NORTH AMERICA RESEARCH GROUP

Fall into Fossils

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Colorful paleosols of the Painted Hills, John Day Fossil Beds National Monument. Photo by James Verheyden.

MISSION STATEMENT

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

A FOSSIL HUNTER'S SEARCH FOR LOST WORLDS

By Annalisa Berta

My first memory of a fossil was 60 years ago in middle school science class in Seattle Washington. I remember my teacher Mrs. Kilbane, an avid fossil collector herself, introducing the class to fossils – "show and tell" that day was shark's teeth, clam shells, and petrified wood. Hoping to inspire a few budding young paleontologists, she told us of a unique opportunity to spend two weeks in a science summer camp in Oregon's John Day Basin, learning about natural history and collecting rocks, fossil plants and mammals. For recreation, there was swimming in the nearby John Day River, campfire sing alongs, and star gazing. I eagerly signed up, attending this summer science camp for the next six years. My passion for paleontology and fossils was ignited!

The John Day Basin of north central Oregon preserves a rich fossil record of Cenozoic vertebrates and plants in a thick sequence of almost uninterrupted Early Eocene-Late Miocene 54 to 7 million years ago (Ma). The region has been studied for more than 150 years. Fossils were first discovered in the John Day Basin by US cavalry soldiers during the Civil War. As early as the 1860s the area was recognized as an important paleontological site thanks to the efforts of a young frontier minister with an interest in geology and paleontology, Thomas Condon. By the late 19th century numerous paleontologists conducted explorations including those at Yale (O.C. Marsh), Princeton (W.B. Scott) and the University of California (John C. Merriam) collecting fossil plant and animal specimens. According to Professor Marsh's instruction to students on the 1873 Yale

Hancock Field Station (aerial view).

Lon Hancock at Nut Beds. Photo by Ed Bushby.

Expedition to the John Day Basin "We were told to buy a copy of and carefully read a book called 'The Prairie Traveler'. This gave complete instructions for crossing the plains, telling how to make backfires in case of a prairie fire, how to camp, how to make temporary boats for crossing rivers, etc. We were required to carry a Sharp's carbine, 50 caliber, as then used by the Cavalry, a Smith and Wesson's .36 caliber six shooter, and a large hunting knife."

More than 750 fossil localities are known in the John Day Basin. Fossiliferous strata include the Clarno Formation, containing a rich assemblage of plants and animals discussed here, overlain by three units, the John Day Formation, Late Eocene-Early Miocene in age, that has yielded more than 100 species of mammals and at least 125 species of plants, the Mascall Formation, an important Middle Miocene interval followed by the Late Miocene Rattlesnake Formation. Together these rock units preserve evidence of extreme climate change from probably the warmest and wettest interval in the last 65 Ma to the desertification of most regions east of the Cascade Mountains today.

Camp Hancock, today known as the Hancock Field Station, is owned and operated by the Portland-based Oregon Museum of Science and Industry (OMSI). The field station occupies 10 acres in the high desert geographically located in the John Day Fossil Beds National Monument established in 1975. Camp Hancock was started in 1951 by retired postman and amateur paleontologist Alonzo "Lon" Wesley Hancock (1884-1961) and OMSI. Lon and his wife Berrie initially took 14 boys and a volunteer staff for the first 12-day rustic, tent camp experience setting up a permanent camp in the juniper and sage grasslands. The camp was near where he made the discovery of a fossil rhino tooth, the first fossil collected from the Clarno Formation in 1942 that was described several years later by vertebrate paleontologist R.A. Stirton at the University of California, Berkeley Museum of Paleontology (UCMP).

Although Lon Hancock had neither college degrees or published papers he amassed a collection of more than 10,000 plant and animal fossils kept in his Portland home that he made available to researchers. He also opened his home museum to school children, thousands of whom learned about Oregon's geologic past from him. He later donated his entire fossil collection to OMSI. Lon often explored the Clarno-John Day country with Berrie who would drive so that he could focus on scanning the hillsides looking for outcrops or roadcuts to prospect for fossils. During the 1950s Lon and Berrie taught classes on geology and paleontology at the camp in the summers under OMSI sponsorship.

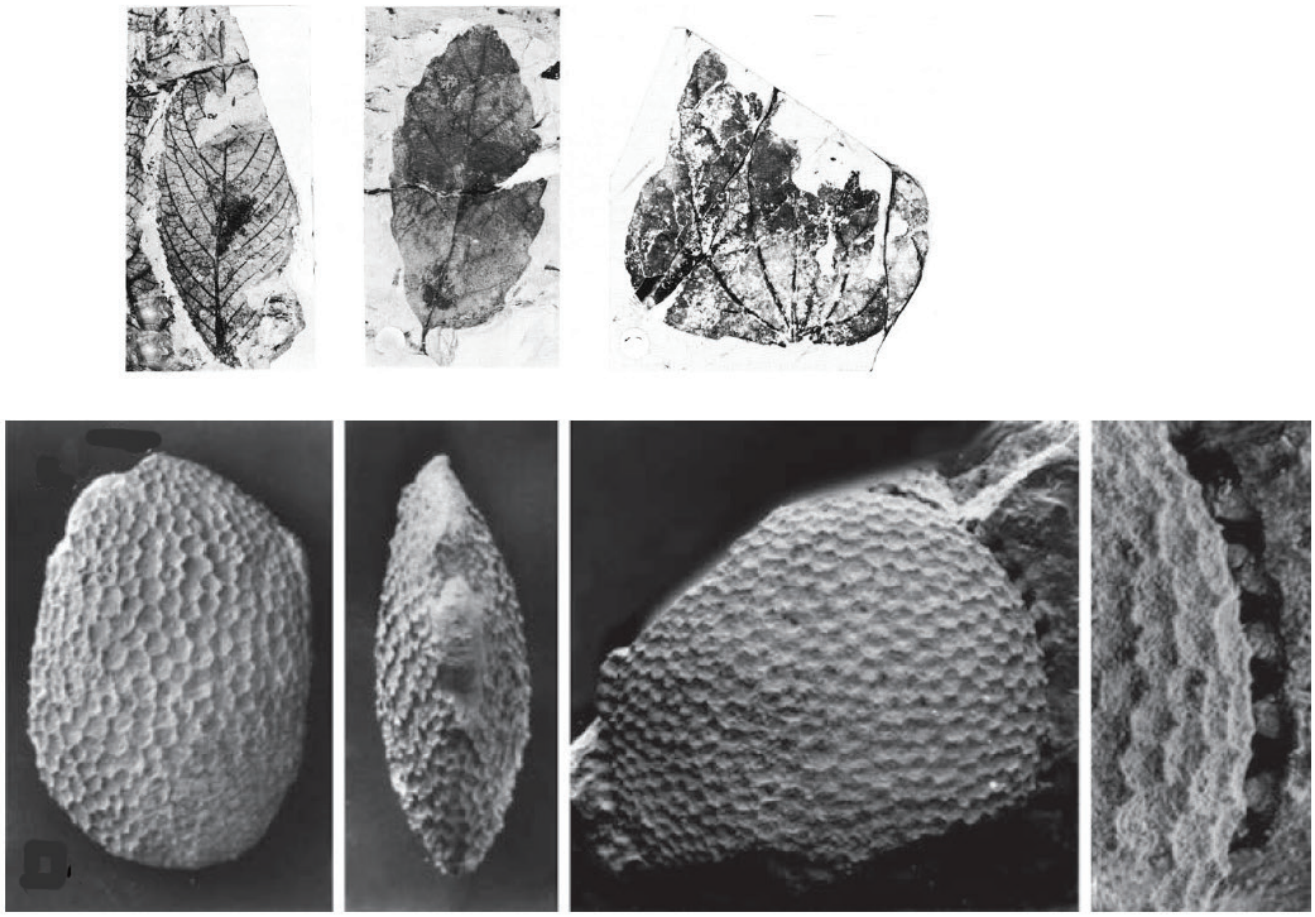
Since then the camp has grown from canvas tents to modern A-frame cabins, a large dining and assembly hall, and a well-equipped environmental science education facility that

