology from the University of Oregon, gave a talk about the breadth of Oregon fossils. While Mike Full, who is from McMinnville, gave a talk about the Willamette Valley Pleistocene Project.. He also displayed some interesting Ice Age fossils he has collected from the Yamhill River.

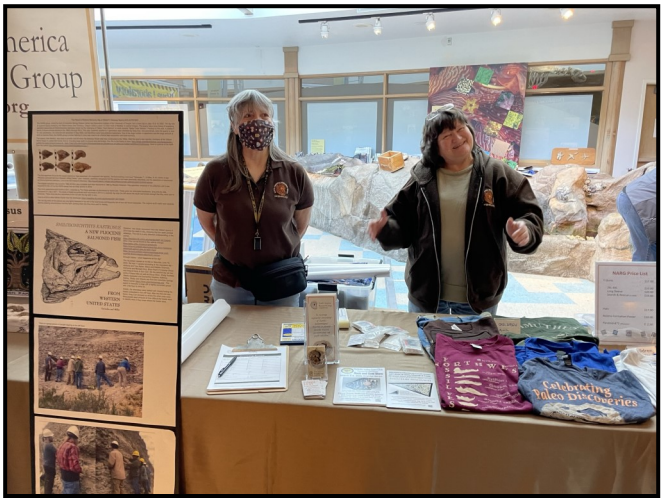
Kent Gibson brought so many Oregon beach fossils they crowded four long tables when displayed. He had porpoise, seal, and *Desmostylus* skulls, shark vertebra, whale ribs, and more. Many visitors were very excited to see all his finds and Kent was busy the entire time answering questions. Aaron Currier was at the identification table and had many interested people coming through. At one time, he had ten people waiting to get information about their finds.

Continued from previous page, Newport FossilFest

Kent Gibson (far left) brought many Oregon beach fossils. Greg Carr (center, brown NARG shirt) helped with the many people interested in these fossils

Several good talks were given in the Hatfield Auditorium

Aaron Currier ready to identify unknown fossils



Debbie Shannon and Linda Harvey selling NARG t-shirts. Gerry Lukos sold merchandise too, but is not shown in this photo.

Renee Fowler, the Hatfield Visitor Center Volunteer Coordinator and Assistant Manager was very pleased with the interest from visitors in the event. This was her first year hosting, as FossilFest had been cancelled previously due to COVID. She said attendance at the Science Center the week prior was 350 people. During FossilFest, 650 people came through the doors! In addition to those working at the show, several NARG attended including Andree and Scott Kraker and Thomas Stevens. NARG members were able to share with all those folks who shared an interest in paleontology.

After the show was over and everything packed back up, several members visited Kent's home in Newport to see the recently collected pinniped fossil blocks he and Weylin brought to the house (see later article). From there, eight NARG members went out to dinner to celebrate a successful FossilFest.

A West Coast Pinniped Arrives in South Carolina

Weylin Charland was looking for fossils along the Oregon Coast south of Newport when he noticed bone embedded in sandstone. Upon closer inspection, he saw many bones in several large rocks. He knew he had something special. He called Kent Gibson, a long-time fossil collector who went with him to investigate. Kent thought they were looking at a mostly intact and articulated pinniped. Both men were excited and extracted the rock from the beach. This was especially arduous as rules of fossil collection from the beach include no use of automated tools, so the two dug out the rock by hand. They ended up removing more than 200 pounds from the beach that day.

Fossil site on the beach

Fossils embedded in the rock

Weylin Charland with 200 lb of fossil rock at Kent Gibson's home

They took pictures and sent them to Dr. Robert (Bobby) Boessenecker, a paleontologist at the Mace Brown Museum of Natural History at the College of Charleston who specializes in prehistoric marine mammals. Dr. Boessenecker was astonished and thought that Weylin had discovered a new or an extremely rare pinniped species. Weylin and Kent reached out to researchers at the University of Oregon to see if they might want to prepare the specimen, but the University was unable to accept the fossils because of limited space and lack of available researchers. Dr Boessenecker quickly jumped at the chance to acquire the specimen. But how to get it across the United States?

Once NARG heard about this exciting find, they quickly allocated funds for packaging and shipping the 200 plus pounds of rock to the East Coast. Additionally, Greg Carr volunteered to safely package up the rock. Three of the rocks were fragile and required special plaster casting. Greg also custom built 7 wooden crates to safely house individual fossil rocks. Altogether, the boxes and fossils weighed 431 pounds, about 280 pounds of rocks. Shipping with Federal Express cost $1074.43. This cost and the cost of shipping materials was provided by NARG.

Continued from previous page, Pinniped Discovery

The pinniped skeleton made it South Carolina with no mishaps. The following is a Facebook post by Mace Brown Museum of Natural History describing its arrival:

> Special delivery! Last week received a large specimen in a bunch of shipping crates from coastal Oregon. Amateur collectors and friends of the museum. Weylin Charland and Kent Gibson. recently excavated a large, 200 lb concretion from the Oregon coast containing an articulated skeleton of an early pinniped! Weylin discovered the specimen and called in a favor from Kent to help him get it out of the ground.
>
> The specimen may or may not have a skull, but at minimum, it contains at least 75% of the postcranial skeleton including fore and hind flippers and most, if not all, of the vertebral column - which seems to be articulated. The specimen is a member of the Enaliarctinae, a group of the earliest known pinnipeds, from which fur seals and sea lions (Otariidae), true seals (Phocidae), and walruses (Odobenidae) all diverged from. The skeleton will likely provide some serious insights into the early evolution of swimming in pinnipeds. While it is possibly a new species, there are many species already reported from this rock unit - the Nye Mudstone - and it could belong to either Enaliarctos, Pinnarctidion, or perhaps Pteronarctos.
>
> In addition to Weylin's generosity, and Kent's assistance, we also need to thank the generosity of the fossil club NARG, who raised funds to cover the cost of shipping to the east coast, and Jim Goedert, who advised Weylin and Kent and helped organize the material for safe shipping.

Boessenecker and colleague unloading shipped pinniped from Oregon coast

The boxes and plaster-encased fossils delivered to Mace Brown Museum of Natural History

Note from Weylin Charland about his discovery:

I grew up beach combing the Oregon coast. Mostly looking for agates, petrified wood or anything that caught my eye. Years later, as an adult, I found a small shark tooth sticking out of the edge of a rock. After posting this tooth on some internet forums I was recommended to contact Kent Gibson as a local collector from my area. He then introduced me to Bobby Boessenecker, an expert on marine mammals located on the East Coast. Through these connections I was able to learn that the small shark tooth I found belonged to a saw shark.

These events were a major influence in my life. By getting to know people who have dedicated their life to this field, I began to pick up little bits that would make me feel a sense of accomplishment through my hobby. With the help of my mentors, I immersed myself in anatomy, geology. and honing my eyes to be able to recognize each in the cross-section of a concretion. Working on expanding my knowledge of bone physiology and anatomy, and also learning different methods of fossil preparation, has shown me that I am capable of making a unique discovery with hard work and dedication. My goal at this point would be to continue to hone these skills while also learning how to get significant items to the experts that would like to see them. I would also like to learn to self-publish my own papers one day.

I'd like to thank you all for hearing my story as well as all the mentors who have helped me along the way. I couldn't be happier for this specimen to make its way to someone I consider a friend and teacher who has taught and encouraged me over the last few years. I have hopes that through the years this discovery and more like it can help give us some insight into our past.

