North America Research Group

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2022 Annual Potluck at the Tualatin Historical Building

About 40 NARG members and their families gathered together on November 12 for our annual member's potluck and auction. It was the first time we were able to do this since the COVID epidemic began in 2020. Linda Harvey organized a great potluck feast. We had pizza to soups to ham for our main courses and fresh baked bread (thanks, Megan Gagner), salads, and veggies for side dishes. But it was the desserts where our distinct NARG personalities shown with three kinds of dinosaur cookies available, along with other cakes, cookies, and pie. Thanks to Dan O'Loughlin for organizing the plates, silverware, napkins and drinks. It was wonderful to sit around the tables and chat with friends as we ate great food and drinks

Sharing in the potluck dinner

Chatting around the tables

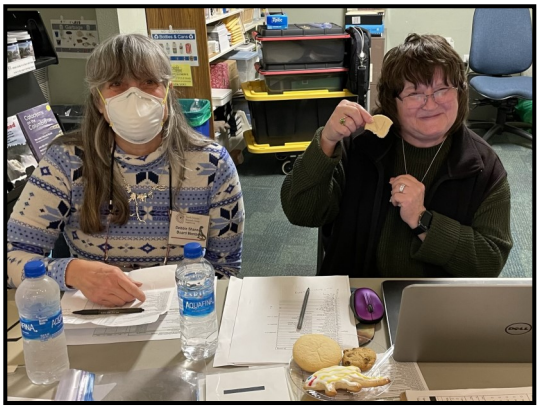
Robert Rosé (right) joined Cory Davis and his two children for dinner

Debbie Shannon's dinosaur cookies.

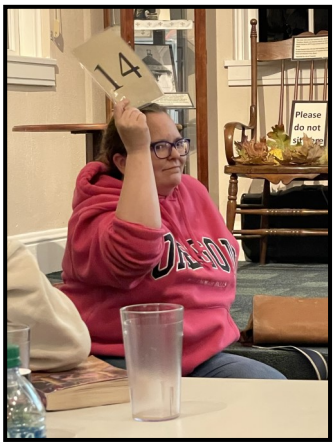
Continued from previous page, Annual Potluck

After the meal, our group was able to participate in a fund-raising auction for the club. Auctioneer/President, Aaron Currier, kept the bidding going and did an excellent job providing information for each item that came up. Members had some competitive bidding going on over geology and non-fiction books, petrified wood, concretions, and other fossils. Linda Harvey and Debbie Shannon kept track of auction items and winners.

Over-all it was a successful annual potluck, our first in the Tualatin Heritage Center, as we kicked off the holiday season as a club.



Debbie Shannon and Linda Harvey at the auction table



Gloria Carr bidding at the auction

Linda Frenette bidding while Gerry Lukos (left) and Greg Gentry (right) look on

Investigating Fossils of Unknown Origin

Fossil Detective: Robert Rosé

In November 2022, NARG held its annual auction at the Tualatin Heritage Center. During the night I bought two fossils. Unfortunately, neither contained written information about how old they were, where they came from or which formation yielded them. One fossil is a bivalve, and the other plant remains. What to do?

Since I have lots of books about fossils I went there to see if I could find a picture that looked like the bivalve I had. Since the bivalve is quite rugose it became obvious that it was an oyster. Turning to the internet I found an article that contained pictures of oysters very similar to mine. Turns out the fossil bivalve is probably Upper Cretaceous and called *Nicaisolopha nicaisei*. The country of origin and formation are unknown.

The plant fossils were easy to identify because of the nature of the plants. I recognized them as being very similar to plants seen in Cape Breton, Nova Scotia and Mazon Creek in Illinois. Knowing this, I was able to give an Upper Carboniferous age to the plants. And since the plant fossils are on flat shale matrix, Mazon Creek could be eliminated. However, the exact location where the plants were collected is still unknown. *Pecopteris* is the name of most of the plant fossils. I suspect this specimen probably came from the eastern part of the United States.

NARG Members Participate in the 2022 Portland Regional Gem and Mineral Show

The annual Portland Regional Gem and Mineral Show was held at the Washington County Fairgrounds from September 30-October 2, 2022. NARG has been a sponsoring club for this regional show for several years and many members participate in the planning of the show, in addition to volunteering during the show. Dan O'Loughlin and Tara Baker were NARG representatives this year on the PRGMS Board. Additional NARG members are on the Board representing their other rock clubs, including Linda Frenette, Greg Gentry, Gordon Hale, Bill Harvey, Linda Harvey, and Cindy Yablok. Many hours are spent planning for this big yearly event.

Days before the show, NARG members helped in set-up of the show. Brian Rauh, Isaac and Megan Gagnor, and others carried in equipment and set-up tables and display boxes. Next, NARG members came to set-up their fossil and mineral displays. We had 14 displays in all:

Greg Carr	Saber-Tooth Salmon
	Meteorites
Aaron Currier	Minerals of the World
	Blue Forest Petrified Wood
	Devonian Trilobites from Morocco
Tim Fisher	Prepared Fossilized Crabs
	Pacific Northwest Fossils
Larry Purchase	Tempskya-Petrified Wood
Brian Rauh	Cave Bear Skull
	Mars and Moon Rocks
Robert Rosé	Petrified Wood-International
	Oregon Fossil Wood
Debbie Shannon and Tara Baker	Oregon Beach Bones
Nathaniel Woodward	Sharks and Fish Teeth from Eastern Utah

Larry Purchase and his wife setting up his display on Tempskya wood

Debbie Shannon and Greg Carr setting up displays

Continued from previous page, PRGMS

Robert Rosé setting up one of his displays

Nathaniel Woodward and his daughter in front of his display of Sharks and Fish Teeth from Eastern Utah

Excitingly, Greg Carr won the Regional President's Choice Award for favorite display. Additionally, Debbie Shannon and Tara Baker won the Oregon Council Trophy, chosen by judges from the state-wide Oregon Council of Rock and Mineral Clubs.

Greg Carr won the President's Choice Award for his display on the Saber-tooth Salmon (*Oncorhyncus rastrosus*)

Debbie Shannon and Tara Baker won the Oregon Council Trophy for their display on Oregon Beach Bones

During the show, NARG members volunteered in various activities from show monitors, greeters, financial counters, and presenters. Aaron Currier and Greg Carr both gave seminars during the show. The NARG booth was staffed throughout the show by Dan O'Loughlin, Greg Gentry, and Jerry Dodson. Greg Carr was there demonstrating fossil preparation of his recent saber-tooth salmon. A crowd favorite, Joe Cantrell demonstrated his gorgeous photography of fossils and rocks on a large monitor.

The Portland Regional Show is a great showcase of many of our local rocks and minerals clubs. NARG was a power-house this year with members participating in all aspects of the event.

For a short video about the 2022 Portland Regional Gem and Minerals Show, check out https://www.youtube.com/watch?v=eLKH3NRDHAg&t=6s

Continued from previous page, PRGMS

Joe Cantrell, Greg Gentry, and Dan O'Loughlin at the NARG booth

Greg Carr demonstrating fossil preparation and comparing the 3D printed salmon fossil skull to the prepared fossil.

Worm Burrows from the Oregon Coast

A photo and description of a common fossil from the Oregon Coast from Bruce Thiel.

The Calcareous burrows of the worm *Dodacaceria fewkesi* fused together formed sediment rock which came loose and tumbled smooth in the surf

Age: 17 million years ago

Locality: Lincoln Co., OR
Nye Mudstone Formation

Get Your Jurassic Dinosaur Here

An Update on the Morrison Formation

Jerold Dodson

Most of us are familiar with many of the animals of the Jurassic world. Chief among them are the great sauropods – Brachiosaurus, Apatosaurus, Brontosaurus (as of 2015 and 2022 update), Camarasaurus, Diplodocus (the predaceous Allosaurus), and the most easily recognized Stegosaurids. Yet there are many more variations of these great dinosaurs that most of us haven't heard of: Suuwassee, Haplocanthosaurus, Kaatedocus, Amphocoelias, Supersaurus, Dyslocosaurus to name a few more long necks. But there are other lesser known (again to some of us): Dryosaurus – an iquanodont, Coelurus, Ceratosaurus, Othnieliasaurus, Nanosaurus (probable Othnielia), Laosaurus – a hypsolophodontid, Camptosaurus, Palaeopterix (dubious with only a few bones), and an Ankylosaurid – Mymoorapelta. And there are other early and mid-Jurassic species/variants.