welcomes about 3,000 guests annually. The curriculum expanded to include astronomy, zoology, ecology, and archaeology and daily field excursions to visit nearby geologic localities and fossil outcrops are an important part of the camp experience. From early campers collecting personal specimens the program has evolved to a focus on environmental stewardship and resource preservation.

The author was a camper at Camp Hancock in the mid 1960s. Among those in the author's cohort were several fellow campers and staff who later became well known paleobotanists Steven R. Manchester (Florida Museum of Natural History), Herb Meyer (retired, Florissant Fossil Beds National Monument, Colorado), geologists/paleontologists John M. Armentrout (former Camp Director, ExxonMobil Oil retired, Research Associate, University of Oregon), Bruce Welton (ExxonMobil Oil retired, Research Associate, New Mexico Museum of Natural History), David Taylor (Research Associate, Portland State University and the University of Oregon), John Faulhber (ExxonMobil Oil retired), Casey Burns (Field Associate, California Academy of Sciences), and vertebrate paleontologists C. Bruce Hanson (San Francisco Bay area) and Ronald G. Wolff (deceased, University of Florida).

The camp also hosted Research Teams and the author was a member of the Paleontology Research Team in 1969 and 1970. The Research Teams trace their origin to Armentrout, who had been a camper in the early 1950, and on staff in 1967, had majored in geology and was hired as OMSI's Outdoor Science Director (1967-1970). John observed during his initial year as Camp Hancock Director that the older multi-year teenage campers were clearly ready for a more intense scientific experience. Through the OMSI community a grant from the Hill Family Foundation of Portland was obtained with subsequent NSF grants that provided funding for two research teams composed of eight high school juniors and seniors with a university graduate student leader/mentor, one team each in vertebrate paleontology and in archaeology. Team mentors included Dave Taylor and C. Bruce Hanson, each later receiving University of California doctoral degrees in paleontology, and Brian Gannon in archaeology. Within just the first two years of this research team program

OMSI sponsored excavation at Nut Beds. Photo by S.R. Manchester.



Fossil leaves and kiwi seed from Nut Beds. Top right to left: walnut family (*Pterocarya*), Oak (*Quercus*), moonseed family (*Odontocarya*). Bottom: Scanning electron micrograph of kiwi seed (*Actinidia oregonense*). Photo by S.R. Manchester.

and camp young scientists continued to be attracted to this experience and have gone on to professional research and academic careers in the sciences.

There are two well known, important fossil localities at the Hancock Field Station, the "Nut Beds" named for its fossil plants especially fruits and nuts which occur there and the "Mammal Quarry", one of the few Eocene mammal localities in the Pacific Northwest. Both localities are in the Middle Eocene Clarno Formation, the oldest stratigraphic unit in the John Day Fossil Beds National Monument. This rock unit consists of siltstones, mudstones and cobble conglomerates containing fossils bracketed by volcanic rocks. The Clarno Formation was named by paleontologist John C. Merriam, who in 1898 led a field party in the exploration of the John Day Basin. At that time, numerous plant fossils were collected from the Clarno Formation but no vertebrate fossils were found. Most of present-day Oregon was under an ocean during the Mesozoic with only marine vertebrate fossils representing this time period. By about 45 Ma in Eocene time the coastline was not too far west of where the Clarno sediments were being deposited. The source of the Clarno Formation was a broad arc of volcanoes formed as North America moved westward over a subducting Pacific Ocean crust. These volcanoes provided abundant volcanic material blown eastward; accumulating in streams and lakes where the abundant plant and animal fossils were preserved.

In the late 1930s Lon Hancock along with his friend amateur fossil collector Thomas

J. Bones made his first discoveries of agatized nuts and other fossilized fruits and seeds in what became known as the Nut Beds. The Nut Beds are about 10 m thick consisting of alternating layers of clayey siltstones and sandstones that likely represent levee and channel deposits of a stream that was periodically choked with volcanic ash. They are dominated by remarkably diverse plant remains as well as a few vertebrates including a large crocodile (*Pristichampus*), a cat-like predator not closely related to modern carnivores (*Patriofelis*, small horse (*Orohippus*), a small running rhino (*Hyrachus*) and a rhino-like animal (*Telematherium*); the latter large mammals likely the result of flood deposits. Radiometric age determinations have revealed that the Nut Beds were deposited during the Middle Eocene, approximately 44 Ma with the overlying slightly younger Mammal Quarry ranging in age between 42.7 and 39.2 Ma.

The majority of Nut Beds fruits and seeds were collected by Thomas Bones between 1942 and 1983. Many Nut Beds specimens were collected in the 1940 and 50s by Lon Hancock and US Geological Survey scientist R.A. Scott, with a majority of the fruits and seeds collected by Thomas /bones between 1942 and 1983. From 1974-1989 field research at the Nut Beds was done in cooperation with the National Park Service. Teams of high school students – the NSF-funded OMSI Young Scholars summer paleontology programs - have been involved in the excavation, especially leaves of the Nut Beds flora. Research led mostly by paleobotanist Steve Manchester has revealed that the Nut Beds have the distinction of being one of the best preserved, most diverse plant localities in North America and the most speciose petrified wood assemblage ever described. More than 20,000 specimens of fossil fruits and seeds are preserved in various ways ranging from compressions and impressions to molds and casts to permineralizations, rendering some of the latter in exquisite 3-D anatomical detail. Judging from the sedimentary environment it is likely that the floral assemblage includes elements from a large watershed with plants from various sources, some local, others carried from various distances upstream. The wing-like extensions of some seeds suggest that wind dispersal was also involved. In other parts of the deposit horsetail ferns are found in vertical growth position at heights of one meter suggesting rapid sediment accumulation.