Guide to Identification of Pinniped Skulls of the Farallones National Marine Sanctuary

CALIFORNIA ACADEMY OF SCIENCES

California Sea Lion (CSLI)	Harbor Seal (HASE)	Northern Elephant Seal (NESE)
		
Skull: Strong sexual dimorphism; triangular postorbital processes; wide intraorbital region; adult male has pronounced sagittal crest	**Skull**: Minimal sexual dimorphism; no postorbital processes; narrow intraorbital region; large auditory bullae (on ventral side, not shown in photo)	**Skull**: Strong sexual dimorphism; no postorbital processes, large nasal shelf
		
Scapula: Large with two ridges	**Scapula**: Comma-shaped with a single ridge	**Scapula**: Large, fan-shaped with a single ridge
		
Teeth: Unicuspid post canines with strong cingulum often bearing accessory cusplets; upper postcanines generally uniformly spaced; third upper incisor enlarged	**Teeth**: Postcanine teeth usually bearing at least 3 cusps (mountainous); upper incisors of uniform size	**Teeth**: Very large canines, postcanines reduced and peglike, lacking cusps; total of 2 lower incisors

Photos: S. Pemberton, California Academy of Sciences

Guide to Identification of Pinniped Skulls of the Farallones National Marine Sanctuary

CALIFORNIA ACADEMY OF SCIENCES

Steller Sea Lion (SSLI)	Northern Fur Seal (NOFS)	Guadalupe Fur Seal (GUFS)
		
Skull: Strong sexual dimorphism; adult male has no obvious sagittal crest; square or rectangular postorbital processes; wide intraorbital region	**Skull**: Obvious sexual dimorphism; postorbital processes point back; greatest width across nasals almost equaling their length (snout short)	**Skull**: Strong sexual dimorphism (no male pictured); postorbital processes point outwards; greatest width across nasals about one-half their length (snout long)
		
Scapula: Very large with two ridges	**Scapula**: Small with two ridges	
		
Teeth: Large canines; unicuspid postcanines, no cusplets; wide gap separating last upper postcanine from its predecessor in adults; third upper incisor enlarged	**Teeth**: Large canines; unicuspid postcanines with possible minor cusplets; third upper incisor enlarged	

Photos: S. Pemberton, California Academy of Sciences

Recent Publication Describes NARG's 2011 Mitchell Dig Site in Possible Pterosaur Poop

Greg Retallack (L) and Adrian Broz (center), two of the authors at the dig site. Picture by Greg Carr

In 2021, NARG member, Greg Carr, organized a field excursion to a site outside of Mitchell, OR known as a site for large and accessible ammonite fossils. Earlier, University of Oregon professor, Greg Retallack, had unexpectedly discovered a dinosaur toe bone at the site (Retallack, et al. 2018). This was unexpected because Oregon would have been covered with ocean during the dinosaur age. It was bewildering as to how the bone from a terrestrial animal would have found itself in an aquatic environment. It was hypothesized that the bone's location was a result of "bloat and float:" the animal died in or near water, the corpse bloated, then floated along with the currents traveling possibly long distances.

Hoping to return to the site and discover more bones, Carr and Retallack put together a coordinated NARG-University of Oregon dig. This required permitting by the Bureau of Land Management and guidelines requiring site preparation, conservation, and recovery. Carr was in-charge of daily activities while Retallack was in-charge of specific scientific collection and post-dig research. Over the two week dig, 84 volunteers (many from NARG) collected soils, ammonites, and more dinosaur bones.

Volunteer Rana Gahwagy (Left), Greg Carr (Center), and Greg Retallack (Right) at the dig site.

An ammonite fossil discovered at the dig site

Continued from previous page, Pterosaur Poop

A recent publication describes the site as it might have been 100 million years ago. Authors Retallack, Carr, and Broz describe the site as a possible guano pile for pterosaurs due to bite marks and breakage of ammonites and phosphorous levels in the paleosoils. The paper has caused quite a stir. Retallack and Carr, as well as Tara Baker (NARG member) and Rana Gahwagy, an intern at the Rice Museum of Rocks and Mineral were interviewed for an article in the national science and technology publication Ars Technica. Additionally, Phys.org, and Oregon Public Broadcasting printed articles as well. Both Carr and Retallack were interviewed on OPB's "Think Out Loud" podcast describing the dig and the discoveries. In the podcast, Greg Carr sums up the dig and what it meant to NARG very well:

"I was gonna say, from my standpoint, it was a quite successful dig. We did actually find some broken pieces of dinosaur bone. We found one entire bone, but it was again another toe bone, so it doesn't help us figure out what kind of dinosaur bone. We found an ichthyosaur bone. We had lots of people, and I organized field trips for our fossil club, and people enjoyed it. Nobody got hurt. Nobody got affected by the heat; the last weekend of the dig was that weekend that we hit 115 degrees, and yet nobody suffered from that. So in my mind, it actually was a very successful dig."

Citations:

Retallack, G.J., J.M. Theodor, E.B. Davis, S.S. Hopkins, and P.Z. Barrett, 2018, First dinosaur (Ornithopoda) from Oregon, USA. First dinosaur (Ornithopoda) from Early Cretaceous (Albian) of Oregon, U.S.A. *Journal of Vertebrate Paleontolog*. DOI: 10.1080/02724634.2018.1486847

Retallack G.J., G.E. Carr, and A.P. Broz, 2023, Early Cretaceous pterosaur guano deposit from central Oregon, USA, *Lethaia*. DOI: 10.18261/let.56.1.3

Early Cretaceous pterosaur guano deposit from central Oregon, USA

Gregory J. Retallack, Gregory E. Carr, and Adrian P. Broz

Abstract

Excavation of a green breccia lens in the otherwise shaley Hudspeth Formation of central Oregon recovered a surprising variety of fossils of different kinds: plant impressions, mollusc shells, and vertebrate bones and teeth. Some ammonites, such as *Mortoniceras inflatum*, which date the deposit as late Albian (103 Ma), were preserved with shell intact below, but dissolved above back to sutures. Intact ammonites were outnumbered by angular ammonite fragments in the size range 1–2 cm. Marine clams, snails and ammonites were found in the same bed as a variety of fossil plants, including horsetails, ferns, cycads, and conifers. Also recovered were bones of fish, ichthyosaurs, dinosaurs, and pterosaurs. Orientation of large fossil logs and branches reveal derivation from the east, where a shoreline of shingle beaches and alluvial fans created the interfingering Gable Creek Conglomerate. The matrix-supported green breccia is massive and ungraded, and interpreted as a mass flow deposit. Enrichment in phosphorus compared with shale above and below is evidence that its fine-grained component includes guano. This guano and unusual fragmentation of ammonites are interpreted as evidence that the Oregon pterosaur, *Bennettazhia oregonensis*, was a mollusc-eater and formed large colonies on nearby cliffs, like modern gull rookeries.

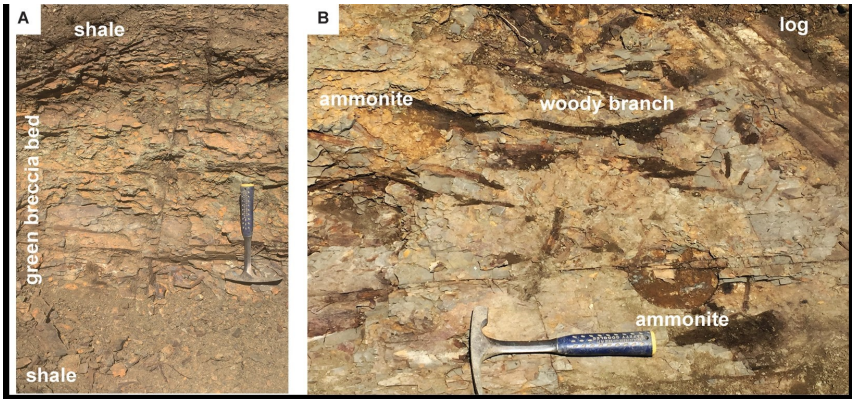


Fig. 3. Field photographs of (A) fossiliferous green breccia, and (B) excavated surface showing ammonites and woody debris. Scale for both is hammer with handle 25 cm long.