Yet my goal in this article is to provide information regarding the Morrison Formation, its evolution as such from the mid to late Jurassic. NARG members that have participated in digs at Como Bluff, WY and in the Nail Quarry know that the Nail is late Jurassic Morrison at about 153 MYA.

Terms that I have used interchangeably and synonymously have different origins: When we talk about "Time" in relation to geology we go from the Late to Mid to Early (going back in time from some present). Correspondingly (and synonymously to me) going from Upper or top "Rock" layers (Later timewise) to Middle (Mid timewise) to Lower (Early timewise) refers to stratigraphy. I'm not confused. Really! Note that the radiometric dating of the Morrison is from Early (Morrison) at 156.3 +or- 2 MYA to Late (Morrison) at 146.8 +or- 1 MYA (I capitalize mya, million years ago, to emphasize age).

So what and where is this Morrison Formation thing?

This was an important lesson to me: the Morrison Formation is huge. It is underlain by the Sundance Formation (plus some unconformity and bits of the Unkpapa Formation) and of course is overlain where the layer exists – not eroded - by the early Cretaceous. The area of the currently known Morrison is approximately 600,000 square miles. Refer to the 1st exhibit – photo of the contiguous US overlain with a diagram of the extent of the Morrison Formation.

Exhibit 1: Morrison Formation Location

To better understand the Morrison, I examined what was happening to the North American (N. Am.) continent before and after. Of course, the N. Am. continent is not independent of the rest of our dear sweet Mother Earth, thus I had to know more about what was happening worldwide geologically. What was happening that resulted in the Morrison and ultimately what brings us to existing exposures of the Morrison? Let's start with the breakup of Pangea. Mind you I won't bother with my rudimentary knowledge of plate tectonics but will mention what was/is happening.

Give or take a few million years, Pangea began breaking up near the Permian/Triassic boundary 250 MYA. By 190 MYA (+-) Eurasia had begun moving away from the rest of the Pangea landmass. This opened-up a small but growing Tethys Ocean which might have appeared as a huge gaping mouth of the still connected supercontinent. The rest of our watery planet was/is known as the Panthalassa Ocean (7-8 times the area of the Tethys). What would become N. Am. straddled the equator. S. Am. and Africa were still joined along with Antarctica, India and Australia and were located fully in the Southern Hemisphere. Climate-wise (and without going into the $C0_2$ and temperature gradients and their measurement/comparisons), Earth had gone from a low point of $C0_2$/temperature in the late Carboniferous/early Permian (with attendant glaciations) spiking to a high at the PT boundary which was also a high for the Mesozoic Era. Note: Paleozoic highs exceeded the PT high with highest spikes in the Cambrian and Devonian Periods.

Continued from previous page, Morrison Formation

By 180 MYA (mid Jurassic), N. Am. and S. Am. were attached via a thinning isthmus, Africa was separating from S. Am. as well as Antarctica/Australia/India. Eurasia had separated from N. America. The Tethys Ocean was growing into the spaces opening as the continents we are familiar with were forming.

Relative motions of the continents: N. Am. and S. Am. were moving slightly clockwise, westerly and northward. Africa continued to shed Antarctica, Australia and India. Africa was moving easterly and northward, Antarctica, Australia and India become separate land masses with Antarctica moving slightly southward, India moving North and East and toward a direct collision with Eurasia, and Australia moving slightly North and easterly toward the Western edge of the tip of S. America. By mid-Cretaceous (100 MYA) the Atlantic and Pacific Oceans had formed, the Tethys was at its peak area wise with all of the land masses we now recognize separated by water. Also, climate (CO_2 and temperature) had fluctuated in a downward trend during the mid-Jurassic but was on an upward trend in the late Jurassic (the Kimmeridgian and Tithonian stages which encompass the Morrison Formation) with another Mesozoic high point at 100 MYA.

Note: At 100 MYA (mid Cretaceous), an apparent high-water mark for all continents, N. Am. was separated by the Western Interior Seaway into 2 landmasses - Laramidia in the West and Appalachia in the East. The Seaway extended from the Arctic Ocean thru N. Am. to the Gulf of Mexico. It was shallow at approximately 2500' depth but was 600 miles wide and 2000 miles long. The Hudson Seaway formed another shallow separation along the northern edge of Appalachia and southern Canada – but this is provided to give visualization reference to the high-water marks over all the continents. In the Jurassic, such a seaway never occurred albeit the Sundance Sea transgressed (advanced) from the North to the South and regressed (receded) from the South to the North at least 5 times.

The Sundance Sea resulted from changes in climate as well as "usual" and unusual plate tectonics. The significance of the Sundance Sea is its trail of transgressions/regressions. The "usual" Westward motion of the N. Am. plate with continual collision and subduction of the Eastward motion of the Farallon plate which was slowly "consumed – subducted" until approximately 30 MYA. The Pacific plate pushed against the Farallon and continues to grind against the N. Am. plate as it too is subducted as it slowly dives below N. America. The results of these motions and collisions are mountain ranges. Periods of mountain building – orogenies. Unusual would include a "theory" of "flat slab" subduction. The "flat slab" theory suggests that the slab, although subducted by the N. Am. plate, doesn't subduct in a wedge like fashion – the flat slab may extend 1000 miles before it stickily sinks pulling a large section of the N. Am. plate downward thus creating a large depression on the surface of the upper plate. The surface depression along with higher climate temperatures/rising sea levels result in a period of transgression. Regression resulted from lower sea levels probably due to cooling and the rebound/rising of the depression as the subducted layer moved Eastward and stopped. This is considered a likely explanation for the advance/recession of the Sundance Sea. The Sundance Formation is the sedimentation (both from marine deposits and erosion from the mountains that had formed from the Nevada Orogeny (roughly 190-140 MYA). We are familiar with the Sierra Nevada and Klamath Mountains of the Nevada Orogeny. There were other mountains and uplifts that occurred as the "Sundance" sank. The Sevier orogeny (roughly 145 – 90 MYA) formed Utah and Idaho mountain ranges – I include this info for those who might consider erosion from the mountains formed during the Sevier as some part of the Sundance and of course is not so.

The Sundance Formation is important to understanding the Morrison. It underlies the Morrison and although not considered part of the Morrison, if a paleontologist/geologist finds the Morrison, it is highly likely that some part of the Sundance Formation is below (unconformities or Unkpapa notwithstanding). The stratigraphy can differ depending on where the Morrison and Sundance are encountered. The Sundance is around 10.6 million years old from upper (157.0 MYA) to lower (167.6 MYA) layers. The 5 stratigraphic layers (upper to lower): Windy Hill Sandstone (3.5 million years of transgression/regression), Redwater Shale (4.5 million years of transgression/regression), Hulett Sandstone (possibly Lak and Pine Butte depending on the State - .8 million years), Stockade Beaver Shale (.7 million years) and the basement layer Canyon Springs sandstone of tidal inlet (1 million years). It can be confusing to read about the Sundance Formation as it may be called something different depending on the State (WY – Sundance, MT – Swift, ND & SD – Williston Basin, ID – Stump Formation and UT – Curtis Formation). Although I didn't research each of these in depth, my guess is that the general stratigraphy of the Sundance in the different States shows unconformities due to erosion. The stratigraphic layers as described are fairly definitive for the Sundance at Como Bluff and the area of the Nail Quarry.

Continued from previous page, Morrison Formation

Consider this (I write it separately to emphasize the relative motions of the colliding/subducting tectonic plates): In the 10.6 million years of the Sundance Sea/Extent of the Morrison Basin, the N. Am. plate moved Westward approximately 473 miles (if at an average rate of 3" per year). Thus the N. Am. coastline/continent could have grown Westward by 473 miles (excluding orogenies). The point is that the N. Am. plate pushed over 473 miles of the subducting Farallon then the Pacific plates. As I'm writing this, I'm thinking about how far a "flat slab" would extend under the N. Am. plate!?! Also, the depression would have shortened the East/West boundaries under transgression and stretched back out as it decompressed in the regression. Food for thought.