The diverse flora, nearly 175 species of fossil fruits and seeds and more than 75 species of fossil wood, is mostly comprised of angiosperms or flowering plants such as walnut

Representative flora and fauna of Nut beds. Key: Left foreground: banana, (*Ensete*), cat-like predator *Patriofelis*, background: horse (*Orohippus*). Right foreground: crocodile (*Pristichampus*), rhino-like mammal (*Telematherium*), vine (*Vitis*), wolf-size rhino relative (*Hyrachus*), Background: Magnolia. Mural by Larry Felder.

Representative flora and fauna of Hancock Mammal Quarry. Key: Left foreground: rhino (*Protitanops*), Center: horse (*Epihippus*), Background: tapir (*Protapirus*), rhino (*Protitanops*), right foreground: horse (*Haplohippus*), Background: vines (*Diploclisis*, *Palaeophytochen*), rhino (*Teleoceras*). Mural by Roger Witter.

(*Juglans*), Chinese wingnut (*Pterocarya*), palm (*Sabal*), sequoia (*Sequoia*), oak (*Quercus*), elm (*Ulmus*), fig (*Ficoxylon*), magnolia (*Magnolia*), kiwi (*Actinidia*), grapes (*Vitis*), banana (*Ensete*), yew (*Taxus*), moonseed (*Odontocarya*), and sycamore (*Platanus*). Wood, pollen and fronds are from gymnosperms including horsetails (*Equisetum*) and ferns (*Dennstaedtiopsis* and *Acrostichum*), pine (*Pinus*), cycads, and Ginkgo. Trees and vines (*lianas*) are mostly represented to the exclusion of herbs. The arid, semidesert conditions in the Clarno today contrast with the climate represented by the subtropical to tropical Eocene flora. Large leaf size and smooth, drip-tip margins, reflect the environment of growth, supporting wet, lush tropical rainforest conditions with a mean annual temperature of 14-21 degrees C and rainfall as much as 300 cm a year which is about 10 times the rainfall in the area today. These environmental interpretations for plant and vertebrate habitats have been confirmed by complementary studies of preserved ancient soils (paleosols).

Approximately one-half of the fruits and seeds and one third of the woods are assigned to families represented by modern genera. Geographic affinities of the Nut Beds are chiefly with present day tropical areas in southeast Asia and to a lesser degree Central and South America, and (rarely Africa). Because fossil fruits and seeds are relatively rare in North America the Clarno Nut beds flora provides an important link for paleobotanical comparisons with the Tertiary of Europe where fruit and seed assemblages are relatively abundant and well known. Comparison of the Nut beds flora indicate similarity with the Middle Eocene floras of western and central Europe especially the London Clay flora of southern England. These comparisons provide evidence of a land connection between North America and Europe across the North Atlantic through Greenland and Iceland during this time. Eocene floras so far studied from Greenland and Spitsbergen, however, do not provide evidence of tropical taxa that would be expected if this route were followed. During this time there was also an open land bridge between North America and Asia via the Bering region. Although Asian Eocene fruit and seed floras are not well known

there is support from the fossil mammals for a connection between North America and Asia. The largest collections of plant specimens from the Nut Beds are housed in the US National Museum (Smithsonian) and the University of Florida.

Lon Hancock continued his search for fossil vertebrates in the Clarno Formation and in April of 1954 located fossil bones less than a 1 km northeast of the Nut Beds in a rich bone-bearing deposit named the “Hancock Mammal Quarry” in recognition of Hancock’s discovery of the area. The quarry (now mothballed) was actively excavated from 1955-1959, and 1969-1972 under the auspices of field crews from the University of Oregon Museum of Natural and Cultural History, OMSI, and later with grants from the National Science Foundation. The stratigraphy and fauna of both the Nut Beds and Mammal Quarry have been largely described by vertebrate paleontologist Bruce Hanson.

The Clarno Formation Mammal quarry bone bearing deposit occurs in the lower 2 m of the John Day Fossil Beds National Monument, has produced over 2000 vertebrate specimens including mammals in addition to a few fragmentary bony fish and a turtle and alligator. Most specimens are isolated teeth, bones and portions of skulls and jaws and occasional carbonized plant remains. The sparse flora containing 30 taxa lacks the tropical plant species typical of the Nut Beds. Most of the mammals are large-bodied herbivores estimated to be larger than 10 kg. Some of the mammals are known elsewhere in North America such as several varieties of dog-sized horses (*Epihippus*, *Haplohippus*) and clawed oreodonts (*Diplobunops*); the latter are distant relatives of camels and commonly represented in the quarry. A few are Asian immigrants supporting a migration of mammals through the Bering region including a tapir (*Protapirus*), a new species of rhino (*Teletaceras radinskyi*), several rhino-like animals (*Eubrontotherium*, *Protitanops*, *Zaisanamynodon*), and a bone-crushing large carnivorous ungulate (*Hyaenodon*). In addition to herbivores a few predators such as a false sabercat (nimravid) have been found. There is debate about the depositional history of the sediments. Some features of the rock units indicate deposition in a pond setting subjected to occasional flooding. Alternatively, the sediments may have been deposited as an ancient point bar, that formed when silts and sands dropped out of a meandering stream. The fossils of Hancock Quarry indicate that it represents a drier, more open habitat in contrast to the subtropical forest of the Nut Beds. Study of fossil mammals continues the tradition by University of California, Berkeley scientists today led by current and former graduate students. The largest collection of fossil mammals from the John Day Basin are housed at the UCMP as well as the University of Oregon Museum of Natural and Cultural History.

The John Day Basin is well known for its completeness, well established geochronology, plant and animal fossils, and record of paleoclimates based on the fossils and ancient soils. Paleontologists of all ages have followed the legacy of Lon Hancock and Tom Bones continuing today to actively explore and study fossils from the Clarno Formation and the surrounding John Day Basin. The Hancock Field Station continues to provide outdoor education experiences in the spring and fall and overnight summer camps that include hikes to local rock outcrops and fossil sites. These fossil localities capture a unique “snapshot” of the region’s natural history. Each year brings to light new specimens added to various museum collections. Specimens are accompanied by field collection data such as geographic location and stratigraphic position. This information becomes part of the regional and global paleontologic record and enables scientists to reconstruct and refine our understanding of ancient biotic ecosystems and climatic trends in Oregon’s geologic past.

Annalisa Berta, professor emerita, Department of Biology, San Diego State University, California is a vertebrate paleontologist specializing in the anatomy, systematics and evolution of fossil whales and pinnipeds. She is author/coauthor of several books including *Sea Mammals: The Past and Present Lives of Our Oceans' Cornerstone Species* (2023 Princeton University Press).