Stromatolites – An investigation of Life on Earth

Joe Cantrell, Jerry Dodson, David Klubert

It's impossible to research and study life on Earth without having some (and perhaps a very detailed) knowledge of physics, chemistry, biology, microbiology, geology, sedimentology, and paleontology. The NARG threesome who have been interested in the study of Stromatolites have learned that achieving an understanding of these fossils (and some small contingent of coexistence in current times) is more than just examining life size and microscopic images of fossil Stromatolites. Our fascination with fossils and this study/articles required our investigative skills.

Initially our goal was to examine in detail the slice of the approx. 3.6 BYO Pilbara region of Northwestern Australia. The geology of this region of Australia presents an element of the Archean Era that is found nowhere else on Earth. In fact, there may be rocks/layers older than 4 billion years thus within the Hadean Era of Archaea; they have been located in Canada, Australia and Africa. If there is a consensus on the earliest life forms, it converges on the time of 3.5 to 3.8 billion years ago. Of note, however, is that the evidence is presented via chemical analysis rather than microscopic e.g. light and SEM. For example, many of us have slices of stromatolites and readily recognize the layering yet there are other very similar layering that are not Stromatolites. Joe Cantrell was doing some photo work for the Rice Museum in Hillsboro, OR and had access to their Pilbara Strom specimen. Great start!

Some things to know and remember: the Age of Earth, the relationship of life to the Age of Earth, and the likelihood of life changing the geology of Life on Earth.

Science estimates that our Earth originated with the violent coalescence of materials that were part of the Big Bang. Gases and galaxies, black holes, solar systems, planets and planetesimal: Creation over "billions and billions of years". Except for astronomers and physicists, most of us look out from our Earth perch on some cloudless nights and see specks of light and halos of galaxies. Our own solar system – our sun and the wondrous satellites orbiting it – is suggested to be approximately 4.8 or so BYO. The earliest acknowledged evidence of life is about 3.6 BYO.

Thus, it took approximately a billion years for life to occur. Evolution? Change over time? Chemistry and the assimilation of minerals – essential for life – and water (Where did all of that stuff come from? Well, that's another story for someone else to tell). What we know is that the Pilbara specimen evidences the earliest life on Earth. Let's dig deeper.

The first known life involves microscopic imaging and examination of the organism that created the layering of prokaryotic life cells with tidal flows of salty seawater and silt. Blue Green algae it is called. But it is not algae. It is an algal-like growth of layers of cyanobacteria. And without it our Earth atmosphere would probably be oxygen deficient with little or no diversity. Cyanobacteria and Nature's invention of photosynthesis. Chlorophyll. But not in green plants. Green plants first appeared in marine environments then onto land thus creating terrestrial environments. Modern cyanobacteria can be imaged but search of the Pilbara specimen produces none. Keep that in mind. And carbon isotope ratios in Precambrian rocks suggest complex plants developed over 1 BYA.

The ancestors of land plants evolved in water. As I have described to OMSI visitors to the Paleo lab, visualize pond scum on a poorly drained pond. Algal scum! The suggestion is that this scum proceeded to land about 1.2 BYA. But the first land plants appear in the fossil record of the Ordovician, that is, 450 MYA. Diversification of land plants is evidenced in the Silurian about 420 MYA. Thus, the abundance of unicellular prokaryotic and eukaryotic plant life (with some multicellular most likely) lived through the Precambrian. And to adequately discuss this aspect of Life on Earth would require more research on my (or your) part.

The importance of this information on green plants is to emphasize that they were NOT part of the oxygenation of Earth atmosphere during the Precambrian. That came with billions of years of cyanobacteria and what we call Stromatolites.

The great oxygenation event is recorded in the rock record as Banded Iron Formation. BIF for short. And this episode will end with images of banded iron. Coloring can be as you will see or can be red rusty bands of rock. FeO2 is abundant in those red, red soils too. The kind that in Southern Virginia where I grew up, there were no white T-shirts as they had been permanently stained by the red dirt we played in.

Continued from previous page, Stromatolites

Of note is the size and general morphology of cyanobacteria. Remember that they are prokaryotes (possessing no membrane covered vacuoles inside the cell). They range in size from 1 micron to 100 microns. They can be ovoid or filamentous. And either unicellular or colonial. Looking for microscopic traces was our goal. Fragmentary evidence of morphology does not exist from the 3.6 BYA Pilbara.

The first image is that of a sliced Stromatolite from the Navajo Sandstone age 180-185 MYA. The banding represents the rock growth as tides pushed silt up on areas of otherwise quiet and very salty lagoons. The silt covered the living layer of cyanobacter – the scum – with a darkening layer of fine sand/silt grains. The cyanobacter was not diminished by this, unless it was so thick that the shoots of chlorophyl filled cell structures couldn't grow up and through the silt layer. New mats of scum would keep the silt beneath it steady and eventually solidify perhaps with the natural cementing by the cyanobacter. And the structure grew for millions of years. Stromatolites must have been periodic fields of sun and wind exposed layering with shallow salt sea water. Of note is that the living "fields" of stromatolites survive and thrive in highly saline sea water – about 7% higher salinity than the existing ocean.

The second image is that of banded iron and is of the age of approximately 2.5 billion years. I suggest that if you are interested in knowing more of this great oxygenation event (and no it didn't occur as suddenly as an asteroid colliding with the Earth at end Permian), then do some research. The internet provides access. And there are some excellent text materials. Check out Stromatolites and The Art of Yellowstone Science.

The next two images are of a block of Stromatolite that show only partial thickness of the original source in the Navajo. The images provide an excellent view of the cauliflower like nature of Stromatolite growth and surface.

Fig. 1: Stromatolite from the Navajo Sandstone

Fig. 2: Banded iron

Fig. 3: Navaho Stromatolite

Fig. 4: Navaho Stromatolite, cauliflower-like appearance

A Brief Introduction to Trilobite Ontogeny

Isaac Gagner

Trilobites are among the most found fossils across the world. Their abundance allows for an impressive glance into their life cycle and growth. Here I'll use the species *Elrathia kingii* to show the basics of the ontogeny of these incredible creatures.

The specifics of trilobite embryology are still unknown, but it has been confirmed that like modern arthropods they reproduced sexually and laid eggs. Either at or sometime soon after hatching trilobites developed their hard shells, from that point we have a solid record of their development.

The life of a trilo is divided into three periods, the protaspid period, meraspid period, and finally the holaspid period.

A freshly hatched trilobite protaspis will go through two stages before reaching the meraspid period. First the anaprotaspis stage in which the trilobite is round and blob-like, then the metaprotaspis stage where the first defining traits begin to appear.

