NORTH AMERICAN RESEARCH GROUP

Fossils on the Oregon Coast

- FossilFest at the Hatfield Marine Science Center
- “Salt Wood” from the Oligocene coastal Sweet Home Petrified Forest
- Fossil whales from a Seattle cement quarry
- Winter beach fossil finds
- And much more…

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ON THE COVER

Winter wave exposed gravel bars containing Miocene marine fossils from the Astoria and Lincoln Formations. Lost Creek Beach, Newport, Lincoln County, Oregon. Photo credit: James Verheyden.

MISSION STATEMENT

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

FOSSIL FEST AT THE HATFIELD MARINE SCIENCE CENTER NEWPORT, OREGON. FEBRUARY 8, 2025

By Tara Baker and James Verheyden

Visitors to FossilFest are encouraged to bring their fossil discoveries for identification. Aaron Currier identifies this fossil as part of a *Desmostylus* skull.

This visitor proudly holds a partial *Desmostylus* skull they found on the beach.

An entire table of fossil skulls found by Kent Gibson, NARG member and former Harbor Master of Newport, Oregon.

Tara Baker filmed a short video about FossilFest which can be viewed on YouTube. Kent Gibson, in the background shows off some of his fossil skulls.

FossilFest in Newport, Oregon, is organized by the North American Research Group (NARG) and the OSU Hatfield Marine Science Center to showcase the fossils of the Oregon Coast. The event features special lectures, fossil displays, and identification services to educate the public about paleontology.

Weylin Charland displayed some of his favorite fossils at his table, while Alice Kitchin represented the Rice Museum. Kent Gibson engaged with many visitors as he shared his extensive fossil collection. Greg Carr delivered two informative talks, and Tim and Tonya Fisher offered NARG t-shirts for sale.

Dan O'Loughlin and Andrew Niehus staffed the NARG table, helping kids sift for fossilized shark teeth. Despite recently being released from the hospital, Arnold Williams still came to lend a hand.

FossilFest would not be possible without the dedication and support of NARG members, whose efforts make this educational event a success each year.

Tara Baker's video of the event can be viewed on YouTube: https://youtu.be/DqPQ67rH3D0

Greg Carr giving on a presentation on Osedax, bone worms, sometimes found in fossils.

Weylin Charland showing a prepared set of 9 articulated vertebrae, including the atlas and axis (left side).

Visitors learning about fossils at Fossil Fest.

Joe Cantrell demonstrating his photography setup used to photograph fine fossils details.

QUARTZ PSUDOMOPRHS AFTER HALITE, ANHYRITE OF THE SWEET HOME PETRIFIED FOREST, OREGON

By James Verheyden

Situated at the base of the Western Cascades between the Oregon towns of Sweet Home and Holley lies the Sweet Home Petrified Forest. Long renowned for its abundance of silicified wood, early paleontologists noted its ubiquity in driveway gravel, retaining walls, and garden decorations (Gregory, 1968). For local farmers, however, the petrified wood was more nuisance than treasure—piles of it were often discarded along fence lines after being unearthed during plowing (Ransom, 1955). In Ames Creek, fossil wood was once so abundant that it constituted an estimated 10% of the stream bottom. Despite its prevalence, much of the material lacks the vibrant colors and polish desired by lapidary enthusiasts; only about 5% of the wood is considered exceptional in quality (Ransom, 1955). Specimens are only silicified, not opalized, and while often dull in color, anatomical details are usually well-preserved with little taphonomic deformation.

The Sweet Home Petrified Forest, at 24.7 million years old, represents one of the youngest Oligocene floras in Oregon. This coastal, stream-bank bottomland is preserved within layers of ash and tuff from the Little Butte Volcanic Series (Ore, 2009). These fossil-rich terrestrial sediments interfinger with the marine Eugene Formation near Brownsville, indicating a coastal margin at the time of deposition. At that time, the modern Cascades had not yet formed (Gregory, 1968). Instead, a shallow ocean merged with an expansive coastal plain, which transitioned into a growing chain of volcanic peaks along the coastline (Ore, 2009). The region's heavy rainfall sustained lush forests, while rivers flowing in between volcanoes drained into a large bay (Gregory, 1968).

Remarkably, much of the fossil forest lies hidden beneath a thriving modern one. Unlike the arid landscapes typically associated with petrified forests, Sweet Home's ancient trees are enveloped by a living forest. As a result, fossil specimens are often only uncovered when the dense vegetation is cleared. Discoveries are frequently made in farmland, along creek beds, or during logging operations.

Fossil wood with cubic quartz pseudomorphs after halite. Sweet Home, Linn County, Oregon. James Verheyden specimen V2064 18cm.

In the hills surrounding Sweet Home, fossilized logs are sometimes found in-situ buried upright in volcanic ash. At the McQueen Ranch, a grove of more than 20 vertical fossilized sycamore stumps, some as wide as six feet in diameter, were found (Ransom, 1955)(Gregory, 1968). In nearby valleys, dense layers of fossil wood, such as those at the Marker Ranch, were deposited as streams eroded lighter matrix material, concentrating the heavier and harder wood. The large angular nature of these pieces suggests minimal transport from their source (Gregory, 1968).

The fine anatomical preservation of the petrified wood has allowed researchers to identify at least 54 distinct species at the Marker Ranch alone. However, represented species span multiple plant communities, indicating that some wood may have been transported from higher elevations by ancestral rivers (Gregory, 1968).

A unique aspects of the Sweet Home Petrified Forest is the remnants of salt inclusions within certain specimens of petrified wood. Quartz pseudomorphs, measuring up to 6 mm and often white to gray in color, form isometric (cubic) or orthorhombic crystal habits in select pieces. While some wood specimens retain enough anatomical detail to allow species identification, many lack defining characteristics. The best specimens of the "salt wood" were collected as float material in a small area approximately 1.5 miles east of Holley (Staples, 1950).

The cubic crystals were formed by halite which crystallized within the wood prior to petrification. Some halite crystals exhibit hopper skeletal features with hollow centers. The orthorhombic crystals are likely from anhydrite, which forms less commonly because halite crystallization is generally favored. However, anhydrite crystals can form in sodium chloride-saturated solutions at temperatures above 25°C (77°F) (Staples, 1950). Sometime after the saline saturation and crystallization phases, fresh water percolated through the wood, dissolving the salt crystals and depositing silica via permineralization (Brown, 1950). In many specimens, intergrown crystal masses dominate the perimeters, while smaller, dispersed crystals appear in the centers. The crystals appear to preferentially align with the wood grain, causing most of the cubes to appear as squares when the wood is cut transversely (Staples, 1950).

Fossil wood with large skeletal cubic quartz pseudomorphs after halite hoppers. Sweet Home, Linn County, Oregon. James Verheyden specimen V1179 6.5cm.

The presence of salt in these specimens indicates proximity to a marine environment. Halite crystal imprints found within fine tuff at nearby Bryson's Quarry, located 4 miles southwest of Brownsville, indicates a supratidal zone (Vokes & Snavely, 1948)(Retallack, 2004). However, the salt concentration found within the wood is inconsistent with conditions suitable for typical tree growth, suggesting that these trees originally grew in an area later inundated by saltwater, such as a lagoon (Staples, 1950). For salt crystallization to occur, a high concentration of salt must have accumulated within the wood. This process likely required the isolation of an inlet or lagoon, where substantial evaporation occurred, concentrating the salt to the point of saturation and facilitating the formation of halite crystals (Ore, 2009). Observations at the Bonneville Salt Flats in Utah have shown that saltwater can wick up telephone poles, leading to cracking as the salt crystallizes. However, much of the Sweet Home salt wood exhibits salt crystals concentrated near the periphery. This suggests that the wood was submerged as salt water infiltrated from all sides (Staples, 1950).