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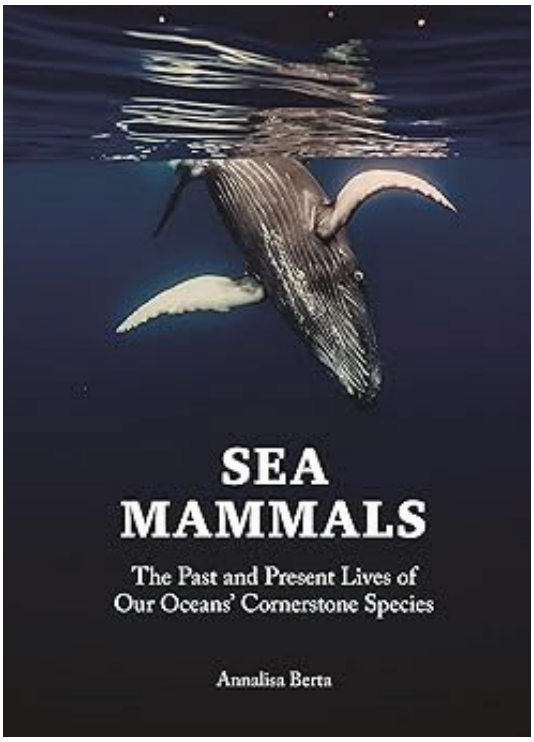
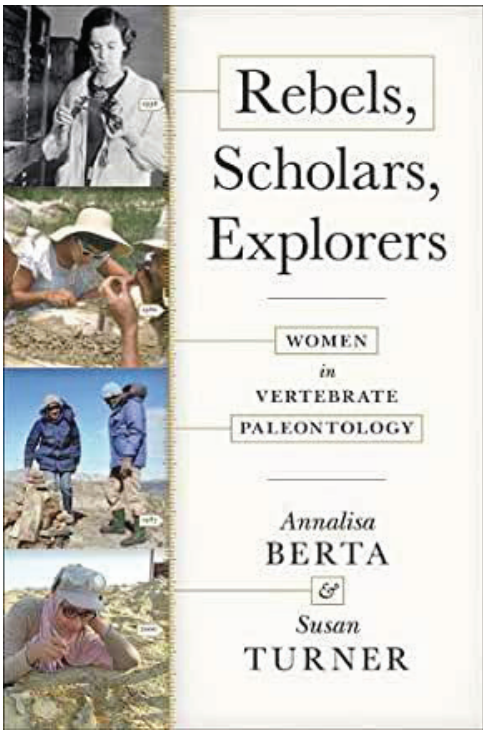


Sea Mammals: The Past and Present Lives of Our Oceans' Cornerstone Species

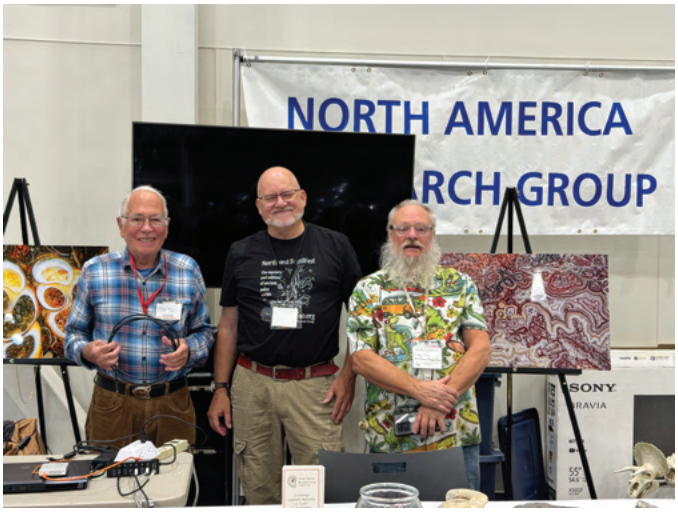


Rebels, Scholars, Explorers Women in Vertebrate Paleontology (short version)

PORTLAND GEM & MINERAL SHOW ASSOCIATION REPORT

By Tara Baker

NARG is a member of the Portland Regional Gem and Mineral Show Association (PRGMSA). While this larger group was founded in 1981 by four regional rock clubs, NARG joined much later. The main purpose of the PRGMSA is to organize a very large annual Gem and Mineral Show, held the first week of October, to increase "the knowledge and popular interest in geology, mineralogy, the lapidary arts, and related subjects" (PRGMSA website). This shared goal of educating the public about our passion—paleontology—and potentially attracting new members is why NARG enthusiastically joined the organization.



Joe Cantrell, Dan O'Loughlin, and Greg Carr at the NARG demonstration area

NARG has historically been very active in the show. Although we are one of the smallest clubs in the association, we regularly have the most display boxes showcasing recent fossil finds. These displays have earned a high number of awards, including "President's Choice," "Oregon Rock Council Award," and "People's Choice." NARG members are also frequent speakers at the show, with recent presentations by Greg Carr and Aaron Currier. In addition, our NARG demonstration table is always a highlight. It features Joe Cantrell's high-resolution rock and fossil photography setup, Greg Carr's 3-D printer producing dinosaur talons, and demonstrations by members such as Andrew Niehus, who showed fossil fish preparation techniques.

Beyond these higher-profile roles, NARG members contribute significantly behind the scenes. Dan O'Loughlin is truly irreplaceable, as he stores, transports, and sets up all NARG materials, including the display boxes used by all clubs and the resources for the NARG demonstration table. Debbie Shannon and Tara Baker serve as NARG's representatives, attending monthly meetings throughout the year to help organize the show. They also encourage NARG members to volunteer in various roles. This year, NARG was responsible for running the Kids' Corner activities, and in previous years we have managed the raffle table and greeting area as well. To see a snapshot of this year's show, you can watch this video I put together (https://youtu.be/vy_esLnx6QY?si=ZMXEyAkhD6z2vNA0).

Andrew Niehus demonstrating fish fossil preparation

The show attracts people from across the Metro area. We see children in strollers alongside elders using walkers, goth young adults alongside polished collectors. This year, we hosted 1,875 paid attendees, which is slightly down from last year's attendance of 2,161.

At the conclusion of the show, proceeds from ticket sales, vendor space rentals, raffle tickets, kids' corner collections, and auction bids are totaled. After expenses are paid, the remaining funds are distributed among the five participating clubs based on the number of members. NARG received a check for $1,446.73. After paying our required "contribution seed" of $630, our overall profit was $816.73.

This year, only seven NARG members participated in the planning, setup, volunteering during the show, and teardown.

The NARG club display box

Debbie Shannon and Tara Baker are stepping down from their PRGMSA Board positions, and we will need new members to fill these roles. Responsibilities include attending monthly Zoom meetings, sharing information about the show with NARG members, and managing a portion of the annual event (such as the Kids' Corner this year). If you are interested in serving as a NARG representative, please contact Tara (tbakeror@yahoo.com) or Debbie.