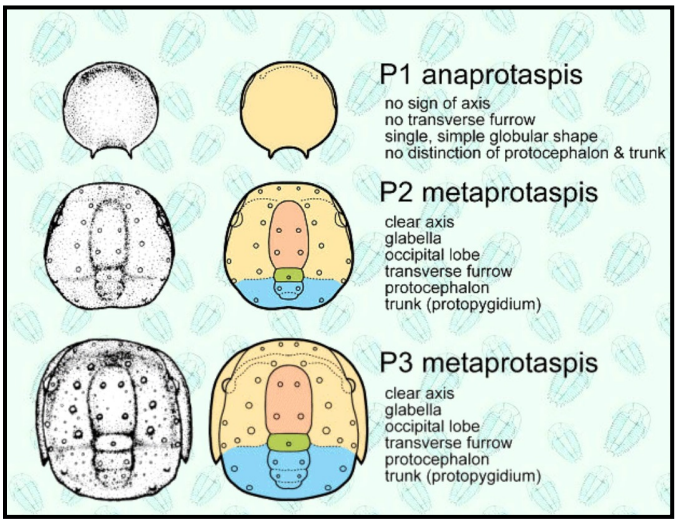


Fig. 1: The trilobite life cycle. Taken from www.trilobites.info

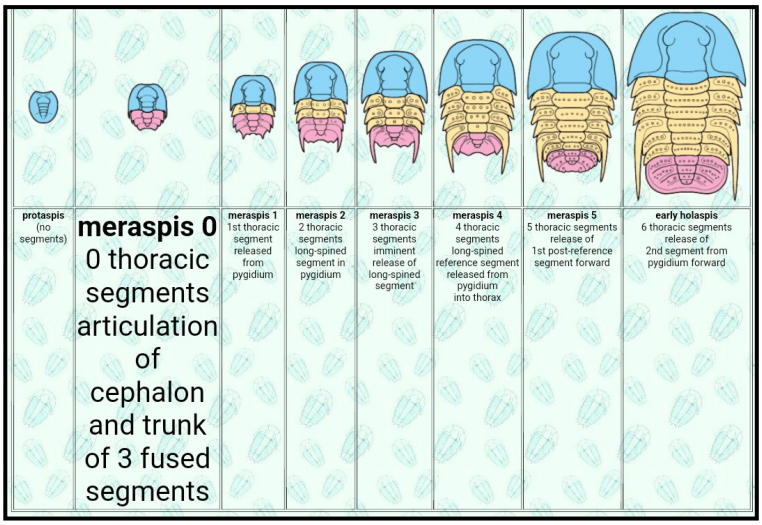


Fig. 2: The stages of the protaspid period. Taken from www.trilobites.info

When the first articulation forms between the cephalon (head) and trunk (body) the trilo enters the meraspid phase. During this stage the trilo will get its signature segmented body. Segments form one by one in the trilo's pygidium (tail) and are released into the thorax in sequential molts. The more segments a meraspis has the more molts it has undergone. Meraspid trilobites are labeled with a capital M followed by the number of segments.

Continued from previous page, Trilobites

This M5 meraspis of *E. kingii* was discovered by a friend of mine this summer and prepared by me. It is an extremely young and small creature, measuring in at just under 2mm in length. (Fig. 3)

Several molts and 6 segments later the trilobite takes on proportions much closer to that of the adults and increases in size, as seen in this 6mm M11 meraspis of the same species, also found this summer and prepared by me. (Fig. 4)

A few molts later and the trilobite now has 13 segments. The number of segments varies greatly by species, for *E. kingii* 13 is the maximum, the trilobite now enters the holaspid or adult period. It's still quite small, this one measuring 1cm. (Fig. 5)

Fig. 3: *E. kingii* M5 meraspis

Fig. 4: *E. kingii* M11 meraspis

Fig. 5: *E. kingii* M11 holaspid

Fig. 6: Average adult trilobite (left) beside M5 meraspis (right)

While no more segments will be added, the trilobite will continue growing and molting for the rest of its life. This allows the lucky few trilobites that live to exceptionally old age to reach immense size, dwarfing their younger counterparts. Most did not live to such age, the average size of most species is still rather small. Here the M5 from earlier is pictured beside an average sized adult measuring 2.8cm (Fig. 6)

The molting strategy varies among trilobites to some degree, this species takes the most common route. When it is time for the trilobite to molt the librigena (cheeks) of its exoskeleton will be ejected along sutures in the shell, this provides adequate space for the arthropod to wriggle out of its old shell and carry on. On the other hand, some groups of trilobites lack the facial sutures and will opt to eject the entire head of their old exoskeletons when they molt. These molted exoskeletons often remain intact and are readily seen in the fossil record, such as this *E. kingii* molt. (Fig. 7)

Fig. 7: Molted exoskeleton of *E. kingii*, note the "cheeks" are detached and missing

Fig. 8: Abnormally large M8 meraspis (left) compared to average more mature M11 meraspis (right)

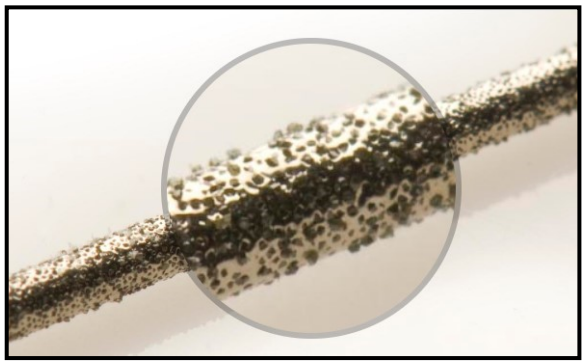
While the general rule that more size = more molts = greater age is useful, it isn't entirely accurate. As with any other organism some individuals are blessed by genetics and/or environment that skew their size from the average. One such oddball seen here is an M8 *E. kingii* meraspis (top) found in the U-Dig quarry and prepared by me. Despite its small segment count this trilo measures 1cm in length, the size of a small adult of this species. Here it is compared with the more mature but much smaller M11 shown earlier (bottom). (Fig. 8)

Diamond Wire Saws for Slicing Fossils and Mineral Specimens

Greg Carr

A diamond wire saw has two forms: 1- A saw used for large-scale commercial rock cutting for quarrying and forming objects such as counter-tops and flooring; 2- The use of a small wire for precision cutting of small objects such as crystals or fossils. In this article I'll be discussing the latter – a precise saw with a very small wire used to cut relatively small objects such as crystals and fossils.

A precision diamond wire saw is a saw that uses a small diameter wire coated with diamonds to cut objects. The wire ranges from 0.1 – 0.4 mm in diameter, so the kerf (the thickness of the saw cut) is extremely thin.

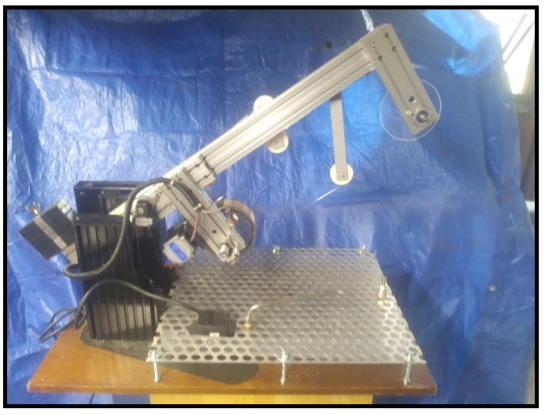


Since the wire has a coating of diamond crystals, it can cut anything else, including rock, metal, or synthetic crystals. The saw works by pulling a wire through the object to be cut, usually with lubrication to flush away the cutting debris. The wire abrades a thin groove in the object. Diamond cutting is actually a grinding process, where the embedded diamonds drag across the object, scraping away a thin layer of the material at a time. Many passes are required. This is the same whether the tool is a diamond saw, a diamond sander, or a diamond wire saw. Commercially, the main use of diamond wire saws is to slice silicon ingots for solar cells.

Two main wire configurations are used: a continuous loop and a long single piece. It is not possible to put a splice in such as small wire, so specialized welding is needed to make a complete loop. The wires are not much thicker than a hair. The most typical arrangement is to use a long single stretch of wire, wound around a drum, with a length of 20-30 meters from end-to-end. Some large commercial saws us an extremely long wire, with a total length measured in miles!

The drum-based saws use an ingenious method to overcome the inability to splice the wire. The wire is wrapped around the drum following a machined groove on the surface of the drum. As the drum turns, it releases wire from one side of the drum at the same time that it picks up wire on the other side of the drum. The drum also rides on a threaded shaft so it moves sideways as it rotated. The "pitch" (grooves per length) of the outside of the drum is the same as the shaft it rides on. In this way, as the drum rotates, the wire unspools and re-spools at the same location all the time. I have included a short video of the process. The saw runs in one direction until the wire runs out, then reverses direction and runs the wire the other way. This cycle repeats until the object is cut.