Research suggests that humic acids, present in shallow marine lagoons, may promote the growth of skeletal halite crystals, further supporting the hypothesis of submersion

(Staples, 1950). The proposed sequence of events includes forest growth, inundation by seawater, increase in salinity, salt crystallization, burial by volcanic tuff, and subsequent wood permineralization and quartz replacement of the salt crystals. Such conditions would be rare and geographically limited, consistent with the restricted distribution of salt wood near Holley. Unfortunately, most of this unusual material has been found as float, and no in-situ logs have been located, making a comprehensive sedimentological study challenging.

Looking at Oregon's modern coastline, the so-called "ghost forests" may be a parallel to the paleo environment which formed the Sweet Home salt wood. These groves of dead trees standing in seawater formed during the last Cascadia earthquake when sudden subsided dropped low-lying coastal areas. Such events have occurred repeatedly over the past 7,700 years, with an average recurrence interval of 642 years (Dipietro, 2018).

As the oceanic Juan de Fuca Plate subducts beneath the North American Plate, stress accumulates along the boundary, causing localized uplift along the coastline. When the fault suddenly slips, the coastline can drop by 0.5 to 2 meters. This abrupt subsidence transforms once-hospitable low-lying areas, such as meadows and forests, into saltwater-inundated zones, killing all terrestrial plant life. Evidence of these events is often found in sand layers deposited by tsunamis that accompanied the earthquakes (Atwater, 1987). However, while this potential depositional mechanism is intriguing, lack of sedimentological data or other stratigraphic context prevents determination of why halite crystals formed within the wood.

While the exact depositional conditions of salt wood remain unknown, its unique and intriguing crystal inclusions have made it highly sought after by collectors.

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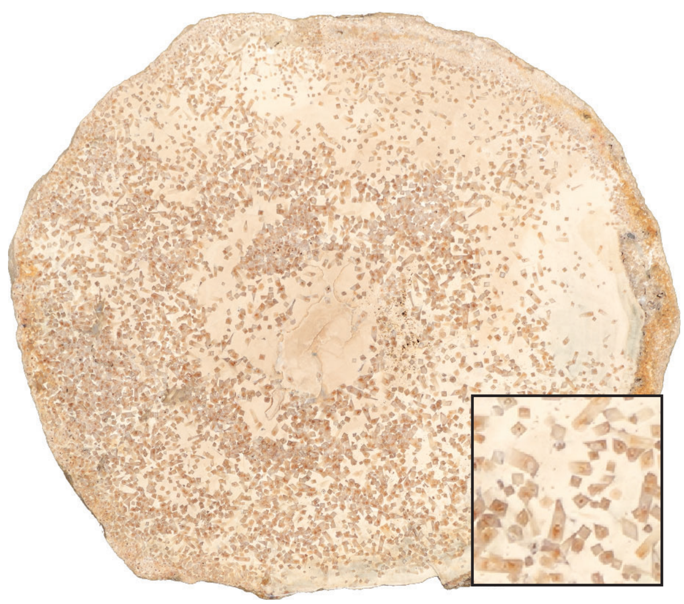
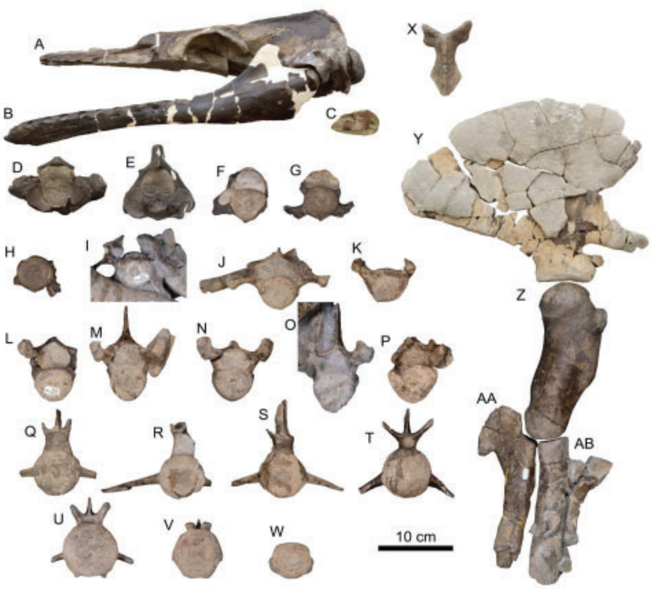


Fossil wood with cubic quartz after halite and orthorhombic quartz after anhydrite. Sweet Home, Linn County, Oregon. James Verheyden specimen V1180 11.5cm.

SECRETS HIDDEN IN OUR SIDEWALKS
A SEATTLE CEMENT QUARRY'S FOSSIL WHALES

By Bruce Thiel

In 1984, NARG advisor Jim Goedert and his wife Gail, along with William (Bill) Buchanan found and excavated a small two-meter-long whale west of Seattle. It was studied and named *Fucaia goedertorum* by L. Barnes in 1994 and housed at the LA County Museum. To this day, Jim's find is still the most complete and well- preserved specimen among 13 other mysticetes species and was recently chosen to be photographed, measured and compared in a morphology recently published in the Journal of Paleontology in 2025, and is beautifully illustrated with many photographs.



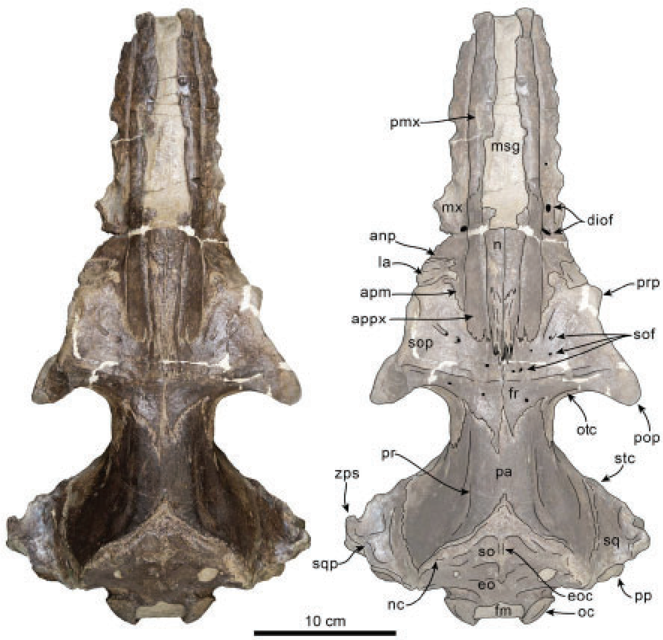
Associated partial skeleton of *Fucaia goedertorum* (Hernández-Cisneros, 2025).

I asked Jim about the 1984 discovery, and about Bill Buchanan, another early fossil collector, and he shared these remarks:

"The quarry that *F. goedertorum* came from was known as the Twin River quarry, and it was just west of West Twin River. They would go in with big bulldozers with a couple of big hooks that went down about 3 or 4 feet and just rip up the siltstone - along with any concretions or skeletons. They would then let it weather a bit to break it down, and come in with earthmovers to scoop it up and take it down to a landing and pier where they loaded the material onto barges to take to Seattle for cement production.