An animated Greg Carr behind his 3D printer

FOSSIL FEST 2026

Fossil Fest 2026, sponsored by the Oregon Sea Grant and the OSU Hatfield Marine Science Center, has invited NARG to set-up fossil displays and present seminars on paleontology in the Pacific Northwest. Fossil Fest 2026 runs from 10am-4pm at the Hatfield Marine Visitor's Center in Newport, Oregon.

Can you volunteer to help? No special knowledge or displays required, just friendly faces! Set-up begins a little after 8am and tear-down is right at 4pm. In addition to set-up and tear-down, we need people to help with the NARG display tables and possible t-shirt sales. If you can help, please get in contact with Dan O'Loughlin (danolough@aol.com) or Tara Baker (tbakeror@yahoo.com).

The cost to attend is $5, however this is waived for volunteers. Parking is free and plentiful.

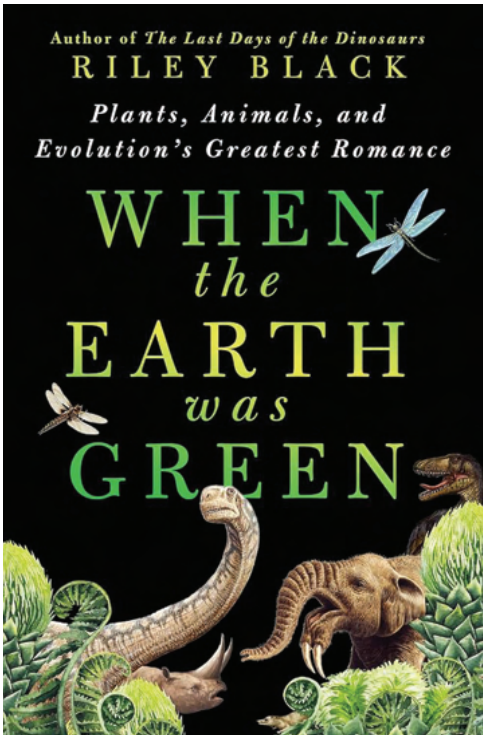
If you can't volunteer all day, come and say hello! Go out fossil hunting: low tide is scheduled for 4:52pm that Saturday. (*Be careful out there!) Take your sweetie out for seafood to celebrate Valentine's! There is never a bad day at the beach!

PALEOBOTANY
BOOK REVIEWS

By Harold Hinds, Jr.

Riley Black, When the Earth Was Green: Plants, Animals, and Evolution's Greatest Romance (New York: St. Martin's Press, 2025).

Riley Black has emerged as this generation's most gifted popularizer of paleontology. The Last Days of the Dinosaurs won the 2023 AAAS/ Subaru Prize for Excellence in Science Writing, and in 2024, she/they was awarded the Friend of Darwin Award from the National Center for Science Education. I'd predict that When the Earth Was Green will be similarly recognized, as do comments on the book's jacket: "Black is a poet of prehistory"; "Brilliant, brimming with insight, and boundlessly entertaining"; and "What a beautiful book! Couldn't put it down!"



The book's format is somewhat unusual. It is divided into three sections: (1) A series of short chapters that "represent significant moments in the long relationship between plants and animals" (p. 216), moving from 1.2 billion years ago to 1,500 years ago; (2) Appendices for each chapter which "provide some basic background on what we know, what I've reconstructed, and how I've shifted focus through each chapter" (p. 217); And a "Reference section that lists technical literature that "The narratives of this book have grown from" (p. 217). I'd recommend not reading the book cover to cover, but each chapter together with its appendix. Then when you've finished the volume, sample the references in the cited literature.

Vignette 1: "Sex in the Shallows:1.2 billion years ago: Arctic Canada"

"Paleontologist have identified multiple candidates for the earliest potential plant…but all these occurrences have been questioned for one reason or other. Given that, I choose to focus on the earliest organism paleontologists agree is relevant to plant origins-*Bangiomorpha pubescens*…[which was] described for the first time in 2016" (p. 220). Black zeroes in on several key evolutionary moments: cyanobacteria capable of photosynthesis were captured by cells, and rather than breaking the bacteria into nutritious components, it incorporated them. "Somehow, the cyanobacteria survived inside the cell and was capable of feeding itself" (p. 25). Over time, these captured cyanobacteria were modified into a chloroplast. And these pristine cells "near the very roots of the plant evolutionary tree" (p. 28), also evolved into multicellular organisms with proto-roots, and capable of sex rather than just reproducing

asexually. Black concludes that "Of all the chapters in this book, this first one is the most likely to change" (p. 218).

Vignette 2: "Worts and All: 425 million years ago: Oman."

Almost nothing is known regarding the earliest plants that colonized the intertidal zone or the ocean's shores. Perhaps they were similar to modern liverworts: "The best physical evidence, fossil evidence, we have are only fragments of plants. Those tiny pieces, found in Oman, resemble modern liverworts" (p. 223). The best evidence we have is indirect, changes to oxygen and carbon cycling in the rock record. For example, the earliest liverworts were "taking carbon out of their environment only to be buried so quickly that the oxygen that might otherwise lead to their decay remains in the atmosphere" (p. 44). The percentage in the atmosphere increased to 16%, while the CO2 dropped. Consequently, temperatures dropped about 9 degrees, resulting in an ice age.

Vignette 3: "The Forest Primeval: 307 million years ago: Ohio"

Carboniferous forests were composed not of trees we associate with forests today, but of mosses, quillworts, horsetails, and liverworts. The evolution of lignin polymers was the key to increased height and strength. These plants thrived in a hothouse environment, which lead to higher oxygen in the atmosphere (about 35%, the highest of all time). The critters that followed plants onto land thrived as well, e.g., insects, amphibians, spiders, protomammals. Herbivores fed on the abundance of plants.

Vignette 4: "Fire and Water: 220 million years ago: New Mexico."

The paleontological moment: The end of the Triassic. The locale(s): The Petrified Forest National Park and nearby Ghost Ranch's Hayden Quarry. The setting: Volcanic eruptions and merciless dry seasons. Then in Black's tight focus and "prose so vivid, and precise that it feels like watching a film" (back cover): a protodinosaur nearly dropped during the dry season during in a torrential downpour. "The running water is a soupy gray, a tea made of water, ash and burnt debris. His splayed back feet pound the streambed and splash the thick water back up, dappling his messy flanks even more, as he reaches the opposite bank, just as it gives way" (p. 64).

And as is frequently the case, she discusses in the Appendix some details, a significant paleontological process, etc. she introduced in the chapter. Here it's the fossilization of wood. No longer is it believed that petrified wood was formed by a simple process of mineral-laden water replacing plant tissue. Recent research indicates that "Hydrogen bonds between silica in water and organic compounds of a tree's cell walls is the critical first step that forms a kind of mineral base for additional dissolved silica to build up inside a tree's tissues. The minerals not only attach to the cell walls, but eventually build up inside, too, and over time can create forms of quartz…" (p. 232).