The overlying layer of the Cretaceous (if it hasn't completely eroded) has different names depending on the State: WY - Cloverly Formation, MT – Kootenai Formation, SD – Lakota, UT – Cedar Mountain, and CO – Burro Canyon. No additional research has been done to further identify and discuss.

The extent of the 600,000 square miles of the Morrison Formation is typical of the range of the Morrison Basin. The Morrison Basin is the geographical extent of the Sundance Sea which is defined by what we know as the Sundance Formation. See exhibit 2 – close up overlay of the Morrison Basin on the contiguous US map. The green circles are areas where Morrison dinosaur fossils were found and excavated. These areas are some of the first finds. Wikipedia search for Morrison Formation dinosaurs produced some quarry sites. Included are sites in CO, UT and WY. Note that this list is not all inclusive and is included here to arouse your interest – these are places you can find on the map and may be able to get to. Just REMEMBER this: You MUST have PERMISSIONS from owners of private property (even just crossing to get to public lands) to both search for and collect fossils. Respect private and public properties and the rights of ownership thus to avoid trespass and charges of theft. WY – Bone Cabin Quarry (off limits) near Medicine Bow, Como Bluff and the Bone Wars plus Nail Quarry, Wyoming Dinosaur Center in Thermopolis, Shell WY where Big Al the allosaurus was found in 1991. UT – Cleveland Lloyd Dinosaur Quarry South of Price, Dinosaur National Monument, the Carnegie Quarry near Vernal. CO – Garden Park BLM Paleo resources where Stegosaurus Stenops was found in 1992, Dry Mesa Quarry near Delta an ancient mudhole where Supersaurus, Ultrasaurus, Torvosaurus have been dug by BYU since 1972 (over 4000 bones have been removed), Fruita Badlands Paleo Resource Area an active but small quarry between Fruita and Grand Junction, and Purgatoire River trackways site in SE CO where over 1500 tracks have been identified. A final note on Exhibit 1 and 2, the lower Lance formation of the Cretaceous is outlined in blue hashing.

Exhibit 2: Lance Formation within the Morrison

There are many more sites – see Exhibit 3 a diagram of the Morrison Basin at 150 MYA. The Basin includes Southern Alberta, Saskatchewan, and Manitoba provinces of Canada, and parts or all of MT, WY, ID, CO, UT, AZ, NM, ND, SD, NE, KS, OK, and TX. Note the black dots which correspond to Jurassic dinosaur sites. Exhibit 3 (Ron Blakey, Colorado Plateau Stratigraphy and Geology and Global and Regional Paleogeography) comes from a website for Montana Jurassic Dinosaurs. It is an ongoing research study of Montana Morrison Formation and paper being developed by Dean Richmond - Geologist, Nate Murphy of the Judith River Dinosaur Institute, and Robin McQuinn – photographer, paleontologist. The exhibits on the website provide interactive links to the huge number of Morrison dinosaur finds. I urge those of you who want more information to view this site and consider helping to fund the research (GoFundMe).

Exhibit 3: Morrison Basin, 150 MYA

Exhibit 4 is a photograph by Jack Pollock, commercial artist and member of the dig crew at Nail, showing the Morrison/Sundance layering. It is typical and was taken near Nail Quarry.

Continued from previous page, Morrison Formation

Exhibit 5 is a great photo of the thick layering of the Sundance exposure that is a half mile North of Nail. The fossiliferous layer is the grey/yellow crumbling sandstone above the red shale. Clouds were shading the colors when I made the photo.

Finally Exhibit 6 is a photo of the Nail Quarry to the right and the exposure of the Morrison/Sundance to the left.

Exhibit 5: Sundance exposure

Exhibit 5: Nail Quarry

I spent many hours researching for this article. Since this article won't be published other than sharing with NARG members in this newsletter, I won't include a detailed bibliography. However, Google and Wikipedia provided ready access to many articles, papers and pictures. Specific references can be found at the bottom of the Wikipedia page https://en.wikipedia.org/wiki/Morrison_Formation.

Below is a USGS reference which provides more detail of the various layers of the Morrison, Sundance, Unkpapa and Gypsum Spring formations. As you can see, rock colors aren't enough to define any stratigraphic layer.

> **Morrison Formation, Unkpapa Sandstone, Sundance Formation, and Gypsum Spring Formation (Source: USGS)**
>
> *Morrison Formation (Late Jurassic)- Light-gray to green and variegated red, brown, yellow, or lavender, siliceous claystone, shale, and siltstone containing interbedded sandstone and fresh-water limestone lenses. Thickness up to 150 ft (46 m). Unkpapa Sandstone (Late Jurassic)- White, massive to thin-bedded, fine-grained, argillaceous sandstone. May be variegated to banded red, yellow, brown, or lavender. Thickness up to 267 ft (81 m). Sundance Formation (Late to Middle Jurassic)- Greenish-gray, yellow, tan, red to orange, and white, variegated, interbedded, fine- to coarse-grained sandstone, siltstone, clay, and limestone. Thickness 250-350 ft (76-107 m). Gypsum Springs Formation (Middle Jurassic)- Massive white gypsum and minor maroon siltstone and shale. Thickness up to 40 ft (12 m).*

I'm a neophyte amateur paleontologist and struggling neo-geologist. I'm enthralled with my research efforts and suspect that I could have made some errors in recording data both on my tablets as well as in my brain. I'm willing to discuss anytime. I hope you enjoy reading this and learn something about the Morrison Formation. Wow!

The Cyclic Stages of Rockhound Site Abundance and Collection

James Verheyden

Rockhounding, is an activity of searching and collecting desirable rocks, minerals, and fossils. Opposed to a scientific directed collection approach, “rockhounds” are drawn to popular, valuable, and visually appealing specimens. Sometimes, rockhounds are drawn to collecting material that can be easily worked and polished through the activity known as lapidary. Over time, popular types of rocks and collecting localities vary over time; sometimes as a result of changing cultural beliefs, but often as the result of depleting or restricted supplies of favorable material. Rockhounding material and locality popularity trends can be illustrated using a cyclic model. A case study of Central Oregon rockhounding trends is discussed.

Stages of Rockhound Site Progression

Stage 1: New Collecting Site - Easy pickings and surface material

A new rock collecting area is discovered by rockhounds. Large amounts of material of all quality are plentiful. The area has not seen prior collecting, so large amounts of surface float material are present. With maximum material abundance, rockhounds select material they most desire whether that be for specimens, cutting, or lapidary. Many collectors only target the best material available. Very little effort is needed to collect a large amount of quality material. Rockhounds do not need to travel far and focus on collecting surface material along roads. Stage 1 is characterized by high quality material availability, large selectivity and minimal effort. News of such an undepleted area quickly spreads.

Stage 2: Depleting Site - Digging required

After the initial site exploitation, medium quality material is still abundant. Selectivity is declining and collecting effort is high. Newfound site popularity and large visitor volumes has decreased productivity of the site. Depending on site characteristics, extraction volume, and remaining reserves, Stage 2 is often reached in as little as a few days to as long as several years. With reduced selectivity, rockhounds are transitioning to collecting previously unfavored material. Surface float is all but picked over, but good material may still be found by digging through the soil. As it takes minimal effort and time to look over vast amounts of land, float material is quickly exhausted by the end of Stage 1. Depending on site geology, limited float material may still be found several miles away from roads. However, the laborious maximum effort required to dig through soil for buried material sustains collecting with mid-quality material. The value of high-quality Stage 1 material is increasing as it becomes more difficult to find quality material. Stage 2 is characterized by maximum required effort to collect moderate quality material.

Stage 3: Depleted Site - Any scrap of material found is collected

After many years of collecting, productivity is minimal. All surface material has been collected and shallow deposits have been thoroughly dug. The area may exhibit numerous pits and trenches, so much so that it takes care to not dig in previously dug earth. The site has low material abundance, little selectivity, and rockhounds put forward minimal effort. The locality has widespread name recognition and the value of the material peaks; however, few visit the site to collect the scarce material. Any material found including chips of low-quality material are collected.

Continued from previous page, Cyclic Stages of Rockhound Sites

Stage 4: Supplemental Sources - A new material is found

Demand for quality material by rockhounds cannot be satisfied by the depleted site. A supplemental source is found, often with lower quality. More common and widespread material is collected. Sometimes this sub-quality material is found in the vicinity of the depleted site, however it often comes from a different area. The cycle repeats itself with this lower quality material and restarts Stage 1. With nearly no-one collecting the exhausted site, name recognition decreases and value of material decreases. At a certain point, the once popular collecting area is lost from the general consciousness and material from the site is no longer recognized. The value of material from the site is low.