It was quite a large quarry - maybe 80 acres or so - and they could work one area while they left the other to break down a bit, then move into it. It was very productive for fossils, and quite messy when wet because the siltstone would become clay-like and very sticky. So your feet kept increasing in size as you walked around, when conditions were moist. We would just set up a grid pattern and walk back and forth across those areas watching for bones or other things of interest. Most people were collecting invertebrates, especially the callianassids which were abundant and large Liracassis. We got quite a number of whales from there - most are in Los Angeles, and the big ones are still in storage. The large whale on display at the Burke came from there, and there is another fragmentary *F. goedertorum* at the Burke that is prepared but not yet studied. Of course, the tractors usually did a number on the whales - Larry Barnes called them 'bustocetes' because many of the bones were broken or crushed. In fact, the tip of the rostrum of the holotype is missing because one of the bulldozer hooks went through it but luckily missed the rest of the skull. There was nothing around there to break concretions on, and one skull we collected has the saggital crest all broken up because collectors were using it as an anvil to break the shrimp concretions on! I guess they thought it was wood or something. The quarry is overgrown now, and the pier removed.

Bill Buchanan helped collect several of



Dorsal view of skull of *Fucaia goedertorum* (Hernández-Cisneros, 2025).

the whales from there, as well as from many other areas along the coast. He had worked as a catskinner for some of the timber companies (and also during the war building roads in Burma), and worked for the Clallam County and other jobs. He was already retired when I first met him. He was a great guy, and always willing to donate fossils. He transported at least two pickup loads of mostly vertebrate fossils from our place to the Natural History Museum of Los Angeles County - he was visiting relatives down there anyway, but this way the museum paid his gas, at least one way. He has a number of species named for him: *Pinus buchanani* (from the Jansen Creek Member of the Makah Formation), *Sklallamiabuchanani* (a sand crab from the Crescent Formation), and *Klallamornis buchanani* (plotopterid from the Pysht). He brought many important specimens to our attention, and collected the holotypes of several other species as well. It is interesting that you and him have a plotopterid in common! He was also present when the holotype of *Kolponomos clallamensis* was discovered by his neighbor, and later brought the second skull from the Clallam Formation to my attention - it was sitting in the rock garden of Mr. Albin Zukofsky in Sequim. Bill recognized that it might be something important, and it surely was. Amazing guy - not formally educated, but interested in lots of stuff, and a very nice person as well. He and his wife, Dorothy, had lived in Clallam Bay from I think the late 1940's, and she had grown up in the depot at Underwood, Washington (now gone, I think) along the Columbia River - and my parents had one of the big signs from one end of the depot for many years when I was a teenager. My dad, working for the SP&S snagged that at some point after the depot closed. Somebody bought it from my mother about 25 years ago."

Jim's narration of the quarry led me to read more about how cement is made. The main essential ingredient, limestone is quarried, ground and baked in a rotary kiln with clay and gypsum—with the final product re-ground to make the cement powder. When one looks at our roads, sidewalks and foundations, one does not think about all the fossils that might have been destroyed to make concrete. If our roads and sidewalks could talk what secrets would they relate regarding what lays inside?

Unfortunately, the article is not open-access, but can be obtained online from local or university libraries. If you need help or would like to obtain a copy, please email me at fossilcrab@icloud.com.

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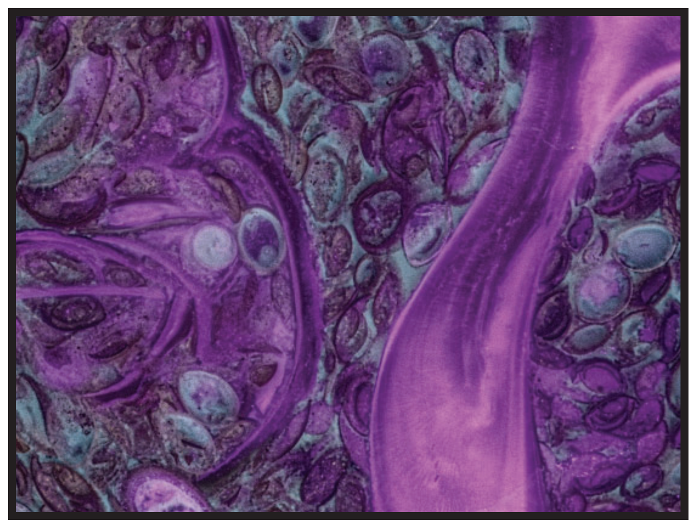
OSTRACODS IN *ELIMIA TENERA* PHOTOMACROGRAPHS

Photography By Joe Cantrell



A slab of *Elimia tenera* fossils I've been carrying around in my pocket for several days jumped under the macro lens today. These are gastropods from one of several inland Western North American lakes, roughly 46-51 million years old. The geometric relationships I found inside those ancient Fibonacci shells, where uncountable numbers of ostracods, ancient seed shrimp, collected and were petrified often in Fibonacci-esque relationships to be found, it was a fascinating time in the Institute of Empirical Blunders. At the end, when ambient light was low enough, I looked with 365nm UV light and hope you agree, that was fun in a different way. I feel so fortunate to be able to do this stuff. Hope you enjoy it.

EXPLORING UTAH'S PALEONTOLOGY TREASURES
PART 1: UTAH'S LOWER CRETACEOUS IN THE CEDAR MTN FORMATION

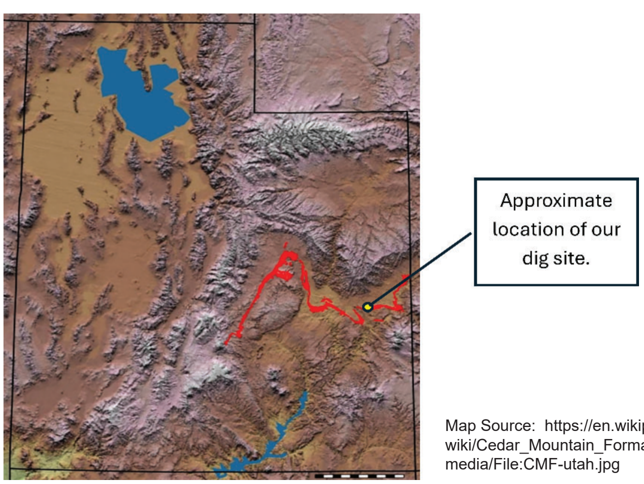
By David Klubert & Jerry Dodson

What does an 'offer you can't refuse' sound like in Paleontology? It goes something like this: "Lorrie's Site is the densest concentration of dinosaur bones I have ever seen. Do you want to come?"

Well, we couldn't resist and hearkened to that call this past September. Fellow NARG member and intrepid off-roader, Jerry Dodson, and I were off to join our friend, Joshua Lively, Ph.D., Curator of Paleontology of the Prehistoric Museum in Price Utah. Our destination was a previously discovered site about an hour's drive outside Green River, Utah, in the Cedar Mountain Formation.

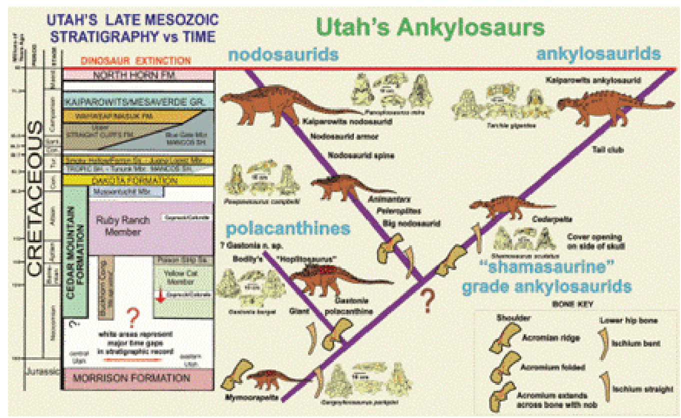
Josh and his folks were there last year exploring and filming content for the BBC segment in its Walking with Dinosaurs series so we felt this was a good opportunity to explore some of the lower Cretaceous in east-central Utah. This trip did not disappoint.