I acquired a wire saw made by the Griffon corporation years ago on an Ebay auction. Although I got it working, it is not really setup for cutting large objects as it did not have a lubrication/coolant flush and it would be difficult to retrofit. However, after I added a precision traveling stage I can accurately make thin slices of small objects (1-2 inches) down to about 1mm in thickness. The wire I'm using has a kerf of about 0.012" – 0.3mm so cutting losses are very small.



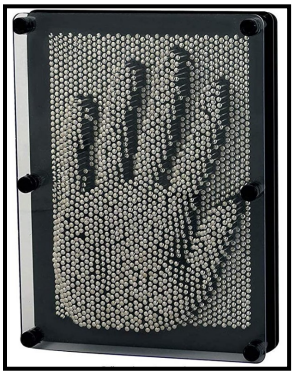
Continued from previous page, Wire Cutter

I have wanted a larger wire saw for cutting larger fossils. I wanted something I could use to slice the saber-tooth salmon skulls if needed to get out the ear bones. I designed a saw that could cut objects about 12" wide by 6-8" high. It had a vertically-swinging arm rather like a horizontal bandsaw, with a stepper motor driving the drum. It uses about 30 meters (100 foot) of wire for each re-stringing. I have a spool of diamond wire that is about 5 km (3 miles!) long so I've got more that enough wire to last my life time. The most difficult part of the project was programming the controller of the saw. It used one NEMA 23 stepper to drive the drum, one switch to detect when it's at one end of the travel, and a couple of manual switches to tell it to run and to return to 'home' position. The finished program runs the drum to the 'Home' position at startup, then runs the drum back and forth repeatedly as long as the operator desires by selecting the 'run' position of the 'run/home' switch. At the end of the cut the run/home switch is set to home, and the drum stops when it reaches the home position. A manual switch to turn on and off the coolant pump and some lights, and the electronics are ready to run.

The whole machine is controlled by an Arduino "Nano" controller, programmed via C++ programming language from the Arduino website. The whole control board is tiny – less than 1" x 3", yet the program only occupies less than 10% of the available memory and function. It is amazing what modern electronics are capable of!

A second problem is the specimen holder. It is very important that the specimen to be cut does not move, even a little. The kerf is so thin that the slightest twist or sideways shift of the specimen will bind the wire, stopping the cut. Since fossils are by nature irregular in shape, I needed a different type of specimen holder. I took my inspiration from a new type of pin-jaw machining vise, which in turn took it's inspiration from the field-of-pins kid's toy.

The resultant design is two rectangular frames of aluminum, 4.5 x 6 inches, one on each side of the wire. The frames are loaded with plastic dowels that stick out toward the other frame. The pins can be locked in place with a couple of hand screws. To use the holder:



Position the specimen at the location and direction so the saw wire will cut as desired.

Loosen the frame clamp on one side and push the dowels in toward the specimen to cradle it in the desired location.

Tighten the clamps to lock the dowels in position.

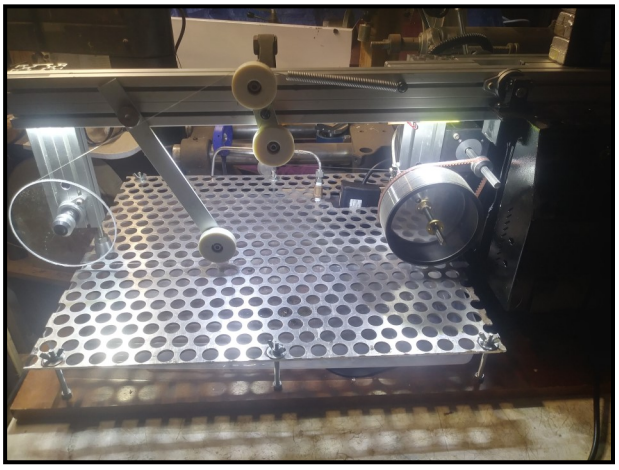
Repeat steps 2 and 3 on the other side so the two sets of dowels push hard against the specimen on all sides. Then cut as desired. Here is a picture of a specimen clamped locked on place in the holder. The dowels are pushed in only down by the specimen so that the upper dowels don't interfere with the cut.

At this point this is still experimental. I have cut one specimen of a Triassic nautiloid successfully, though it took several attempts to do the first cut. The saw cuts about 3-4 square inches an hour, relatively slowly. I had to replace the initial wooden dowels with plastic as the wood swelled when it got wet and jammed the clamp operation. I also had to replace the V-belt drive with a cogged belt as slippage during operation disconnected the drum position and step counts (meaning the drum wasn't where the controller 'thought' it was. This led to the drum running out on one end and breaking the diamond wire at the very end. It seems to work with the cogged belt, keeping accurate counts of where the drum is.

Continued from previous page, Wire Cutter

There is a shallow tub of water under the perforated aluminum working table. The water is circulated by means of a miniature 12V aquarium pump. It works well as long as the pump doesn't jam on chunks of rock. It can be easily siphoned out by a hose down through the perforated working table.

I'm looking forward to doing a lot of cutting with this machine.



Preparation of a Rare Crab from Mitchell, OR

Bruce Thiel

Eucorystes platys is an Albian Cretaceous crab (100 - 113 MYO) that Andrew Bland found near Mitchell, OR and gave to me which I prepared. This species of crab was identified, described and named, in 2001, by Drs. Schweitzer and Feldmann, who are renowned fossil crab experts at Kent State. The description was based on a single broken crab, found years ago by Dr. Greg Retallack, 3 miles west of Mitchell and 1 mile south along Gable Creek Road and sent to them at Kent State to identify and/or describe. Because it turned out to be a new species, it was designated a holotype and was placed in the Smithsonian's collection. A holotype is a single specimen upon which a new genus or species description is based and is used for future comparison to identify additional specimens.

Before starting to prep a new crab that I'm not familiar with, I always like to find the scientific article that described it, as they always contain pictures or detailed illustrations showing all the body parts, which might be uncovered during preparation. The picture of the holotype did not show a complete claw or detail of the legs. Because this specimen appeared to be better preserved and more complete than the holotype, and showed both claws, I sent it to Dr. Feldmann, who photographed it for reference, before returning it.

Because the crab has a distinctive pattern on its shell, described as a "strap-like ornamentation," I photographed it in late afternoon sun with shadows to highlight the shell pattern.

A second picture shows a more complete version of the specimen with its front rostrum and partial side legs.

Reference:
Schweitzer C. E., Feldmann R. M. (2001) New Cretaceous and Tertiary decapod crustaceans from western North America, ***Bulletin of the Mizunami Fossil Museum*** 28, 173-210

NARG Members Screen for Mammoth Bones

On April 22, 2023 NARG members met at Woodburn High School to screen for mammoth bones from 20 plus five-gallon buckets of soil. The soil was collected from last year's excavation of the football stadium at Oregon State University. Many mammoth bone fragments were found, most the size of quarters. Aaron Currier found the largest fragment, around fist-sized. Dave Ellingson, NARG member and Woodburn High School biology teacher, organized the screening.

South Dakota Trip Report

Megan Gagner

Isaac and I went to Rapid City, South Dakota to visit South Dakota School of Mines and Technology at the end of February. This trip afforded us the opportunity to visit three incredible museums, a national park, national forest and a national monument. What follows is a brief overview that may be helpful to members planning other things to see on the Naughty Nautilus dig this summer.