Vignette 5: "Land of Giants: 150 million years ago: Utah"

Black's primary focus is on the Morrison Formation's large sauropod Apatosaurus, its life cycle and feeding habits, together with the Salad Bar that provided sufficient nourishment to allow these dinosaurs to become giants. Particular attention is given to horsetails, monkey puzzle trees, and gingkoes. How could these sauropods get so large on the low-quality forage that paleontologists assumed these giants consumed? "It turns out that part of the answer involved checking our assumptions…Many Morrison Formation plants have living relatives

with similar anatomy. By 'digesting' these plants in laboratory settings, paleobotanists have found that ferns, horsetails, monkey puzzle tress, and especially gingkoes would have provided adequate food for dinosaurs like Apatosaurus" (p. 235).

Vignette 6: "In Bloom: 125 million years ago: Northeastern China."

The tight focus is on an early angiosperm, *Archaefrutus*, and the early bird-like *Jeholorvis*. Particular attention is given to the near complete consumption of plants, of their leaves, fruits, seeds, and flowers, as well as of rotten wood fibers, as a source of food. Attention is also given to the dispersal of seeds via passing through digestive systems virtually unscathed.

A theme Black repeatedly emphasizes is that the fossil record is very incomplete, with many gaps. So identifying the earliest flowering plant is impossible: "we know that there has to be something even older that we either haven't found or just did not become preserved" (p. 238).

Vignette 7: "A Sticky Situation: 100 million years ago: Myanmar."

Black focuses on the Cretaceous Resinous Interval, when a warm, humid climate prevailed and abundant resin-producing trees, especially pines, sealed wounds with resin, that hardened into amber. And critters rarely fossilized were trapped in that resin, e.g., insects and even birds, reptiles, and amphibians.

Contrary to the blockbuster novel and movie, Jurassic Park, internal organs are rarely preserved, not the DNA ("any original DNA will be broken down within about 6 million years," p. 244). Mineralized water seeps into crack in the resin, bonding with organic tissues producing a "mineralized cast" (p. 113).

Vignette 8: "Rainforests and Revival: 60 million years ago: Columbia"

A coal mine in La Guajira, Colombia provides "a glimpse into how forests underwrote life's comeback after the extinction that ended the Cretaceous" (p. 225). Approximately 40% of plants survived. After 6 million years, the community of plants at La Guajira consisted of more than a thousand species and had "built up to pre-extinction diversity" (p. 249).

Perhaps given this tropical rainforest and swamp's "incredible" botanical diversity, Black's chapter lacks a particular focus; it's rather more of a kaleidoscope. You might want to compare this description of life 60 million years ago in Colombia, with the PBS Nova program, "*Titanoboa*: Monster Snake," which details the discovery and analysis of a giant snake and, an ancient crocodylomorph, and their ecosystem.

Vignette 9: "Adrift: 40 million years ago: The Southern Atlantic Ocean."

Black explores the accidental vegetation rafts that ferried primates across the Atlantic: "At least two, if not three, primate groups that crossed the ancient Atlantic" (p. 252). Fossil evidence is scarce, but in 2015 and after, paleontologists have discovered traces of South America's first primates. But Black must rely on what is known about modern primates, to imagine what the cross-ocean voyage might have been like. "I based my characterization of the primates in this chapter on common behavior among modern primates, admittedly projecting the present into the past, but a necessary step given the story would otherwise be about the travels of teeth between continents" (p. 253).

Vignette 10: "Seas of Grass: 34 million years ago: Nebraska"

It's the late Eocene. "For tens of millions of years, from the time of *Titanoboa* until now, a

warm Earth has hosted dense and broad forests to full of flowering plants with sumptuous fruit and thick delicious leaves" (p. 139): A world well suited to brontotheres ("like a rhino, but not quite," p.139). The climate was changing. A drier climate favored the spread of grasses, and early horses, *Mesohippus*. Animals with long lower legs, hooves, and high-crowned teeth would eventually emerge as evolutionary winners.

Vignette 11: "Partners in Pollination: 17 million years ago: New Zealand"

Pollinators may have originated over 201 million years ago. For this snapshot, Black primarily focuses on a more recent pollinator, bats belong to the genus *Mystacina*, which has inhabited New Zealand since the Miocene, and today consumes insects on the ground and plant nectar (from Kahakaha). "While it's unlikely paleontologists will find a fossil of a pollen-covered Miocene *Mystacina*, the paleontologist who described the ancient bat found relatives of the plants the bats pollinate today were also growing in the same forests where prehistoric *Mystacina* lived. It's possible that the relationship between the living bats and the plants they pollinate goes back a long, long way" (pp. 260-261).

Vignette 12: "Nip Trip: 9 million years ago. Western North America"

Saber-toothed cats (*Machairodus*), catnip, nepetalactone, the environment, and a cat's coloring, are Black's focus. Connections are speculative: "Chances are slim that we'll ever know whether saber-tooth cats enjoyed plants with psychoactive compounds." "I have a better chance of winning the lottery than finding such a fossil," but both cats and catnip have been around for tens of millions of years, and we have every reason to think they would have had some response to catnip just like our purring family members" (p.262).

Why are Miocene *Machairodus* imagined with "spotted pelts, long and wavering stripes of black contrasted against coffee-with-cream brown"? (p. 107). "Given that Machairodus lived during a time of spreading grasslands among patches of woodland, I chose to give them coats of ambush predators who lurked among the tree trunks" (p. 265).

Vignette 13: "Far From the Tree: 6 million years ago: Ethiopia"

Six million years ago "the global climate had shifted toward being a little cooler and drier, conditions that favored the spread of grasslands rather than dripping forests" (p. 268). Our evolutionary family adapted. This sketch imagines the adaptation of *Ardipithecus ramidus*, one of the earliest humans yet discovered.

Vignette 14: "Ancient Autumn: 3 million years ago: Willershausen, Germany"

Rather than two seasons, dry and wet, there were four in Germany's Pliocene. Could fall colors have been preserved in leaves? Yes, under just the right conditions, in Willershausen "the various fossils had accumulated in what had once been a lake, with extremely salty waters" (p. 271). "By using UV light, paleobotanists are also able to see shades [red, orange, and yellow] that prehistoric Germany's [fall] plants wore around 3 million years ago" (p. 270).

Vignette 15: "After the Ice: 15,000 years ago: New York State"

The interglacial period landscape, toward the end of the Pleistocene, was shaped by many critters. Black focused on just three, based on her personal favorites: mastodons, leafcutter bees, and *Monotropa uniflora* (which gets its food from fungi).

Addendum: 3 Additional Paleobotany Books, Briefly Noted

Patricia G. Gensel and Diane Edwards, eds., Plants Invade the Land: Environmental Perspectives (New York: Columbia University Press, 2001).

Now dated but will provide an interesting comparison with Black's emphasis on recent research. A more advanced and technical collection of articles.