The map below identifies the general area of Utah we were working in. The red line represents the Cedar Mountain Formation. This Formation is one of the last major dinosaur-bearing formations to be studied in the United States. Except for sporadic bone discoveries serious research did not begin until 1990.



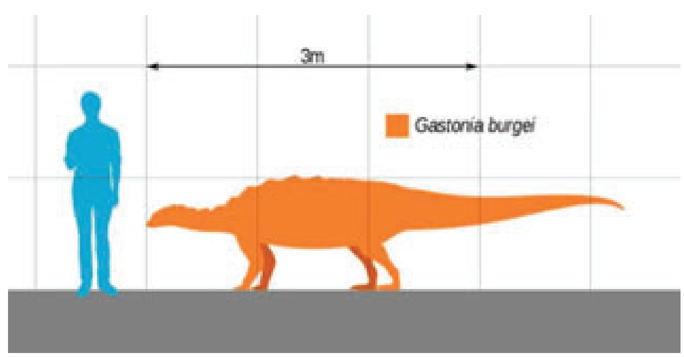
Map Source: https://en.wikipedia.org/wiki/Cedar_Mountain_Formation#/media/File:CMF-utah.jpg

This site mostly preserves *Gastonia lorriemcwhinneyae*, but some tantalizing specimen bones of dromaeosaurs have also been found over the years, including during the excavations in 2023 and 2024. *Gastonia burgei* was named in 1998 by Jim Kirkland. *Gastonia lorriemcwhinneyae* was named in 2016 by Billy Kinneer, et al. Dating of the site is a bit uncertain but we are looking at something in the 130-135 Ma range.



Stratigraphy and proposed relationships for Utah's ankylosaurs.

Utah was once home to a variety of ankylosaurs. We were after *Gastonia lorriemcwhinneyae.*



Size perspective of *Gastonia burgei.* Source: Slate Weasel, Public domain, via Wikimedia Commons.

Views of the approach to the dig site (top) and perspective of the stratigraphy (bottom) showing elements of the Ruby Ranch Mbr, Poison Strip Ss, and the Yellow Cat Mbr.

A mature Gastonia was a heavy (1.9 tonne) large (5 m) creature. Gastonia was an herbivore. However heavily armored with bony plates, scutes, and osteoderm peppered skin and possessing a large tail with triangular bony blades, Gastonia was well-equipped to defend itself.

The clusters of fossils in our bone bed and the varying specimen sizes suggest herd-like behavior. The grouping also is suggestive of the death and subsequent scavenging either at a waterhole during a drought or mass drowning while forging a river.

Work underway on the bonebed

For the most part our work was done in a recumbent fashion with dental picks and awls. Work in the bone bed itself was complicated by the large number of bones that were on top of each other intermixed with numerous concretions and osteoderms. Specimens that could be freed up individually were tagged with their grid locations and bagged. Larger blocks of bone were plaster-jacketed and removed as a block.

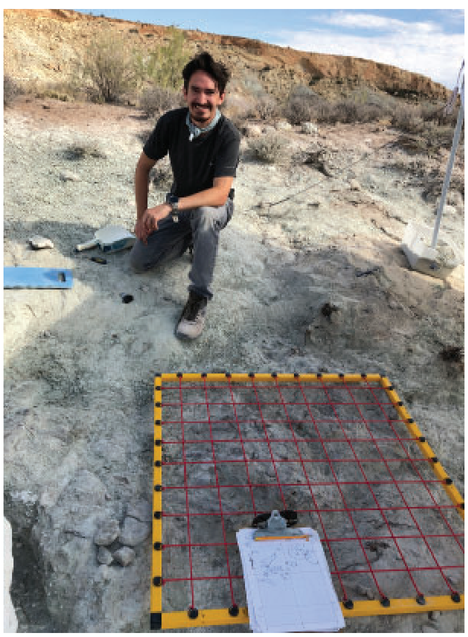
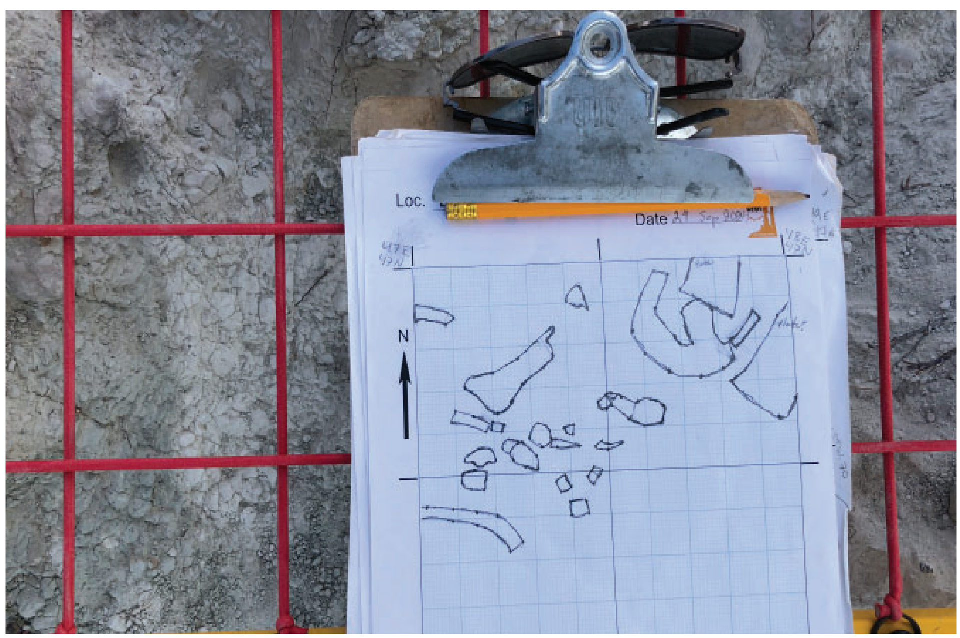
This field trip gave us hands-on experience with a variety of basic skills: extracting specimens, creating field notes, photographing, grid mapping and sketching, and plaster bandage and burlap jacketing specimen blocks.

Views of the dig site (top & bottom).



Work underway (left, middle). Jacketed rib bone (right).

Part of a large rib bone was discovered in an adjacent bed. Here a burlap and plaster cast has been applied over the top of the specimen and the object successfully flipped. It is being cleaned of extraneous material before the bottom casting is done.

One-meter grid placed over the bone bed (left) and a diagram of its bone fragments (right).

Two separate bone fragments suspected to be metatarsals from dromaeosaurs (left, right).

Specimens in matrix likely representing caudal (left) and dorsal (right) vertebrae.


Specimens likely representing ischium fragments (left, right).

Part of the crew relaxing after a long productive day.

The field work this year at Lorrie's Site produced 50 field jackets and numerous bagged fossils with an estimated total of 400+ fossils.

Next time you are traveling through Utah, plan a stop by the Prehistoric Museum in Price. It is home to three mounted armor-plated ankylosaurs skeletons: *Gastonia burgei*, *Animantarx ramaljonesi*, and *Peloroplites cedromontanus*.

Next: Read more about Exploring Utah's Paleontology Treasures in Part 2: Utah's Middle Cambrian as we explore the Wheeler Shale available in the next issue of the NARG newsletter.