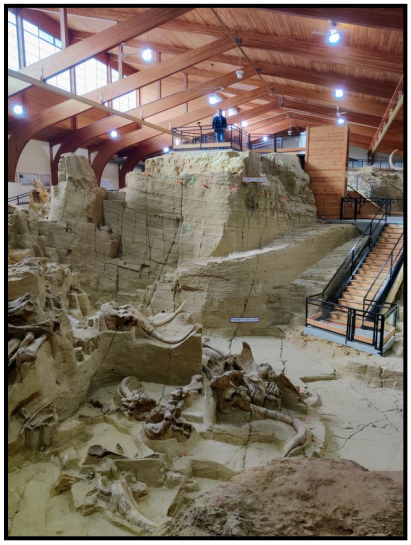
Our first stop was the converted gymnasium in Hills City that houses the Black Hills Institute Museum. Walking in the door feels a little like Alice stepping into wonderland. Every square inch has something to see. Many of the dinosaurs are cast replicas with a plaque noting where you can find the original. The mounts and poses are engaging and sometimes even humorous. I'm looking forward to going back in June. There are plenty of plant and fish fossils to go along with the dinosaur experience.

After falling down the rabbit hole of the Black Hills Institute, the Museum of Geology at South Dakota School of Mines and Technology might feel a little bit of a let-down. However, a closer look reveals some real gems at this free on campus museum. The statues by world famous paleo artist Charles R. Knight alone are worth a look, but certainly not the only thing of note here. We found the hell pigs particularly interesting.

The southwest corner of the state is full of caves. Taking a tour of one of these magnificent caves is a great way to step back in time. Isaac and I spent part of a morning taking the scenic tour through Jewel Cave, the longest cave in the area at 217 mapped miles and counting. The national parks service has improved a small area of this cave with electric lights, steel walkways and stairs to allow many visitors to enjoy this unique walk through the geology of the region. The tour starts in Mississippian Limestone deposited 350 million years ago. Then skip forward millions of years in a few steps to main passages of the cave, formed in the early Cenozoic with the uplifting of the Black Hills. Today, the cave walls are covered in fascinating calcite formations. Reservations are required for Jewel Cave National Monument and can be made online.

Continued from previous page, South Dakota

The Mammoth Site, an hour south of Rapid City, is also worth a visit. The building was purposefully built around the dig site. This summer you will have the opportunity to watch the dig in progress inside the museum. You could even dig there as part of the Ice Age Explorer's program. I don't think you'll ever see more mammoth fossils in one spot anywhere else. This is the most expensive museum on the list costing $14 for adults with discounts for children and adults 60 plus.



We saw just a small corner of Badlands National Park. It was a treat to visit in February with almost no other visitors. With over a million people visiting the park each year (almost all in June through August) this may not make your itinerary during the June field trip.

NARG Summer Field Trips

Here is a list of the proposed summer field trips for the NARG group. If you plan to attend, please make sure to pay your membership dues. Only members can attend these trips due to insurance restraints.

1. **May 13 & 14** - Salmon dig at the Vibbert's quarry near Madras Oregon. Information on this is already sent out. We may be lucky enough to have Ray Troll there on Sunday the 14th to fulfill his years-long desire to see this site.
2. **June 3 & 4**- Possible June Salmon dig (if we need to finish the job) - same location. I'll update whether this is a go or no-go after the May dig.
3. **June 23 +** Fee dig, South Dakota - not an organized group travel dig, just show up if you have paid the folks at "Naughty Nautilus" -
4. **July 22 & 23** field trip - At the Suture Beds near Mitchell. There are plant fossils available too at the nearby "White Cliffs" site by the Painted hills unit of the John Day National Monument.
5. **August 12 & 13** field trip - Post BLM sections. Collect agates, petrified wood, calcite crystals, explore relatively untouched BLM sections just East of Post Oregon.
6. **September 2 & 3** field trip (Labor Day weekend) - Beulah Reservoir by Juntura Oregon. Plant fossils, mainly.

If anyone is interested in leading any of these I can mentor you about how to prepare and any details of the sites. Remember, no one person will be around forever and other folks need to get up to speed.

If you have any comments, please email me.

Sincerely, Greg Carr (greg.fossil.hunter@gmail.com)

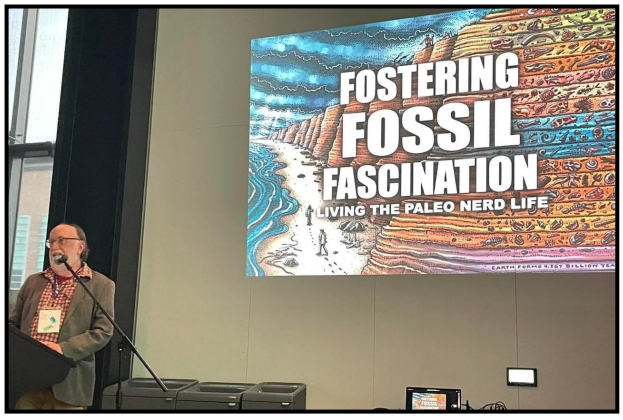
Annual Meeting of Association of Materials and Methods in Paleontology

NARG members, Thomas Stevens, Greg Carr, and Dan O'Loughlin attended the 2023 Annual Meeting of the Association of Materials and Methods in Paleontology (AMMP) April 4-8. It was hosted at the Burke Museum on the campus of the University of Washington in Seattle, Washington. The AMMP is a national, non-profit organization that has a similar mission statement to NARG. Tom says he "had a great week, meeting fascinating people, exhibits, seminars, workshops and adding to my beginning paleontology skills."

Tom working on fossil prep

Clarrisa Koos holding a bone she discovered. The new species was named after her: Clarrisasaurus.

A hadrosaur bone found in the stomach of a *T. rex*. Showing the bone mark matches a *T. rex* tooth



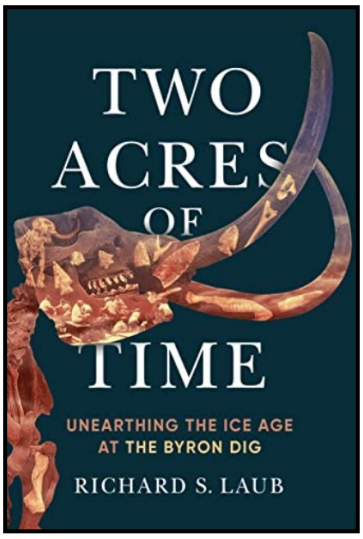
Artist and author, Ray Troll, gave a seminar

Ray Troll art at the Burke Museum that includes saber-tooth salmon

Ice Age Mastodons and More in Western New York

Harold E. Hinds, Jr.

Book review: Richard S. Laub, *Two Acres of Time: Unearthing the Ice Age at the Byron Dig* (New York: Columbia University Press, 2023).



Participants in our local paleontology club (NARG) will be familiar with Ice Age fauna, including mastodons. Several of our members have participated in the excavation of Ice Age fossils beside Woodburn High School under the direction of David Ellingson. Perhaps the most exciting discovery there to date (and the largest critter uncovered) was the 2008 find of an almost completely articulated partial skeleton of an Ice Age bison, *Bison antiquus*. Many other kinds of Ice Age fauna have been discovered at Woodburn, but so far no mastodons.

NARG meets at the Tualatin Historical Society, where an Ice Age mastodon tusk is displayed at the back of the main room. This fossil is from a 1962 excavation near the Tualatin Library, undertaken by two Portland State students. The bulk of the partial articulated skeleton (*Mammut pacificus*), is now displayed at the Tualatin Public Library. Other parts of this mastodon, most notably a jawbone, had been discovered in the 1870s and sent to the Smithsonian.