Case Study

Central Oregon has long been popular with rockhounds with one of the first rock clubs in the area, the now defunct Deschutes Geology Cub based in Bend, Oregon having been formed in 1934. Over the past century, numerous occurrences have been found, collected, depleted, and lost to time. Research and talking to the few remaining “old-timers” can shed light onto many of the historic localities whose existence is unknown to most. Central Oregon currently possesses all four stages of locality evolution and has recently witnessed examples of rapid progression.

The BLM and US Forest Service have designated several areas in Central Oregon as Rockhound Sites. These areas are signed, publicized, and featured on the inter-agency Central Oregon Rockhounding Map. Many of these areas are Stage 2, due to the lack of surface material yet moderate quality material available when digging. Stage 2 is currently sustained due to the geology of the sites, where material erodes from the bedrock underneath the soil necessitating labor intensive digging, and federal regulations prohibiting mechanized excavation. While surface material is absent, many rockhounds can find moderate success digging. The manual labor required to dig is self-limiting on the amount of dirt which can be searched by an individual, extending the duration of Stage 2. In hard-rock mining sites, Stage 2 is a shorter duration due to the limited extent of exposed rock and the high difficulty to retrieve material. Hampton Butte, Bear Creek, Congleton Hollow and White Fir Springs are all examples of Stage 2 sites. Some of these sites are progressing towards Stage 3 due to the decreasing remaining unsearched dirt left. Many of these sites are riddled with holes from previous diggers. Occasionally, reclamation work is performed by filling holes, thus preventing injury to people, vehicles, and livestock, and improving vegetation cover and decreasing erosion. However, filling in holes has the unintended consequence of further progressing sites towards Stage 3. When holes are filled in, rockhounds may have difficulty finding unsearched dirt and inadvertently dig through previous dug soil. This reduces or eliminates the amount of material found by rockhounds, causing the site to transition to Stage 3.

A notable exception to the Stage 2 sites administered as Rockhounding Sites is Glass Butte. Glass Butte is a rhyolitic volcano with numerous obsidian flows. Due to the sheer volume of these flows, the area largely continues as a Stage 1 site. With the exception of unusual obsidian varieties such as “rainbow sheen” and “fire obsidian” which display interesting optical properties, quality obsidian can easily be found in large amounts. Many easily fill an entire vehicle with obsidian in less than 30 minutes from arrival, quickly reaching the legal limit of 250 lbs per year. Stage 1 is sustained by the sheer volume of the obsidian flows. Unlike other collecting material such as petrified wood, agate, jasper, and thundereggs, the obsidian makes up most of the rocks in the area. The obsidian is so voluminous that it will likely continue to sustain Stage 1 for a long time if managed properly.

Stage 3 sites such as Swartz Canyon and Deschutes Canyon are depleted, not visited, yet are still widely known and valued by collections. These two petrified wood areas quickly progressed through Stage 2 due to their limited area and hard rock environment. Petrified wood from these localities formed within the palagonite between basalt pillows where flood basalts entered ponds and lakes. As a result, the petrified wood is encased within hard basalt. Along the ridgelines of river-cut canyons, early rockhounds found these fossil logs eroding out of the cliffs where they could be easily collected. However, with finite rimrock and hard rock preventing digging, these areas quickly progressed from Stage 1 to Stage 3. Even though many of these areas are now closed to collecting by private landowners, a rockhound with permission would hardly find any material if at all. Petrified wood from these areas is still highly valued by collectors and these localities are still well known.

Continued from previous page, Cyclic Stages of Rockhound Sites

As unproductive sites slowly fade from the collective consciousness, the value of their material declines. Many of these areas are not widely known and not recognized by the current generation of rockhounds. Sites such as Sunset Agate, Carey Plume, and Powell Butte Plume are no longer well known, and the value of these once highly valued material has as a result decreased. While the value of such material may be maintained by familiar collectors, other rockhounds will value the unrecognized material less.

With the need for a supplemental source of material, the cycle will restart when a new locality is found. Recently, the "Lilly Pad Jasper" site between Redmond and Madras has increased in popularity. While the site has been known to a few rockhounds for at least a decade, within the last several years the site has seen a surge in popularity. Primarily as the result of social media, YouTube vlogs, Facebook groups, and the local rock club, the site has seen a rush in collecting to this "new" plentiful spot. While the material is more of a rhyolite than a true jasper, it is still a popular substitution for lapidary work. Just like how many prospective miners fueled the Gold Rush bandwagon, groups of rockhounds connected by clubs and social media have led to this "Rock Rush". With the initial thrill of abundance of new material beginning to wane, this site will likely follow the four stages of rockhound site progression.

The four stages of rockhounding locality progression help to describe how these sites and collecting practices change over time. By understanding what drives rockhounding, one can better understand how and why sites increase and decrease in popularity over time. Additionally, by understanding how sites evolve, land managers can work to ensure long term productivity for future generations. Keeping sites in Stage 2 by limited material removal, allowing digging, and prohibiting mechanized equipment use can prolong the lifespan of popular collecting sites.

References

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2022 Katherine Palmer Award to Kent Gibson

Each year, the Paleontological Research Institution recognizes an individual who is not a professional paleontologist for the excellence of their contributions to the field. This award is named for PRI's second Director, Katherine Palmer, who was an avid supporter of avocational paleontology.

PRI is pleased to announce that Kent Gibson has been selected by PRI's Science Committee as the recipient of the 2022 Katherine Palmer Award.

Kent was nominated for this award by Dr. Edward Davis, Associate Professor at the University of Oregon and Curator of Fossil Collections at the UO Museum of Natural and Cultural History. Excerpts from Dr. Davis's nomination letter follow:

"I have known Kent for about ten years, and I am consistently impressed by the dedication he brings to his work as a fossil collector. Kent worked for 33 years for the Port of Newport on the Oregon Coast, so he spent much of his career working in and around the fossiliferous rocks of the Astoria Formation and the Nye Mudstone. He discovered his eye for fossils by accident, picking up his first marine mammal skull because of his dog's interest in the specimen. Very quickly, he learned that he could spot the cobbles in the surf zone that held interesting fossils and began building his collection.

Kent has always taken his collecting practice seriously, planning his trips based on the tides and the annual cycle of sand movement that leaves these Oregon beaches clear for prospecting during the winter, but covered with sand in the summer.

When Kent approaches a likely beach, he plans out a grid search pattern and proceeds to methodically work through every loose cobble and collect the ones that hold important fossils.

Not only is he methodical in his collecting practice, but Kent also desires to see the specimens get into the hands of museums, where both researchers and the public can learn from them over time. Some folks might see these specimens as a way to make money, but Kent has a focus on the science. He is a role model for the way avocational paleontologists can support the educational and research mission of the discipline. Recognizing him with the Katherine Palmer Award is both an appropriate reward for the selfless way he has conducted his work and a way to more broadly publicize his approach to paleontology.

Kent has specimens in both our museum at the UO and in the National Museum of Natural History, so his legacy as a paleontologist is secure. Even so, he continues to go out to the coast, discovering new treasures and sharing them with the world. I expect Kent to continue contributing to the work of paleontology in Oregon for many years to come, and I am glad that I get to work with him in following this passion."

In recognition of Kent's many important contributions to the advancement of the science of paleontology, we are pleased to present him with the 2022 Katherine Palmer Award. Information about the Katherine Palmer Award, including instructions for how to make a nomination and a listing of past recipients, may be accessed here.

Printed at Paleontological Research Institute blog, https://www.priweb.org/blog-post/2022-katherine-palmer-award-to-kent-gibson, on September 7, 2022.