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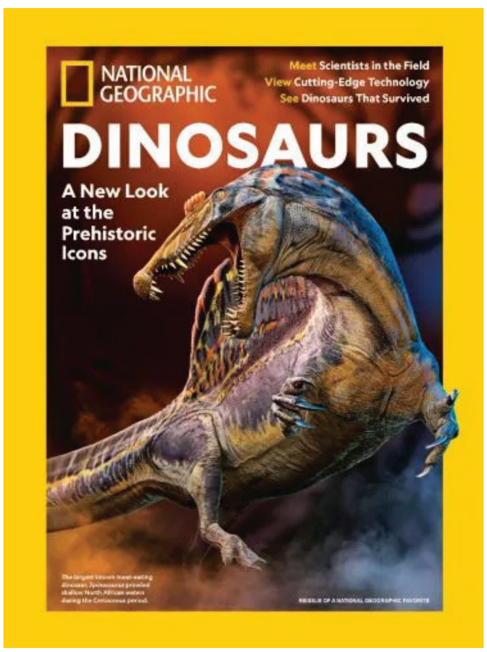
DINOSAUR BIOLOGY: LEVELS OF DESCRIPTION AND ANALYSIS BOOK REVIEWS

By Harold Hines, Jr.

LEVEL 1

Recent dinosaur discoveries and especially their biology are hot topics. Thus, it wasn't very surprising that my local supermarket's magazine section was offering a National Geographic's 2024 special issue, "**Dinosaurs: A New Look at the Prehistoric Icons**." Actually, not all the contents are "new." Rather the volume draws on "material" previously published ca. 2014-2020, at nationalgeographic.com, or in an issue of National Geographic. As you'd expect, the well-written and informative essays are lavishly illustrated. These often-remarkable illustrations alone easily justify the $14.99 price.



In "Paul Sereno Reflects on His 40-Year Career as a Dino Hunter," he states that the study of dinosaurs has changed dramatically: "When I entered the field, we were naming maybe two or three dinosaurs a year- we're naming 20 a year now. [And] There are more people studying dinosaurs" (p. 26). Furthermore, the volume's introduction emphasizes that new technologies, e.g., computerized tomography and CT scans, are revealing previously hidden detail.

A sample of the volume's recent discoveries or interpretations:

1. Paleontologist Lawrence Witmer "used CT scans to show that major groups of dinosaurs evolved distinct cranial air-conditioning systems to keep their brains from overheating. [e.g.] Armored dinosaurs …relied on their nasal passages, which evolved into ducts shaped like crazy straws to shed heat as the animal breathes, cooling the blood destined to the brain" (p. 15).
2. Jasmine Wiemann "showed that when dinosaur eggshells are struck with a laser, the light that scatters back reveals degraded protoporphyrin and biliverdin, compounds that give modern bird eggs color and speckling. Based on such analysis, the calcified eggs of the Velociraptor relative Deinonychus had a bluish hue" (p. 32).
3. Johnna Rizzo in "Ian Miller Talks Fossil Flurries and Prehistoric Plants in Ancient Landmasses," analyzed the plants of the late-Cretaceous continent Laramidia, that stretched from Alaska to Central America. On Laramidia's East flank is a formation called Kaiparowits, in today's Utah. The formation's plant fossils reveal an ancient lush landscape that resembles the swamp lands of Louisiana. And Kaiparowits' environment produced an ecological zone that segregated the animals and plants, although related to those elsewhere, e.g., those of Alberta, Canada. Populations separated by latitudes, climate, and vegetation resulted in new species, and thus nearly every organism discovered in Utah has been a new species.

LEVEL 2

Amy M. Balanoff and Daniel T. Ksepka, "**What Was It Like to Be a Dinosaur? New Insights into their senses, perceptions and behaviors**," Scientific America (September 2024): 24-29. This article, aimed at the scientifically literate layman, despite its title, is actually devoted to Tyrannosaurus rex, and especially to "T. rex Brain Anatomy" revealed by CT scans that build digital endocasts" (p.27).

"Researchers typically look at measures of brain size compared with body size to estimate cognitive capacity of vertebrate animals. By this simple metric, T. rex is unlikely to have had primate-like intelligence" (p. 25).

Digital endocasts of T. rex show "expanded olfactory bulbs [which] indicate an exceptional sense of smell that would have been helpful for locating prey" (p. 27).

These endocasts show "large optic lobes…that T. rex also was probably capable of identifying and following prey with its eyes" (p. 27).

Perhaps most intriguing are the virtual endocasts of the semicircular canals. These "casts of the inner ear space [were used] to estimate what the labyrinth would have looked like in life. Their data indicate that most dinosaurs were restricted to walking and running. But in the lineage that led to birds, the structure of the ear changed…the semicircular canals grew larger…[and thus] had an ear that could sense the complex movements associated with flight" (pp. 28-29). T. rex would have been "capable of only walking and running"; while those dinosaurs "closely related to Velociraptor had an ear…[allowing for] gliding or a rudimentary form of flight" (p.29).

LEVEL 3

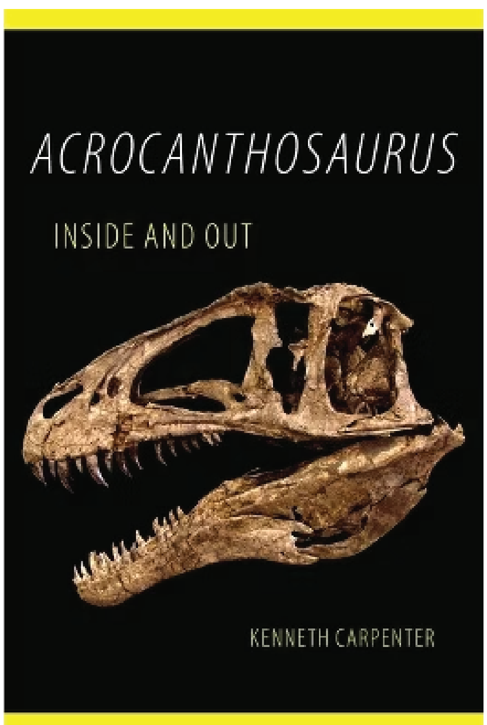
Kenneth Carpenter, **Acrocantosaurus Inside and Out** (2016: Norman: University of Oklahoma Press, 2022). Kenneth Carpenter, Director and Curator of the Prehistoric Museum of Utah State University-Eastern, brilliantly demonstrates what the bones of a large carnivorous dinosaur, that lived in the Early Cretaceous of south-central U.S., can reveal about its appearance, biology, and behavior. For the reader who has "some idea about what a dinosaur is" (p. xiii), Carpenter distills an extensive scientific and technical literature, and his own expert knowledge based on the most complete skeleton of "Acro" known. Indeed, this volume will "appeal to general readers and scholars alike" (back cover).

In nine short chapters, Carpenter addresses the following:

1. The discovery of Acro's five known partial skeletons,
2. What distinguishes Acro from its closest relatives: its tall neural spines,
3. How Acro's known bones were fossilized: calcium carbonite and pyrite are the key,
4. "the tall neural spines on the neck-, back-, and tailbones of Acrocanthosaurus…[receive] their own chapter" (p. 49): they probably were secondary-sexual characteristics,
5. Acro's internal anatomy: since soft tissue normally does not fossilize, scientists believe "if a certain feature is present in both

crocodilians [dinosaurs distant cousins] and birds [which evolved from earlier dinosaurs], then it most likely also occurred in Acro and all dinosaurs as well" (p. 59),

6. Acro eggs and hatchlings: since none have been discovered to date, "we can get some insight about what might have happened from studies of modern animal behavior" (p. 81),
7. "Acro the Hunter": Acro "was primarily a predator, hunting and killing rather than feeding on carcasses like a scavenger" (p.120), although there is "no consensus amount paleontologists" (p. 120) as to its prey,
8. Acro's environment: a relatively warm and dry climate, but fossil leaves and wood found in association with Acro "have not yet been studied" (p. 114).