In both the Woodburn and Tualatin cases, discovery was accidental: during a sewage line upgrade (Woodburn), and while digging a drainage ditch (Tualatin). Such was also the case for the Byron Dig. In 1959, a farmer, Charles Hiscock, decided to turn a damp meadow into a pond, and in the process exposed some large bones and teeth. The farm was near the village of Byron, some fifty miles east of Buffalo, New York, and the damp meadow contained "fragmented mastodon bones, jumbled together with those of other animals" (p. 14). Despite this exciting discovery, quickly brought to the attention of the Buffalo Museum of Science, and to other experts, the site remained undeveloped from 1959 to 1983. What changed? (1) A new director of anthropology was appointed in 1981. Richard "Mike" Gramly had a professional interest in North American Ice Age archaeology, and soon decided to give the Byron mastodon site a second look. (2) The farmer decided to allow a major scientific examination of the site. (3) The Museum hired a skilled fossil preparator. (4) Most importantly, the Museum's geologist, Richard S. Laub, accepted the assignment of initiating and directing the Hiscock Site project, as the Byron Dig came to be known. Laub directed the project for 29 seasons, 1983-2011.

Two Acres of Time relates the development and the significance of the "Hiscock Site, one of North America's most important archaeological and paleontological localities" (David S. Steadman, back dust jacket). The text is divided into five main sections, each a stage of the site's investigation: Discovery, 1959, 1983, 1990, 1991-2001, 2002-2005, 2006-2011. Sandwiched into the initial two sections are "Interludes": The American Mastodon, "the most obvious and certainly the largest actor in our tale" (p. 25); and The Clovis People, "Now a bit about the culture from which that fluted point [found at the site] derives" (p. 94).

Each section describes the development of the archaeological site; the period's major findings; the contributions of consulting and visiting experts; the significant assistance and discoveries made by the hundreds of volunteers, including town residents; the application of key diagnostic tools (e.g., Fourier transform infrared spectroscopy, p. 169); and the scientific hypotheses, their revisions in light of new evidence, and first the tentative, then the final conclusions.

Perhaps the comment on the book's dust jacket by Jonathan Lothrop, curator of archaeology,
New York State Museum, captures the essence and primary contribution of *Two Acres of Time* for a general audience: "Laub very effectively conveys … how scientists investigate paleontological sites, including the development of research questions, field methodologies … and laboratory methods for specimen conservation and analysis." And, I would add, also conveys the application of these concepts to unraveling both the animal and the human presence at a very significant Ice Age site.

Continued from previous page, Two Acres In Time review

In the development of the Byron Dig, there were, according to Laub, several quantum leaps forward in understanding the site. (1) "One was the discovery of the first Ice Age projectile point, which told us that humans were here at the same time as the mastodons" (p. 271). (2) Another was the "recognition that mastodons were digging holes in the floor of the Hiscock basin" (p. 271). (3) The third was "that Hiscock had been a mineral lick during the Pleistocene" (p. 271).

Laub concludes that, for him, the Hiscock site produced "two standouts … mastodon dig-outs and Pleistocene tools made from bone" (p. 293). For precisely how he reached these conclusions, you'll need to engage more deeply with this outstanding description of the excavation and analysis of an important Ice Age site.

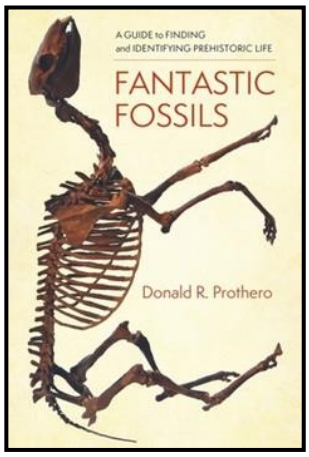
However, that's easy, since in order to keep the reader engaged, Laub urges us along. For example, "The tusk … belonged to a mastodon that had died toward the end of the winter season. How do we know its season of death? Well, that's a tale for a little later in this book" (p. 63); "The tusk and the elk skeleton are not the end of this story" (p. 68); and "I learned a valuable lesson, but it would not be the last time I was temporarily fooled" (p. 72).

Highly recommended, and available at our library.

An Introduction to Responsible Fossil Collecting

David Klubert

Book review: *Fantastic Fossils: A Guide to Finding and Identifying Prehistoric Life* by Donald R. Prothero ISBN: 0231195788 ISBN13: 9780231195782



There is something about breaking rocks and playing in the dirt that helps one grasp the actual joy of paleontology. But sooner or later the desire to better understand exactly what one is finding; how it got there; and what its real significance is takes hold.

Many of the amateur paleontologists and collectors I have met are largely self-taught. Some have had an opportunity to take a class or two. They often exhibit a deep fund of knowledge as well as possess well curated collections reflecting years of activity. The question for the novice then is where is the on-ramp to more information about this exciting and rewarding hobby? Most turn to the internet or search out helpful books. Is it possible to find an introductory book crafted to the needs of someone new to amateur collecting or venturing more deeply into the field? Is there a such a "Goldilocks" work out there?

I believe that Donald Prothero's latest work, *Fantastic Fossils, A Guide to Finding and Identifying Prehistoric Life*, fits the bill nicely.

I came upon this book browsing the paleo section of the local bookstore. I was familiar with Prothero's previous work, *The Story of Dinosaurs in 25 Discoveries,* so this new work seemed like a good bet.

Prothero intends that his book be suitable for an introductory college level. I feel that for the average reader some background in earth science will be helpful. Prothero divides his book into two major sections. Section One, "Fossils are Where You Find Them", covers how fossils are formed, basic geology, fossil dating, and collecting fossils in badlands, beaches, quarries and roadcuts. This section concludes with a brief discussion of the critical process of accurate documentation.

Continued from previous page, Fantastic Fossils book review

Section Two, “Identifying Your Fossils”, begins with nomenclature and then features a series of essays on the major phyla: Porifera, Cnidaria, Brachiopoda, Bryzoa, Arththropoda, Mollusca, Echinodermata, Hemichordata, Chordata and concludes with Paleobotany.

Prothero has a knack for weaving historical vignettes into his discussion of important finds that help to keep the reader’s interest. His wry sense of humor is often on display. The early “paleo war” impact on scientific naming of new species (pp. 65-66) is a good example.

As one might expect Prothero’s writing becomes fairly telescoped in areas where there is a lot of scientific information and numerous identified species, even still I wish that he had included some foot notes or additional references. For example, his discussion of *receptaculitids* (pp. 285-286) states that these “sunflower corals” are neither coral or sponges, but “plants known as the *Dasycladacean* algae”. I haven’t been able to prove that out in my own reading and believe definitive taxonomic classification remains controversial.

Prothero’s charts and diagrams are very helpful as are the illustrations of Mary Persis Williams. One drawback for me is that some of the black and white photos lack enough contrast or clarity for specimen identification.

Prothero writes with an appreciation of the allure that field work and collecting fossils have for the serious amateur or citizen scientist. His emphasis on ethical and responsible collecting will resonate with NARG (North America Research Group) members. He features common but important fossils that illustrate the broad scope of paleontology and the sweep of evolution. These are the fossils most likely to be found by collectors or purchased for reasonable amounts. Pointing to these fossils helps to focus the collecting of the enthusiastic amateur while preserving the space for the professional paleontologist.

On balance this book is a good resource, one that is fun to read and one that you will return to frequently. I recommend you give it a look.

Mystery Fossil

Andrew Bland found this fossil near Mitchell, Oregon, in the Hudspeth Formation, Albian, Early Cretaceous—which dates from 100 to 113 MYO. Because it was mostly inside a concretion, Andrew asked me if I would prepare it. When it was done, we had no idea what it might be, so we asked Dr. Wm. Orr. He suggested perhaps it was mouth parts of a large fish and suggested we ask Dr. Ed Davis. Ed posted it on his Facebook page where many of his paleo friends could see it, but no one had any suggestions as to its identity. Jim Goedert also examined it and felt that it was not a fish plate and suggested we send pictures to some of his European friends. One of them thought it might be the mouth plate of a large ammonite, but none of the ammonite experts we then asked would concur. Posting it on The Fossil Forum also did not provide any answers.