Herbert W. Meyer and Steven R. Manchester, The Oligocene Bridge Creek Flora of the John Day Formation, Oregon (Berkeley: University of California Press, 1997).

Technical, but essential guide to this important ancient Oregon flora. I personally collected at the Knox Ranch and Iron Mountain localities. My specimens are now part of the Condon Museum, University of Oregon. Prof. Manchester will need no introduction to our group.

Beth Ellis, Douglas C. Daley, Leo J. Hickey, Kirk R. Johnson, John D. Mitchell, Peter Wild, and Scot L. Wing, Manual of Leaf Architecture (Ithaca, NY: Cornell University Press, 2009).

A blurb on the back cover by James A. Doyle of the University of California, Davis, succinctly captures the content and importance of this guide: "The book is a clear, well-illustrated, logical, and…[guide to a] more powerful and objective methods for the identification of fossil angiosperm leaves."

I wish I'd had this guide when attempting to identify fossil leaves I've collected over the years.

All of the above studies will be donated to our NARG library.

APPRECIATION FOR HAROLD HINDS JR.

Harold E. Hinds, Jr. has been a long-time member of NARG. Over the past several years, he has generously contributed book reviews to the NARG newsletter. These have been thoughtful summaries of both popular and technical paleontology works. Harold has a gift for providing just enough detail to spark interest without spoiling the pleasure of reading the books themselves. Drawing on his analytical background in history and academia, he has also written more in-depth reviews that thoughtfully examine groups of books centered on a single topic. His writing is consistently clear, well organized, and accessible.

In addition to his writing, Harold has been extraordinarily generous in donating his paleontology books to the NARG library. More than 100 volumes have been added to our collection thanks to his voracious reading habits, greatly enriching our open library.

Unfortunately, due to health issues, Harold will no longer be able to continue writing book reviews for us. We hope you will join us in thanking him for his many excellent contributions and in wishing him all the best. Notes of appreciation may be sent to him at hindshe@morris.umn.edu .

FOSSIL TRAVELOGUE: MISSOURI CAPITOL BUILDING

By Tara Baker

In August 2021, my daughter was wrapping up a year-long AmeriCorps internship in the Missouri capital, Jefferson City. I flew out to help her pack up and drive back to Oregon. As with all my travels, I like to look for opportunities to explore local paleontology sites. While researching Jefferson City, I was surprised to discover that the Capitol building itself offers a self-guided fossil tour!

It turns out that the exterior, and much of the interior, of the Capitol building is constructed from limestone quarried at locations throughout Missouri. About 355 million years ago, during the

The front of the Missouri Capitol building in Jefferson City

Mississippian subperiod of the Carboniferous, Missouri was covered by an inland sea teeming with crinoids, bryozoans, sharks, and other marine life. Remnants of these organisms were fossilized in the limestone that was later used to build the Capitol.

Because these fossils are visible in the polished stone inside the building, a self-guided fossil tour was developed for visitors. I was able to download a very informative brochure here. So, I dragged Meghan along with me and we headed to the Capitol building to hunt for fossils.

The brochure provided directions and photos of specific fossils to look for on the interior walls. It is significant to note that these fossils are all 2D, presented on the flat polished stone. It was fun roaming up and down staircases and hallways, carefully studying the stone. I passed lawyers arguing in their offices, representatives moving between floors, and office managers hustling through the halls—all while I stood there staring at and touching the walls. I didn't see anyone else looking for fossils!

Throughout the building, I found a nice variety of marine invertebrates, including bryozoans, brachiopods, crinoids, corals (both horn and tabulate), and clams. I was especially

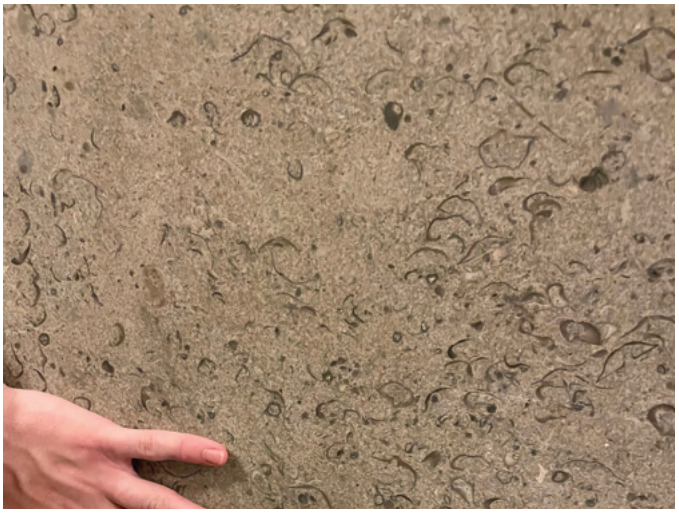
Meghan Baker next to a stature of Meriwether Lewis inside the Capitol building. Note the polished limestone marble panels lining the walls

bummed that I couldn't locate the shark tooth reportedly embedded in the floor in front of an arched stairwell on the first floor.

After exploring the fossils in the walls, I took some time to visit other exhibits highlighting the history of Missouri.

Overall, this was a fun and unique way to spend an afternoon. I'm from the Midwest and grew up sifting through limestone gravel in my grandparents' driveway, so I'm well acquainted with the three-dimensional fossils of Mississippian crinoids and brachiopods. Seeing these familiar fossil "friends" preserved in polished stone inside the Missouri Capitol building offered a new perspective.

Brochure: https://dnr.mo.gov/document-search/capitol-fossils-pub2488



An example of a polished limestone panel with many fossils embedded.

Closeup of a 2D fossilized horn coral

Polished 2D fossilized crinoid stalk

Fossilized horn coral (left) and bryozoan (right).

PLIOCENE CALISTOGA PETRIFIED FOREST
SONOMA COUNTY, CALIFORNIA

By James Verheyden

The Pliocene Calistoga Petrified Forest is located near Napa Valley, California and preserves some of the largest petrified trees in the world. The fossil forest formed 3.4 million years ago, when a redwood grove was burried by an eruption from Mount St. Helena. First studied in 1870 by O. C. Marsh, who identified the trees as largely *Sequoia langsdorfii*, subsequent research by scientists at the University of California, Berkeley demonstrated that these trees grew significantly farther inland than modern coastal redwoods. Beginning in the early 20th century, the forest was developed as a private tourist attraction and remains open to the public today.

REMEMBERING THOMAS STEVENS

By Tara Baker

Tom with a huge 73.5 million-year-old ammonite (*Placenticeras meeki*) he discovered on a field trip with NARG to South Dakota (2023).

On October 30, 2025, NARG member Thomas Stevens passed away suddenly at the age of 70. He was a member for only a few years, but he joined with gusto and threw himself wholeheartedly into fossil discovery and preparation.