Each of these well-illustrated, succinct chapters is packed with additional descriptions and analysis of Acro's traits and likely associated behaviors. A few examples will have to surface to illustrate why I highly recommend Carpenter's fine study.

Were Acro's lungs more like a crocodiles or birds? Both have one-way breathing, but birds have air sacs throughout the body cavity, some of which extend into hollow bones. "Openings… into the vertebrae of Acro…and birds suggest that Acro had a more bird-like than croc-like breathing system" (p. 73).

"How good was Acro's vision while it was hunting?" (p. 64). This depends on several variables, Firstly, the bigger the eye, the better the eyesight. The size of the eyeball can be estimated from the size of the eye socket. Secondly, the size of the pupil can be estimated from the sclerotic ring which supports the eyeball. Finally, peripheral vision, which is related to the spacing and location of the eyes. Taking all of these factors into consideration, Acro must have been well adapted for hunting.

"It is fairly certain that the female Acro laid eggs, although no Acro eggs are yet known" (p. 83). Eggs from other dinosaurs have been discovered, and both crocodilians and birds lay eggs. But were Acro's more likely bird-like or crocodile-like? A study of dinosaur eggs through a polarizing microscope "reveals the arrangement of calcium crystals that make up the shell," and their structure is more bird-like (p. 83).

LEVEL 4

David Hone, **Uncovering Dinosaur Behavior: What They Did and How We Know** (Princeton, NJ: Princeton University Press, 2024).

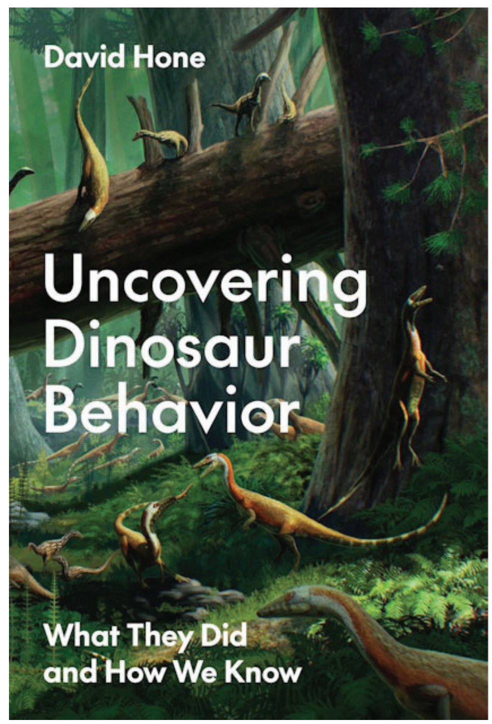
Hone's volume is a superb review and commentary on dinosaur behavior studies, 400 of which he cites in his References. He hopes this book will be "accessible to the lay reader, the student, and the academic" (p. x). For the most part he succeeds. Technical language is minimal, but at times he fails to adequately introduce a term or methodology, e.g. "Finate Element Analysis (see pp. 126, 150). The greatest challenge to the reader will be references to the 42 dinosaur clades throughout the volume. The Appendix briefly describing each of the clades is useful, but it can be difficult to keep them straight when they appear briefly at any and/or widely separated points in the text. Hone, perhaps is best tackled, after Carpenter's study.

Both the title and jacket promotional statements by eminent paleontologists at least partially mislead. For example, Paul Barret on the back of the jacket states the following: "Drawing on hundreds of studies of animal ethnology and comparing these with the often-capricious evidence available from the fossil record, Hone shows how we can deduce dinosaur behavior in rigorous, evidence-based fashion. Compelling, authoritative, and entertainingly written, this account treats dinosaurs as living animals and shows how it is possible to reconstruct these past worlds from the limited data available to paleontologists. In a field rife with hyperbole, speculation, unsupported assertions, this book provides an essential overview." And Alice Roberts succinctly states "This book isn't just about what we know about dinosaur behavior, but importantly how we know it." However, those statements miss what truly sets this volume apart: Hone stresses what we do not know about dinosaur behavior and why we may never be able to answer some key questions.

A few examples:

1. Most dinosaur species are known only from a few, often incomplete remains: "often we are working from only one or a handful of individuals that may not themselves be representative of a population or species" (p. 23).
2. Specimens are…single data points…that give us no idea of the degree of intraspecific variation, changes over ontogeny (growth), or change over time for the species, what seasonal or regional variations there were in the population, or how widespread it was" (p. 24).
3. More specifically, on "Group living," he notes that "despite the abundance of dinosaur fossils found in groups, the actual evidence for group living is rather sparse" (p. 60).
4. And "Just how social these animals were, and whether they engaged in social interactions (e. g., dominance and behaviors like collective hunting or allogrooming), is impossible to determine from the fossil record (p. 68).

Throughout the volume, Hone suggests



possibilities for further research. For example, in the chapter on "Feeding," he concludes that "the basic diets of many dinosaurs are understood and well-supported across multiple lines of evidence. Although detailed studies using biomechanics, trace fossils, stomach contents, comparative anatomy, and other lines of data are limited to a handful of species" (p. 147).

At times, Hone's volume will be a

challenge for the lay reader, but it is highly recommended.

LEVEL 5

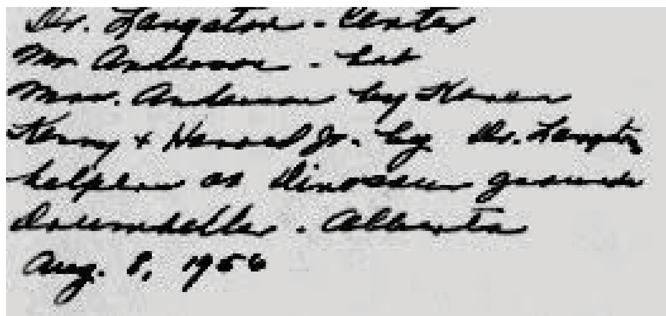
Michal Parrish, Ralph E. Molanar, Phillip J. Currie, and Eva B. Koppelhus, **Tyrannosaurid Paleobiology** (Bloomington, IN: Indiana University Press, 2013).

David Hone noted that “Tyrannosaurus rex has become a model organism for dinosaur research, and despite the limited number of good skeletons that have been recovered, probably more scientific papers have been written about it than any other dinosaur” (p. 36). This collection of studies is an excellent example of high-quality scientific papers devoted to T. rex and its close relatives.

Individual articles “fall into three broad categories: (1) systemic students of descriptions of new material, (2) projects incorporating functional morphology or (3) life reconstructions focusing on paleoecology, taphonomy, and paleopathology” (p. xi).

In short, the volume is a mixed bag of scientific essays focused on the Tyrannosaurid clade. A few representative examples: highly technical chapters are devoted to the near T. rex relatives Nanotyrannus; tyrannosaurid teeth, feet, brain size, jaw musculature, and jaw mechanics; craniocervical mobility; tooth and claw marks; osteomyelitis (Brodie abscess); and scavenging versus predation. Two additional articles focus on a juvenile tyrannosaurid association with palynological, paleobotanical, and paleomagnetic data; and on the paleoart reconstruction of a tyrannosaurid head.

All 5 of these studies devoted to dinosaur biology will be donated to our library.