Oregon Chapter American Fisheries Society Native Fish Committee 2022 Nongame Native Fish Workshop Featuring Saber-tooth (Spike-Tooth) Salmon Workshop Summary

James Capurso, Native Fish Committee Chair

On 7-8 September 2022, 18 fisheries biologists and paleontologists gathered near Madras, Oregon to study a species from the paleontological records, known for its extraordinary size and protruding spiked teeth, the Sabretooth Salmon or Spike-tooth Salmon (*Oncorhynchus rastrosus*). The workshop consisted of an afternoon of presentations followed by a morning of digging for specimens in a nearby gravel pit. Portland General Electric (PGE) volunteered its Trout Creek Ranch north of Madras for presentations, dinner, and camping. The Oregon Chapter of the American Fisheries Society sponsored dinner from Rusty Swine Catering the first night. The Vibbert Family allowed us access to their quarry to dig for the salmon specimens.

The interdisciplinary nature of this Nongame Native Fish Workshop provided fertile ground for interaction and idea exchange between fisheries biologists and paleontologists. Originally planned for September 2020, it was postponed two years due to the pandemic. This workshop is considered to be one of the most informational Nongame Native Fish Workshops over the 9-year series.

The workshop participants enjoyed 4 presentations on September 7th in the barn located on the PGE Trout Creek Ranch. The first one, by Dr. Edward Davis, a paleontologist from University of Oregon, shared the early history of collecting specimens, publications, CT scans, phylogeny, and the steps to excavate responsibly. Although Dr. Brian Sidlauskas from Oregon State University couldn't attend in person, he contributed a pre-recorded video presentation featuring the skeletal characteristics of the species, where they best fit phylogenetically, and delved deeper into the fish's characteristics, including its likely dependence upon filter feeding for nourishment, the orientation of its spikes, and what the spikes may have been used for. Then, Greg Carr, an amateur paleontologist with the North America Research Group, described what we think we know about the species, where their remains have been observed, a history of the collection of specimens, the evolution of our understanding regarding its tooth orientation (from sabretooth to spike-tooth), 3D scanning and printing of skulls, and how larger and smaller varieties of what appears to be the same species have been observed. Lastly, Alaskan Artist Ray Troll contributed a whimsical and informative prerecorded presentation including the evolution of our understanding of the species' physical characteristics.

The next morning was spent digging for specimens in a nearby quarry where the first specimen was found. After the group excavated for a few hours, two specimens were uncovered. One appeared to be a large and one appeared to be a small variety of the species. This was likely the driest fieldwork the fisheries biologists in the group experienced in their careers, as they chipped away at the sediment wall in the hot sun in search of the species. The elevation of the site high above the valley floor far below was striking, considering it used to be the bed of an ancient river. Although an ancient fish, contemporary fisheries knowledge was used to locate the large specimen deep in the sediment deposits. At the sampling location, deteriorating wood riddled the sediments, indicating an ancient wood accumulation. That would likely have served as cover or caught the carcasses of the spawned-out salmon as they floated downstream. By focusing upon excavating near the wood, the salmon was uncovered.

Everyone left the workshop enriched by the lessons from the past. The interdisciplinary interaction added a special aspect to the workshop as the paleontologists and fisheries biologists shared their experience and views enriching collective understanding of the species.

(Reprinted in NARG newsletter with permission)

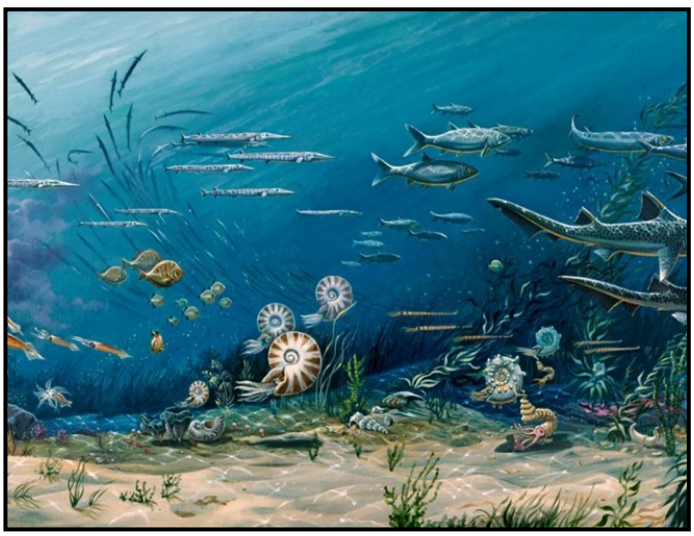
The Heart of the Western Interior Seaway: The Pierre Shale Seaway of South Dakota

By Don Litchfield, The Naughty Nautilus

The Cheyenne River Basin and associated tributaries of Central South Dakota cuts through the 73.5million-year-old sea- bed exposing large septarian concretions filled with extinct Ammonites such as Placenticeras, Baculites and Scaphites, Nautilu,s and the giant clam, Inoceramus. The concretions on rare occasions are filled with bright yellow Calcite crowned with gemmy Golden Barite crystal sprays. The Elk Creek Tributary location is one of the top 50 important mineral and fossil localities in North America.

During the Late Cretaceous Period, 73 million years ago, a large seaway stretched from the present-day Gulf of Mexico to the Artic Ocean. This large seaway covered much of the Western Interior Region of North America for over 12 million years. During the Cretaceous Period 145 - 65 million years ago, Earth was at its warmest temperatures and highest CO_2 concentrations. A worldwide greenhouse condition existed where the Polar Poles were covered in delta forests and sea level was 250 feet higher than today. Dinosaurs ruled the land and swimming reptiles like Mosasaurs, cruised the vast oceans in search of their favorite food, the Calamari of the Sea, Ammonites! Elk Creek cuts through this 73million-year-old Pierre Shale Formation exposing the extensive molluscan fauna of the *Baculites compressus* / *Baculites cuneatus* Biozones which flourished and evolved over a 536,000-year period.

The Hornbrook Formation of Oregon is of similar age and consists of marine clastic sedimentary rocks. The Elk Creek, South Dakota location is one of the "Top 50" important Fossil & Mineral localities in North America. Over thirty bivalves, twenty gastropods, a dozen Cephalopods, and six associated Septarian Minerals occur at this amazing locality. This site is also renowned for its large, often iridescent, *Placenticeras meeki*. Both the minerals and fossils from this location fluoresce brightly under UV light. Additional study and collection are underway of the marine molluscan fauna diversity to provide a foundation for further investigation of environmental settings, paleoclimates, paleogeography, concretion genesis, types of marine predators, molluscan species richness and related assemblages.



1st Annual World Class - Elk Creek, South Dakota - Fossil and Mineral Collecting Expedition

(**Editor's Note**: Below you will find details about an upcoming 2023 NARG field trip to private land in South Dakota. Don Litchfield is the owner of the Naughty Nautilus who has a yearly collecting trip to the area. NARG members met Don at the 2022 Portland Regional Gem and Mineral Show where he was selling impressive fossils and minerals from the Elk Creek area. Don agreed to host NARG members who wanted to collect at his site. More details will be upcoming, but this article includes some specifics about the trip.)

The timing for this trip is flexible for us but looks like the 3rd or 4th week of June 2023 might be best, and we can do at least a ½ day, 1 day, ½ day and up to 4 nights.

The closest towns are Wall, SD (Famous for the Wall Drug Store). It is 30 miles from the Ranch. Rapid City, SD (MT Rushmore, SDSM&T Museum) is 45 miles from the Ranch with paved roads, then 10 miles of good gravel roads to the Ranch. 4x4's are not necessary but helpful at times of inclement weather.

This is a working Ranch that also provides game hunting facilities in the Fall that we can use.

Meals, rooms and facilities are available for $150 per person per night at the Ranch.

Camping sites are available with water and power hookups at $50 per night onsite.

We have a prep lab onsite and will provide training and various educational opportunities every evening.

We are only surface collecting on private property, so **no** special permits or licenses required, disclaimers and waivers **are** required.

The fossil balls and concretions we will be collecting are very rich in specimens and we can guarantee the following Suite of Specimens: **"The Elk Creek Collection"**

Scaphites*; Hoploscaphites brevis* and *nodosus*, multiple specimens 1/2" – 3" in size

Baculites; *Baculites compressus* and *cuneatus*, multiple specimens 2" – 24" in size

Nautiloids; *Eutrephoceras dekayi* and *nebrascensis*, rare specimens 1" – 4" in size

Mollusks; Many species of the giant clam Inoceramus, multiple specimens 2" – 24" in size

Gastropods; Many species ranging in size from 1/2 inch to several inches in size

Placenticeras meeki, *intercalare* and *costatum*; rare specimens 3" to 3', anything > 6" is extra.