The four separate sections are all very flat and plate-like and have a thin crystalline structure very similar to the structure of crab carapaces. The plates have no supporting structure underneath but rest on the matrix, as we were able to tell with the broken pieces we assembled. There is also a small tube worm attached in the bottom lower left corner, which indicates that it would have remained exposed on the ocean floor long enough for the worm to attach and grow.

The scale shown in the picture is in centimeters. Here is a close-up of the bottom right plate. Note how it shows a somewhat repeating pattern

Submitted by Bruce Thiel

Fossil Hackathon: UO students catalog a huge collection

Lexie Briggs, Museum of Natural and Cultural History

https://around.uoregon.edu/content/fossil-hackathon-uo-students-catalog-huge-collection **(April 21, 2023)**

When former Newport harbor master Kent Gibson's fossil collection had gotten out of hand, he knew exactly who to call: experts from the University of Oregon and the Museum of Natural and Cultural History.

Gibson, now retired, begins most of his days with a walk on the beach near his home in Newport, keeping his eyes peeled for fossils. Over the past 25 years, Gibson's fossil collection has grown with the tides.

"Sometimes I'll be coming off the beach with 25 or 30 pieces," he said.

The fossils are collected ethically; Gibson has all the proper permits for collecting fossils on public lands, and the fossils must be donated, not sold for profit. Now in the thousands, his hoard is one of the largest and most significant collections of marine mammal fossils in North America.

"Kent has a more comprehensive collection of fossils from the Astoria Formation than almost anywhere else, and certainly the largest on the West Coast," said associate professor Edward Davis, director of the museum's Condon Collection, referring to a geologic band exposed along the Oregon and Washington coasts.

Eventually, Gibson would like to donate the bulk of his specimens to the Condon Collection. With a collection of that size, however, it is a challenge to even catalog, harder still for a citizen-scientist.

Enter the expertise of UO students, professors, and staff. Davis organized a Fossil Hackathon: three weekend extravaganzas in 2022 and 2023 to tag, identify and catalog Gibson's fossil collection.

The students, staff and volunteers set up a paleontological command center in Gibson's barn, processing hundreds of fossils per shift in an assembly line along several tables pushed against a wall. Volunteers Simon Zabaldo and Jacob Faulkner Jones painted small white blazes on the fossils, each approximately a centimeter long by half a centimeter high, so their colleagues could inscribe catalog numbers.

Continued from previous page, Fossil Hackathon

Student Emma Giometti and Jordan Rogers, a lab technician for the museum, created the collection database, a massive spreadsheet containing information about the fossils, while earth sciences doctoral candidate Kellum Tate-Jones worked with them to identify each fossil.

Andy Quintinilla, another museum lab employee, was a utility player, transporting wheelbarrow loads of fossils from the collection to the processing table and jumping in to help identify whether a fossil is a bone or a piece of driftwood, which fossils are too delicate to process in the wheelbarrow, and what is, after all that, mostly just a rock.

It's a bustling atmosphere, and it's clear there's no time to waste. Thousands of fossils need to be identified, after all.

"This kind of hands-on learning is so useful," said Giometti, a second-year undergraduate student majoring in earth sciences on the paleontology track. "I think it's one of the best ways to learn, especially if you're interested in fieldwork, like I am."

Tate-Jones, a doctoral student in earth sciences, said the only way to really learn how to identify fossils is to physically handle them.

"You start to see patterns in the shapes and textures of the preserved material," she said. "After handling hundreds of specimens in the Hackathon, I can now pick up a weathered cobble with a little bit of bone showing and say, 'Yep, that's definitely a fish skull.'"

Quintinilla, who graduated in 2021, agreed.

"My background is in biological anthropology, and I can more easily identify primate species and hominids than marine animals," she said. "But, with the hands-on fossil work through several visits to Kent's collection, I can now tell when I'm looking at fish bones, shark vertebrae or even marine mammal bones now."

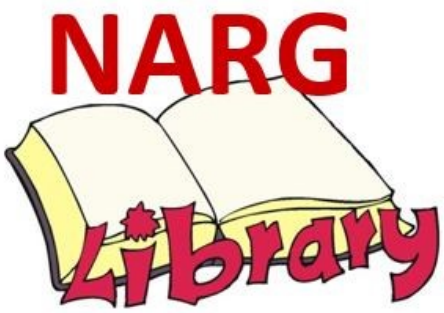
"There's always room to learn the difference between mollusks, however," she added.

Davis called it a joy to help students get such hands-on learning. "Working with a collection like Kent's is a once-in-a-lifetime opportunity," he said.

"I know sometime down the road — maybe not in my lifetime, but someday — people are going to be doing incredible work on this collection," Gibson said. "Maybe someday I'll get one named after me."

Oregon Council of Rocks and Minerals Club Award Presentation

At the 2022 Portland Regional Show of Gems, Minerals, and Fossils, NARG members Tara Baker and Debbie Shannon won the Oregon Councill Trophy sponsored by the Oregon Council of Rocks and Minerals Clubs (OCRMC) for their display on "Oregon Beach Bone Fossils." This was determined to be the best all Oregon display at this year's show. At the April 2023 NARG monthly meeting, Debbie and Tara were presented with their awards by Linda Harvey, representing the OCRMC. Each received an award plaque. They were also awarded with a newly made traveling trophy. This trophy was made from polished Oregon wood. 12 polished Oregon stones were placed as hours on a clock. Tara's and Debbie's names are engraved on the trophy that will be returned and presented to next year's winner(s).



The NARG library has just become easier for members to use. The 430 books can be viewed by using the link below. Once you find a book you want, click on it and find its "index" number. Requests for books using the index number are made to danolough@aol.com. He will notify you if the book is already checked out. If it is not, he will bring it to the next NARG meeting. Members can check out 2 books at a time and should return them at one of the following 2 meetings.

http://cloud.collectorz.com/danolough/books

NARG Membership

NARG's membership dues are due January 1, 2023.

Individual Membership	$25
Family Membership	$40
Student Membership	$10

Pay your membership by:

***Mail a check to:**

NARG
Membership
PO BOX 726
North Plains, OR 97133

***Pay via credit card with PayPal (No account necessary.):**

Use the following links:
Family membership $40, click here.
Individual membership $25, click here.
Student membership $10, click here.

Fossil Calendar

May 13-14	Field Trip, Madras, OR Saber-tooth salmon dig
June 3-4	(Possible) Field Trip, Madras, OR Saber-tooth salmon dig II
June 7	NARG Monthly Meeting, Tualatin Heritage Center, Tualatin @ 7P
June 23-	Fee dig, South Dakota (Naughty Nautilus)
July 5	NARG Monthly Meeting, Tualatin Heritage Center, Tualatin @ 7PM
July 22-23	Field Trip, Mitchell, OR Ammonites and plant fossils
August 2	NARG Monthly Meeting, Tualatin Heritage Center, Tualatin @ 7PM
August 5	Annual FossilFest, Tualatin Heritage Center, Tualatin @ 7PM
August 12-13	Field Trip, Post, OR Agates, petrified wood, and calcite crystals
September 2-3	Field Trip, Beaulah Reservoir, Juntura, OR Plant fossils
September 6	NARG Monthly Meeting, Tualatin Heritage Center, Tualatin @ 7PM

Please email Greg Carr (greg.fossil.hunter@gmail.com) for details.
Or check the web-site, emails, and Facebook for any changes or alternatives.

For a listing of local gem and mineral shows check out:
http://www.mineralcouncil.org/shows.pdf
http://orerockon.com/ Click on Portland Area Rock Clubs, includes PNW Clubs)

NARG Officers:

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NARG Auction	**Linda Harvey**	
Portland Regional	**Tara Baker**	
	Debbie Shannon	

NARG's Mission Statement

To encourage responsible stewardship of earth's pale-ontological resources; to promote scientific research, communication, and public education.