August 1956 at Provincial Dinosaur Park, Alberta, Canada, with Dr. Wan Langstron Jr. (center) & crew, etc., Harold (teenager with hat) . See NARG Newsletter , Summer/Fall 2024, pp.15-16, for Harold’s essay “Canadian Dinosaurs.”

BRUCE THIEL'S FOSSIL CRAB EXHIBIT AT THE RICE MUSEUM OF ROCKS & MINERALS

Explore fossil crabs from the Pacific Northwest at the new exhibit at the Rice Museum of Rocks & Minerals.

A special exhibit on fossil crabs collected and prepared by Bruce Thiel just opened at the Rice Museum of Rocks & Minerals. Running from March 2025 through 2026, the exhibit explores how concretions form and the detailed work involved in preparing them. Bruce, a longtime NARG member, continues to impress with his meticulous and exceptional preparation skills.

OREGON COAST FOSSIL FINDS
NEWPORT, OR

Kent Gibson exhibiting some of his recent finds at FossilFest.

Fossil skull in matrix. Astoria Formation, Miocene, Newport, OR. Photo by Kent Gibson.

Unprepared concretion with embedded fossil bone. Astoria Formation, Miocene, Newport, OR. Photo by Kent Gibson.

Prepared articulated dolphin vertebrae. Astoria Formation, Miocene, Newport, OR. Photo by Kent Gibson.

Debbie Shannon posing in front of a fossil she found at Beverly Beach in February. Photo by Debbie Shannon.

Only three days after taking this photo, sand had already recovered this fossil. Photo by Debbie Shannon.

A fossil pinecone found by Kent Gibson. Photo by James Verheyden.

A shelf of shark vertebrae found by Kent Gibson, freshly labeled with University of Oregon tags in preparation for their permanent home. Photo by James Verheyden.

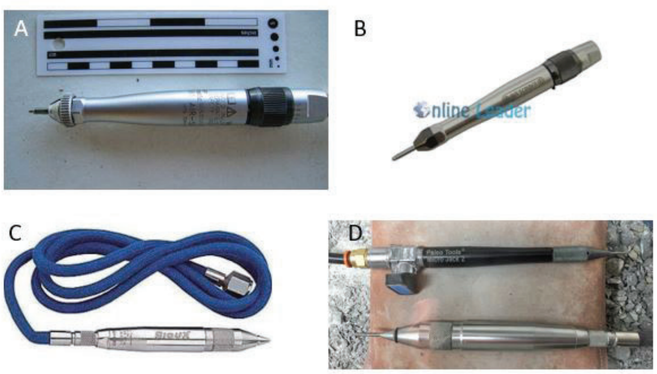
INTRODUCTION TO FOSSIL PREPARATION WITH AIR SCRIBES

By Greg Carr

When do we use air scribes? When the matrix is too hard for hand tools? When it is desirable to rapidly remove matrix? What kinds are there? These are questions often faced by those new to fossil preparation. This short guide seeks to provide helpful information for air scribe beginners.

Air scribes are divided into two main groups:

1. "Chicago Pneumatic" type – stylus hit by an internal oscillating piston
   - Paleotools ME9100
   - Chicago Pneumatic with modification
   - Chinese knock-offs with Modifications
2. Direct Oscillation of stylus with air seal "ARO", "Paleo Jack"



Commonly used air scribes of the Chicago Pneumatic (A,B) and Direct Oscillation (C,D) styles.

Air Scribe Maintenance

- Most important – frequent stylus sharpening – maybe several times a day
- Daily – oiling and O-ring replacement (for "ARO" type) (purchase in bulk online)
- Air Dryer Media replacement as needed (weekly, monthly)
- As needed – cleaning, stylus replacement, internal piston replacement

Chicago Pneumatic stylus (top) and ARO stylus, spring, and o-ring (bottom).

Stylus Sharpening

- Stylus has a tungsten carbide rod with the end ground to a sharp point or a flattened chisel. This must be ground on a diamond wheel or plate. They get rounded by breakage or abrasion.
- Sharpness of the point is not the same as the grind angle – blunt or acute! Blunt grind is for hard matrix, acute grind is for deep excavations or softer matrix.
- The difference between a sharp point and a rounded point is on the order of microns – generally not visible to the naked eye except in the form of a point of light reflected off a rounded point. But you can feel the

difference when using them! Inspect under the microscope.

- Sharpening the stylus will shorten it. Plan on replacing stylus – purchase or make your own! When working on the Oregon Thalattosaur I had to sharpen the stylus every hour and they only lasted 2-3 weeks. At $75 each from Paleotools I decided to make my own – approximately $5 in supplies – but I need a lathe to make the brass stops and a propane torch to silver-solder the stops to the carbide rod.

Different stylus styles.

Air Dryer

The air used in the scribes should be clean and dry. Home air compressors will not dry the air. In use, the tools may spit water droplets or there may be liquid water droplets left in the tools when shut down. This causes the tools to rust. Drying the air can be done by modifying a water filter to insert in-line in the air supply. A cartridge filter is placed in the housing and a silica Gel desiccant poured between the filter and the housing. As air passes through the desiccant it is dried, then filtered. The desiccant is replaced when it changes from blue (dry) to pink (wet) and can be regenerated in a warm oven.

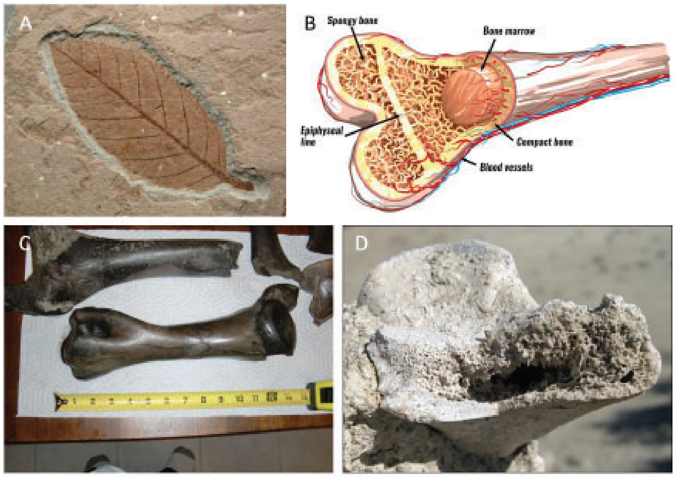
Fossil Considerations

Fossils of interest can be areas of weakness in the rock caused by the organism like leaf impressions causing a layer of weakness where they prevented the rock grains from interlocking

Packaged desiccant (A), loading filter (B), used desiccant (C), fresh desiccant (D).

during the hardening process. Or they can be remnants of the original organism, generally mineralized internally as well as encapsulated within the matrix.

If the organism had a smooth impervious surface the matrix can be removed by breaking it away relatively easily. However, if the surface was rough or reticulated, the matrix cannot be easily be broken away from the surface. It must be removed layer by layer until enough of the object appears to meet the need. If we are attempting to determine overall bone shape, loss of a few tenths of a millimeter may be acceptable. This is what we have in the Ichthyosaur material.



Fossil leaf - just a weak layer in the rock. Hammer & Chisel work (A). Bone structure (B). Smooth bone surface - easy to take off any adhering matrix (C). Rough bone surface - where exactly is the surface on the sub-mm scale? (D).