Barite, Calcite & Selenite; large concretions with crystals to 1.5 inches, anything > 1.5 inches is extra.

Extra Misc.; Fish & Mosasaur bones, sharks teeth, petrified wood, exceptional or large specimens, extra.

All specimens are generally well preserved with complete nacre, sutures and/or colorful ammolite. See our website at https://TheNaughtyNautilus.com for examples of specimens recently collected.

Continued from previous page, 2023 Elk Creek Field Trip

Collecting details:

Our goal is to provide an exceptional, fun, safe and fulfilling collecting experience. Although the fossil balls and concretions are abundant at times, the specimens contained inside are delicate, rare and need to be collected with care. Having collected several thousand fossil balls and concretions over the past 40 years, there are several techniques and approaches we will need to adhere to in order to preserve the potential specimen value, hidden within. We will provide specialized training and supplemental tools to assist with your World Class Collecting Adventure.

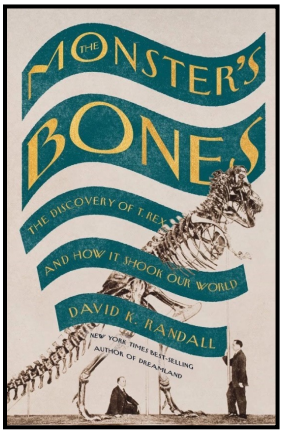
The plan would be to break into multiple groups of 3 - 4 people, plus an experienced guide provided by us, and assign each group to several Pierre Shale Formation cut banks. Each person can open 3 - 5 large fossil balls, and 1 - 3 calcite/barite concretions. This number of concretions will provide access to the Suite of specimens described above which is designed to fulfill your "Elk Creek Collection". We will do careful dissecting of the fossil balls in the field, as there can be multiple specimens hidden within each fossil ball. Specialized tools used will include battery operated drills, roto hammers, diamond saws of various sizes, rock tomahawks, chisels and pry bars, paleo bond, 4x4s, trailer, stretcher and shade covers. We will break for lunch and work around the weather as necessary.

It can be hot, cool, windy, wet, dry and dusty all in the same day. Dress in layers, mud boots and hiking boots both recommended. Safety glasses, hearing protection and gloves required. There can be horse flies and mosquitos depending on the year. Rattlesnakes are rare but are seen on occasion. Lots of wildlife and natural beauty for photographs.

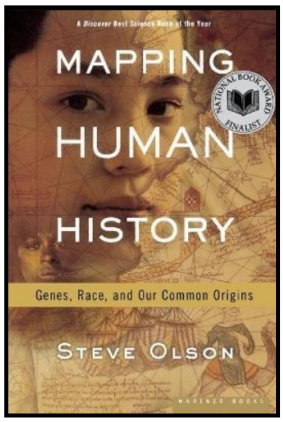
Introductory Fee: $1,000 per person.

Cooler weather means READING

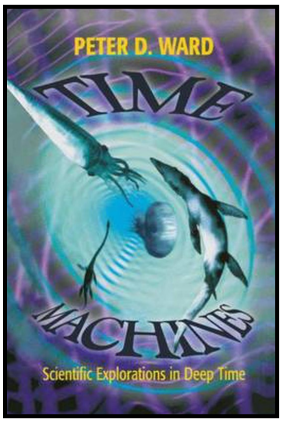
Book reports by Debbie Shannon



I recently read a book called "The Monster's Bones, the Discovery of T. Rex and How it Shook Our World" by David K. Randall. The copyright date is 2022, so it's a new book. If you have read any books about the "Bone Wars" in the late 1800's, you might enjoy this one. It about the finding of the 1st Tyrannosaurus *rex* in Montana in 1902 in the Hell Creek Formation on a hill called Sheba Mountain. The finder was Barnum Brown, a fossil hunter who worked for New York's American Museum of Natural History. The author had access to Barnum's papers that are still at the museum, so you get a good picture of what it was like in the early days of the 1900's fossil hunting in wild and remote areas of the western USA. Barnum also traveled around the world searching for different kinds of fossils. For example, he spent time in Patagonia and found fossils of an *Astrapotherium* which looks like a cross between an elephant and a hippo but is related to neither of these. Many of the fossils that he found are still at the museum in New York, including 2 of the 3 T. *rex*'s that he found. The book is about 235 pages and is a pretty quick read but is a really fun read. (It made me want to get out in the field and start digging!)



Another book I just finished is "Mapping Human History-Discovering the past through our genes." It's by Steve Olsen and it's the book I purchased at the 2022 NARG auction. It's not really a paleontology book, however it is about Human DNA and how you can use it to get an idea of human migration around the world over the last 200000+ years. If you have an interest in DNA, it's not a bad read, but it is kind of old. It's from 2001and over the last 21 years knowledge about human DNA has grown exponentially due to the ready availability of DNA test kits by a variety of companies like Ancestry and 23 and Me. I may try to find a more recent book on this subject, it would be interesting to see what has changed in our knowledge of migration patterns. Stay tuned and I'll let you know when I find something.



"Time Machines: Scientific Explorations into Deep Time" by Peter D. Ward

Book report by Anne Sivers

I have long been curious about the age, composition, and evolution of our Earth. My first reaction to the Oregon coast was to wonder why it looks so different from the US East coast. Geologists now agree that the Pacific Northwest is an agglomeration of small land masses that drifted into the North American continent from the South-western Pacific and thus certain regions originated at latitudes very different from their current location. There is a legend among the indigenous peoples of Haida Gwaii that a certain mountain near a river "walked" to the ocean in the past. Archeologists attribute this illusion to a long-term rise in sea level. How can they prove this? I also wondered how Thomas Condon could have dated Oregon fossils before the availability of radiometric dating.

In "Time Machines", Peter Ward weaves the answers to these mysteries into a colorful narrative of his amazing career as a geologist/paleontologist. When I was in the 4th grade and saw a Mercator map for the first time, I raised my hand and commented that it looked as if Africa and America used to fit together. Since I was thoroughly ridiculed for this observation, it has been gratifying to see the theory of plate tectonics verified by magnetochronostratigraphy and paleomagnetics. I had heard previously about stratigraphy and William Smith, but Peter Ward explains how truly invaluable it is. Not only is it useful in connecting soil strata all over the world, but the density, texture, and composition of a strata can determine the depth under water at which it was deposited!

And then, there are the fossils. Once the fossils of flora and fauna of a given generation are dated by radiometric dating, DNA analysis, or some other means, their appearance can be used to date other strata around the world. Of course, fossils provide vital information in addition to dating. Their analysis can allow the climate and ecology of a given period to be determined.

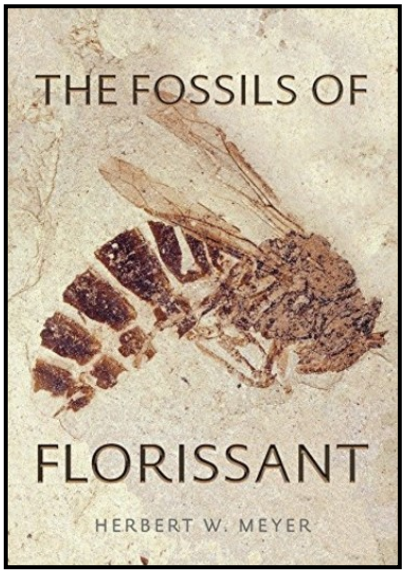
But this book isn't just a dry recitation of the methods of dating geological phenomena. I was impressed by the use to which Peter Ward put these methods in his long career and by his willingness to question established, but illogical, geological dogma and find better explanations. For example, he was able to wring an amazing amount of information from his studies of the Nautilus and to help establish the true structure of its evolutionary tree.

This is an enjoyable book for anyone wanting to learn about the ingenious methods that geologists have developed to understand the history of planet Earth.

One of the World's Most Amazing Fossil Sites: Colorado's Florissant Late Eocene Fossil Beds

Harold E. Hinds, Jr.

Book Review — Herbert W. Meyer, *The Fossils of Florissant* (Washington, DC: Smithsonian Institution, 2003).