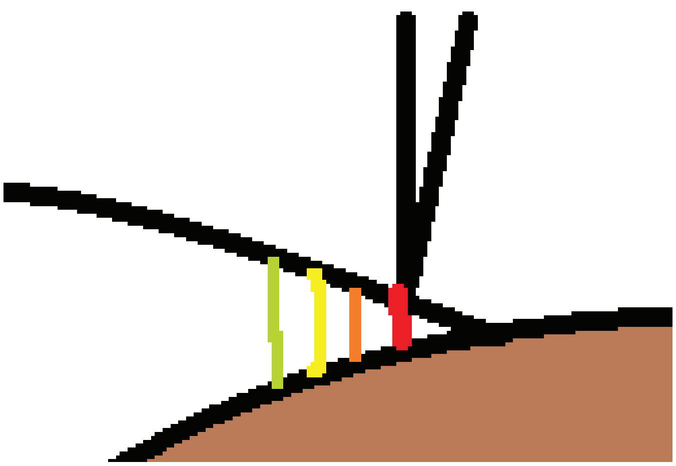
Manual Techniques

1. Get a good work area – table with great illumination, comfortable chair, binocular microscope with a boom mount. EBAY can be a good source if you know how to clean and align microscope optics.
2. Use protective gear – ear protection, eye protection, dust collection (if you can), dust filter if the matrix contains crystalline silica or uranium (example Hagerman horses, Morrison Fm. dinosaurs).
3. Take frequent breaks – continuous use of a vibrating tool can cause nerve damage to hands. I recommend a 10 minute break every hour. This can include bathroom breaks, refreshments, talking with visitors, documenting work with a camera, just looking at the specimen and planning the next move, etc.
4. Be careful with your glasses – rock dust and chips will cause lens scratches! Plan on a 'disposable' set of glasses which can be scratched.
5. There is no correct way to hold the tools – change up is helpful. Don't hold the air scribe too hard, and arrange the air hoses so that they do not tug on the tool. Large "U" and "S" curves help with minimizing the force necessary to hold the tool correctly.
6. Keep glue handy. Superglue is useful and may be allowed by your institution, but is not yet universally accepted by everybody. Apply to small cracks as soon as they appear, preferably before the loosened pieces fall off! Clean the area frequently so that if a small chip comes off you can find it and glue it back on ASAP.

Removal Techniques

- Remember, rock is strong in compression and weak in tension. Air scribes work by punching into the rock, causing cracks, and allowing the matrix to crack off into free air. Air scribes make poor drills.
- Match your tools to the task at hand. Rough shaping and removal of large barren chunks can be done by good old-fashioned hammer and chisel – I prefer ¼" wide carpenters chisels.
- I use the larger tools such as Chicago Pneumatic for most work, reserving the Paleotools #1 for very fine work where the fossil is very susceptible to cracking. If the CP is very sharp I can use it for surface work, since eye-hand coordination under a microscope is more important than the actual power of the tool.
- I have 3 main movements that I use –
    - Fast removal chiseling – push the tool tip into the rock so as to chisel out a continuous groove. Use your forearms, not the wrists. Keep the grooves roughly parallel, and shallow enough that the tool does not stall. Tool path is parallel to the rock surface, generally 1-4 mm removal at a time. Watch for pieces of specimen to appear in the groove – if you see them you've gone too deep or taken off too much!
    - Sideways scraping. Move the stylus

sideways back and forth by flexing the wrist. Advance the tool by a part of a mm each pass. If desired rest the back part of the stylus bevel on the specimen to limit the removal to 1/10 mm or less on each pass. This can generally remove all matrix down to the specimen surface, and is necessary to remove fine layers when the matrix is tightly bound to the fossil.
    - Punch and wedge. Where the specimen surface is smooth and the matrix separates, you can push a sharp stylus directly down into the matrix right at the edge of the specimen, causing the matrix to be broken and pushed sideways off the surface. You have to have good control so that the tip of the stylus does not touch the surface of the specimen since it will leave a hole. Can leave an excellent surface.
- Don't be afraid to use both hands to guide your tools.



Removal technique.

Problems & Tips

- Specimens without firm, smooth surfaces may require removal of a little bit of the specimen surface to reveal the underlying structure. This is particularly the case where there is no hardness or color difference between the specimen and the matrix. This is the certainly the case for the California Ichthyosaur material.
- Specimens can be distorted and not go the expected way. "Following the surface"(see below) can help.
- Specimens are frequently broken along microcracks and will be offset. Be on the lookout for the surface popping up above the plane you are working on. If the specimen apparently vanished, dig down a little and see if it is offset down.
- Following the edge or surface of a specimen is often the safest way to uncover it. Digging a pit with an air scribe to find where the surface goes can lead to unwanted damage.
- If you break it, re-glue it. Often it is unknown if a fossil is in a matrix (example crab concretions) . The choices are to slowly dig down through a concretion looking for a crab, risking some lost time if the concretion is barren. The other option is to break it, and if a specimen is encountered then glue it together and do it correctly.
- If you have thin sections, add some temporary supports during the preparation process. For example, a thin scapula or illium can be prepared on one side, and then a support applied. The support can be polyester innerliner layers and Vinac glue, or latex mold material and plaster. After the support is applied, prepare the entire other side, then remove the support. I have prepared thalattosaur illiums 8x10cm about 1-3mm thick in this manner.
- Oxidation by air frequently follows cracks and bones since these are easier diffusion paths. Sometimes there is an red/orange/brown layer of matrix for 1-2 mm at the bone surface. Be aware of color changes.

GREG GENTRY CRAB COLLECTION UPDATE

By Bruce Thiel

Prepared fossil crabs donated by NARG member Greg Gentry at their new home at the Smithsonian National Museum of Natural History.

Dr. Carrie Schweitzer, Faculty at Kent State University and world-renowned fossil crab expert, visited the Smithsonian over spring break and sent us an email and picture of one of the mobile cabinets and drawers housing the collection of fossil crabs that Greg Gentry donated this past year. She writes: “I am at the Smithsonian and having an amazing time with the recently donated collection. There are so many possible avenues of research with a collection of this size. I only have three days this time but will definitely be back for more data. Please thank Mr. Gentry for the donation—do you have his contact information? I’d like to tell him myself. As always thank you both for your generosity. This collection is very exciting.”

For more information on Greg Gentry’s crab collection donation to the Smithsonian, see NARG Newsletter Volume 13, Number 2, Summer/Fall 2024.

NARG MEMBERSHIP

Annual NARG membership dues are due January 1st of each year.

Membership Types

Individual	$25
Family	$40
Student	$10

New Members: Please fill out and mail an application to the below address

Pay your membership dues with one of two convenient methods:

Mail a check to:
NARG (North American Research Group)
Membership
PO Box 233
Tualatin, OR 97062

Pay via credit card with PayPal:
Family Membership
Individual Membership
Student Membership

NARG LIBRARY

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

NEWSLETTER ARTICLE SUBMISSION

Interested in submitting an article for the newsletter? We are looking for your articles, fossil collecting reports, book reviews, photos of your recent finds, and more. Send your contribution to james@verheydengeological.com for inclusion in the NARG newsletter. Make sure to attach photos separately in the email and do not include them in your manuscript.

FOSSIL CALENDAR

April 2	NARG Monthly Meeting: Scuba Diving the Willamette Valley for Fossils
May 7	NARG Monthly Meeting: A Dinosaur in Washington: Suciasaurus
June 4	NARG Monthly Meeting: Feeding Behavior of Theropods
July 2	NARG Monthly Meeting: New Modern Albatross from the Pacific NW
August 2	Northwest FossilFest: Trace Fossils and Other Oddities

NARG meetings typically occur on the first Wednesday of the month at the Tualatin Heritage Center at 7pm Pacific Time. Check the website nargpaleo.org and Facebook for meeting updates or meeting day variances.

For a listing of local gem and mineral shows, check out:
https://mineralcouncil.wordpress.com/ https://orerockon.com/

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