In 1994 Herbert W. Meyer was appointed the initial paleontologist at the Florissant Fossil Beds National Monument. Although the Monument had been established in 1969 by President Richard Nixon, and Florissant fossils had been studied for more than 130 years, it was only with Meyer's appointment that a systematic database of Florissant late Eocene (34.07 million years) specimens was initiated. Meyer personally visited 17 museums that housed the most important Florissant collections of plants, insects, fish, and mammals. "All of the specimens discussed in the scientific literature were examined, recorded, photographed (many for the first time), and placed into a database maintained by the Park Service" (p. ix). A complete listing of the fossil organisms from Florissant and a comprehensive bibliography of publications that relate to Florissant, as of 2003, are included in Meyer's book as Appendices.

This volume, however, aside from those appendices, is intended as a general introduction to the amazing fossils found at Florissant.

Meyer initially provides a brief historical overview of amateur and academic collecting at Florissant, and the attempts to protect its late Eocene paleontological treasures. Then he describes, in easily understood language, the geological and biological processes of fossilization that created Florissant's amazing fossils. The key aspects of these processes were highly unusual, and account for the extraordinary preservation of plant, and especially insect, life. Volcanic flows dammed a stream creating a lake. Volcanic ash with a high silica content settled in the lake, which produced diatom blooms. Mucilaginous diatom mats entrapped leaves and insects and sank to the lake bottom. This was repeated over and over, producing wafer-thin alternating layers of volcanic ash and paper shale. The result: "a record of as many as 1,500 species of insects and 150 species of plants; more known species of fossil butterflies than any other fossil site; the only known fossil record of the tsetse fly … petrified redwood … and one of the world's earliest records of freshwater diatoms" (p. 45).

The bulk of the book, then, is devoted to brief descriptions of selected examples of the major groups of plants, spiders, insects, fish, and animals entrapped in the paper shale. Each example is placed within its order and/or family, and beautifully illustrated in one of the book's more than 200 color photographs. Perhaps of special interest is Meyer's analysis of the conditions under which different organisms are fossilized, their probability of being fossilized, and the subsequent challenges of reconstructing an organism. For example, plants can be fossilized as leaves, fruits, pollen, and wood, but rarely are different parts of a fossil plant attached to one another. And fossil pollens and spores can readily be recovered by dissolving the shale in various acids, but those dispersed by wind are more likely to be entrapped and preserved than those spread by insect pollination. And since evergreen plants shed their leaves less frequently than most common deciduous plants, evergreens are rare in Florissant's fossils.

Paleoentomologists face problems like those of paleobotanists, identifying which early life cycle stages correspond to a given adult species: "it can be nearly impossible to know which fossil larva corresponds to which adult (p.128)." Insects present an additional challenge: "modern entomologists base much of the classification of insects on characters of the genitalia. But genitalia are not preserved in the fossil record at Florissant" (p. 128). But since hard parts are more likely to be preserved, beetles are "by far the most diverse and dominant of any group of organisms in the ancient Florissant community. Beetles account for 40 per cent of modern insect species and 38 per cent of the insect species known as fossils at Florissant" (p. 148).

Continued from previous page, Florissant Fossil Beds

An excellent example of Meyer's analysis is the case of leaf-rolling weevils: "Modern members of this group lay their eggs by cutting slits into a leaf and creating a leaf roll in which a single larva develops. No evidence for this sort of reproductive behavior has yet been discovered in the fossil record at Florissant. The absence of such evidence could mean that this type of behavior had not yet evolved, or that the insect fossils such as this one [figure 178] are not validly identified, or that fossil leaves with this type of damage simply have not been found or recognized yet" (p. 155).

Mollusks, clams, snails, ostracods, crustaceans, and fish fossils receive brief attention, as do other vertebrates which are rare in the Florissant beds. Strangely, reptiles and amphibians are totally absent. The fragmentary evidence of brontotherid fossils is especially important: "the presence of a brontothere at Florissant is one of the strongest lines of evidence that Florissant is Eocene, not Oligocene, in age" (p. 185).

The Fossils of Florissant is a beautifully illustrated, readable example of a fossil lagerstätte, a deposit where delicate and soft-bodied creatures were fossilized. And it's available in our library!

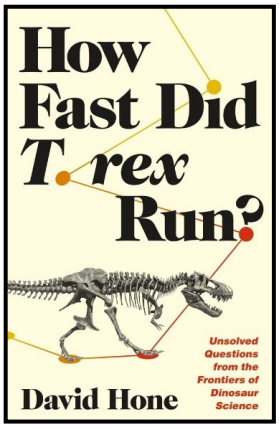
Valentine's Ideas for Paleontologists

From Very Bad Paleontologist Jokes

Dinosaurs: The Probable Future and Limits of Research

Harold E. Hinds, Jr.

Book Review — David Hone, *How Fast Did T. rex Run? Unsolved Questions from the Frontiers of Dinosaur Science* (Princeton, NJ: Princeton University Press, 2022).



It seems that hardly a month passes without a new scholarly volume on dinosaurs. Most of them cover what is presently known about dinosaurs or focus on recent advances in dinosaur science. For example, Michael J. Benton's *Dinosaurs: New Visions of a Lost World* (New York: Thames & Hudson, 2021) is a fabulously illustrated volume that principally focuses on "the appearance of [dinosaurs] — their colours, patterns, and the nature of their skin coverings" (p.23). In contrast, David Hone, a paleontologist and senior lecturer at Queen Mary University of London, focuses on "the promises and limitations of the fossil record." Hone isn't so interested in what we know, but rather in what might be gleaned about dinosaurs in the future.

The volume is chock full of examples of possibilities and limits to. Topical chapters are devoted to extinction, origins and relationships, preservation, diversity, evolutionary patterns, habitats and environments, anatomy, mechanics and movement, physiology, coverings, appearance, reproduction, behavior, ecology, dinosaur descendants, and research and communication. Of these topics, I will introduce only a select few.

Just how diverse were dinosaurs? We may have discovered most major groups but could still be missing entire lineages. "Of course, we may be missing some incredible and undreamed-of species — there are strange and rare animals like the platypus or aardvark that are known from only one species and a limited area — and a dinosaur equivalent might be very hard to find" (p. 70). And it's not likely that a dinosaur would be preserved and fossilized in some environments, for example, volcanic islands (p. 70), or rainforests, other forests, and mountains (p. 42). Floodplains and deserts are more likely to preserve a dead specimen (p. 42). So these latter environments are most likely to be over-represented in collections, and thus distort our concept of dinosaur diversity.

Accurately establishing the geographical range and environments of a species or group can be a significant challenge: "some groups do not appear where we would expect them to be" (p. 83). For example, horned dinosaurs, ceratopsians, arose in China in the Jurassic, then spread to and became common in North America. But not until 2010 did even a fragment of a ceratopsian turn up in Europe. "Why are they so rare here [Europe] and yet so abundant in other locations?" (p. 83) "There are no obvious limitations in the biology and ecology of the ceratopsians that should have prevented this move," (p. 83) especially when "many [other] dinosaurs did so in the Jurassic and Cretaceous" (p. 83).

Most dinosaurs are known from only a single or a few examples, and then often from incomplete skeletons. Small bones are regularly missing, especially toes, ankles, tips of tails. "There is pretty much no such thing as a truly complete skeleton" (p.100). These absences, Hone reasons, "can therefore mask lots of cryptic diversity," and "dinosaurs were probably a lot more weird and varied than we recognize" (p. 103).

Did dinosaurs have lips? A trivial detail? Hone doesn't think so. That this is an unresolved issue matters: "… completing the jigsaw of every detail of their appearance and their lives is what brings them to life metaphorically and allows us to understand them properly scientifically" (p. 140).

How did dinosaurs reproduce? They must have, but scientists are not even certain that they "showed strong sexual dimorphism." Presumably they did, but "most dinosaurs are known from only one specimen, which doesn't allow for much in the way of telling apart the sexes … even where there are good size samples, there have been no good demonstrable examples" (p. 164). They were likely "egg layers" (p. 164), but "there are dozens of dinosaurs for which we have no eggs (or at least we have eggs where we have no idea to whom they belong). As a result, it is hard to say much about what most dinosaurs were doing and what kind of eggs they laid, how large they were, what their nests looked like, or how the eggs were incubated" (p. 171).

What areas are most likely to produce new discoveries? — Hone ends on a hopeful note — biomechanics, behaviors of dinosaurs, and ecology.

This is a volume to be consumed slowly, as you ponder, together with the author, the "unsolved questions from the frontiers of dinosaur science." Highly recommended, and available in our library.

It's All in the Details!

Joe Cantrell

When I was 19, 5 years into photojournalism, I bought my first 35mm camera and saved for what seemed like ages to fit it with a 28mm lens that cost $32. That lens serves me well to this day, 56 years later.

But the exciting thing I did with the wide-angle lens, the life changing thing, was to tape it backward onto the camera, which made it a macro lens. I had a lacewing, lovely little insect, in a jar in the refrigerator where the coolness kept it alive but inert. I took the lacewing to a south window, put it on my index finger in that sunny window, and made a wild guess what the settings should be for the film exposure. The lacewing stirred, raised back on its hind legs as though it were beholding the sun. I made the exposure, and it was perfect. The beautiful bug earned return to the wild; I hope it lived long and prospered.

That was that, since then I've loved closeup photography. I mean, how much sign does a Cherokee kid need?

Many of you have seen me focus stacking with fairly elaborate-to-fancy equipment at the Rice Museum or many NARG-attended rock shows, even among the mudders of invention at the Woodburn paleo dig every summer. I was going to give basic instructions how to do that yourselves, but it does require skill and equipment beyond a normal household's inventory.

However, in the last couple weeks I have found a much simpler, faster method that immediately had me turning out excellent extreme closeup images in a fraction of the time and effort. And it does not require (very) expensive equipment, at least by current photography price standards. Next newsletter, I will show you how to do the new method which you CAN do yourself, and we'll be off to the digs.

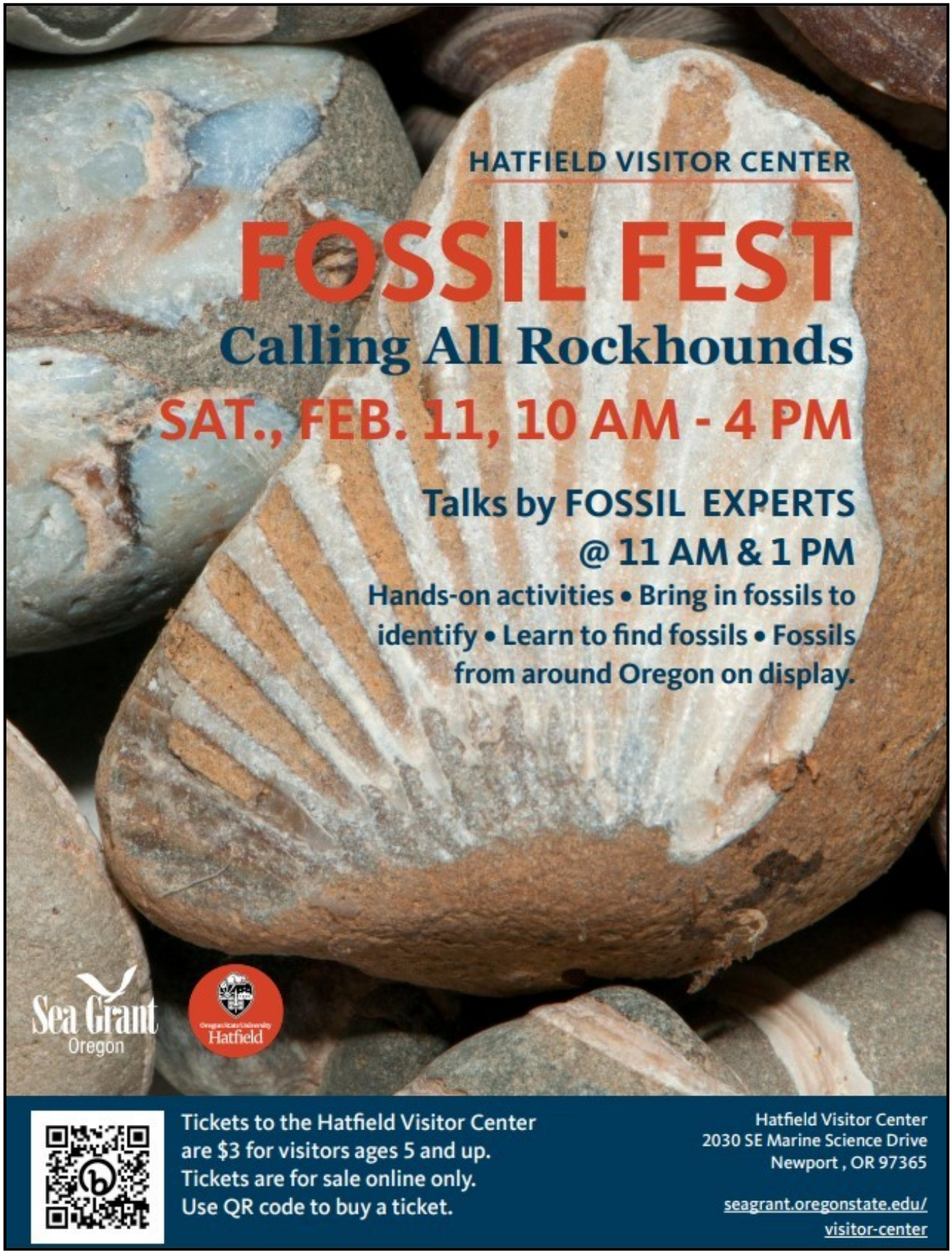
This really is a gamechanger, no sense wasting space on the old way when this is so much more adaptable and logical. For now, enjoy these photos of fossils in fine detail taken with my "elaborate-to-fancy equipment."

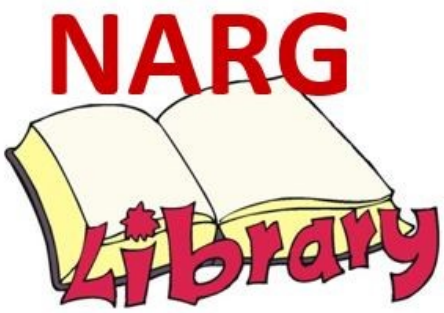
Cross-section of petrified palm

Petrified oak

Ammonite

Plant fossil, vascular system


HATFIELD VISITOR CENTER
FOSSIL FEST
Calling All Rockhounds
SAT., FEB. 11, 10 AM - 4 PM
Talks by FOSSIL EXPERTS
@ 11 AM & 1 PM
Hands-on activities • Bring in fossils to identify • Learn to find fossils • Fossils from around Oregon on display.
Sea Grant Oregon
Oregon State University Hatfield
Tickets to the Hatfield Visitor Center are $3 for visitors ages 5 and up.
Tickets are for sale online only.
Use QR code to buy a ticket.
Hatfield Visitor Center
2030 SE Marine Science Drive
Newport , OR 97365
seagrant.oregonstate.edu/visitor-center



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

February 1	NARG Monthly Meeting, Tualatin Heritage Center, Tualatin @ 7PM
February 11	FossilFest, Hatfield Visitor Center, Newport, 10AM-4PM
	Meet-up to discuss Oregon coast pinniped discovery, Newport, after FossilFest
February 12	Possible beach fossil foray, Beverly Beach, details to come
March 1	Portland NARG Monthly Meeting, Tualatin Heritage Center, Tualatin @ 7PM
April 5	Portland NARG Monthly Meeting, Tualatin Heritage Center, Tualatin @ 7PM
June	Field Trip, Elk Creek, South Dakota, details to come

Please 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:

President:	**Aaron Currier**	**(503) 364-2979**
Vice President:	**Greg Carr**	**(503 754-6392**
Secretary:	**Tami Smith**	**(503) 620-5317**
Treasurer:	**Linda Harvey**	**(503) 310-3036**
Directors:		
Lisa Schenk		**(503) 915-5911**
Robert Rosé		**(541) 367-2052**
Peg Johnson		**(253) 370-8892**
Debbie Shannon		**(503) 887-7423**
Dan O'Loughlin		**(503) 866-5997**
Honorary Directors:		
Michael Santino		**(503) 981-8902**
Larry Purchase		**(360) 254-5635**
Committees:		
Newsletter:	**Tara Baker**	
	Dan O'Loughlin	
FossilFest:	**Linda Harvey**	
	Dan O'Loughlin	
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.