Tom was a resident of Olympia, WA, so he was not always able to attend meetings. However, he was a regular at the Fossil Fests in Tualatin and Newport, and he loved the NARG holiday parties as well. Thomas also enjoyed going on NARG field trips. On a trip to South Dakota, he discovered a huge ammonite that he was especially proud of. Most recently, Tom attended the 15th B.C. Paleontology

Symposium on Vancouver Island along with six other NARG members. He was always excited about being in the field and found several good crab and marine fossils on that trip.

When he first joined NARG, Tom was still working at Weyerhaeuser and had access to many fossil sites that were closed to the public. He loved going out alone or with others from the club to collect crab concretions and was very excited about learning how to meticulously prepare fossilized crabs. Tom quickly realized that Bruce Thiel was the NARG crab expert and reached out to him for mentoring. Bruce and Tom spent a great deal of time together talking and honing their craft.

Because he lived near Seattle, Tom was able to take a short train trip and volunteer once a week at the Burke Museum. He was learning

Thomas and Bruce Thiel at the 2023 NARG Holiday Party.

how to make microscopic slides from thin slices of petrified wood so he could study the cellular structures of these ancient trees. When I saw him last, he was very excited about what he was learning and pulled out his phone, which was filled with photos of tree cell structures. He was so proud—like a young father showing off photos of his child.

On December 12, Bruce Thiel, Greg Carr, and I attended Thomas's Celebration of Life service. It was a pleasant two-hour drive to Tumwater with the guys. At the service, we learned that Tom had participated in growing nearly 1.5 billion tree seedlings during the decades he worked for Weyerhaeuser. In addition to changing the land and ecosystems of the Pacific Northwest, we saw just how many lives he had touched.

In true paleontology geekiness, the guys and I drove up to Tumwater with an entire dolphin skull fossil in the trunk. Bob Manley had discovered and prepared this skull. We met up with NARG advisor Jim Goedert, who was also a close friend of Tom's. We wanted his opinion on the species of dolphin and who might benefit most from studying it. So there we were, gathered in the parking lot examining this specimen before the service. I think Tom would have loved that and might have been right there with us, gawking at this Miocene monster.

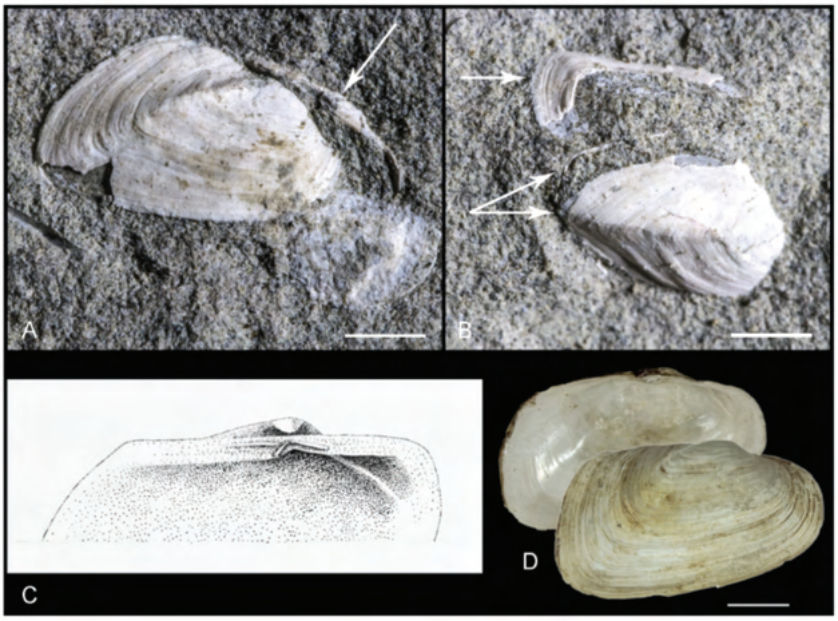
Tom was a happy, joy-filled man who made you feel good just being around him. I don't think I have ever met a man kinder than Tom. I will miss him and his effusive passion for learning and paleontology.

He leaves behind his daughter, Taylor, and his one-year-old granddaughter, Rylee. Here is a link to his obituary.

Tara Baker, Thomas, Kent Gibson, Greg Carr, Trevor Contreras, and David Klubert attending the 15th B.C. Paleontology Symposium in August 2025.

RECENT PUBLICATIONS ON KEASEY FORMATION BIVALVES

By Casey Burns



Saxicavella burnsi, Hickman, n. sp. is one of twelve heteroconch bivalve species from deep-water extreme environments in the Paleogene Keasey Formation in Oregon during a time of global climate change. Citation: Hickman, C.S. 2015. Paleogene marine bivalves of the deep-water Keasey Formation in Oregon, Part III: The heteroconchs. PaleoBios.

Dr. Carole Hickman at the Museum of Paleontology at UC Berkeley has been publishing various papers in the past decade on the bivalves of the Keasey Formation. These are accessible at these links.

- Hickman, C.S. 2025. Paleogene marine bivalves of the deep-water Keasey Formation in Oregon. Part IA: The protobranchs (Nuculidae, Sareptidae, Pristiglomidae). PaleoBios 43(4):1–29. https://escholarship.org/uc/item/3c46d2rh

- Hickman, C.S. 2023. Paleogene marine bivalves of the deep-water Keasey Formation in Oregon, Part II: The pteriomorphs. PaleoBios 4-(5): 1–51. https://escholarship.org/uc/item/47m7252q

- Hickman, C.S. 2015. Paleogene marine bivalves of the deep-water Keasey Formation in Oregon, part III: The heteroconchs. PaleoBios, 32:1 - 44. (October 2, 2015) https://escholarship.org/uc/item/603017mr

- Hickman, C.S. 2014. Paleogene marine bivalves of the deep-water Keasey Formation in Oregon, part IV: The anomalodesmatans. PaleoBios 31(3):1-14. https://escholarship.org/content/qt6vf3t60q/qt6vf3t60q.pdfhttps://escholarship.org/content/qt6vf3t60q/qt6vf3t60q.pdf

KENT GIBSON'S FOSSIL FINDS FROM THE ASTORIA FORMATION IN NEWPORT, OREGON

Part of a block found last May. Photo by Kent Gibson.

Preparing fossils. Photo by Kent Gibson.

Preping a whale skull originally found 5 years ago, but unfinished due to covid. Photo by Kent Gibson.

Other side of the whale skull. Photo by Kent Gibson.

NARG MEMBERSHIP

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

Membership Types

Individual	$25
Family	$40
Student	$10

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Pay your membership dues with one of two convenient methods:

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

Pay via credit card with PayPal:
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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

Feb 4	NARG Meeting; “Sea Mammals Paleontology” by Annalisa Berta
Feb 14	Fossil Fest 2026, 10am-4pm; Hatfield Marine Science Ctr, Newport, OR
March 4	NARG Meeting; “Keasey Formation” by Casey Burns
April 1	NARG Meeting; “Oregon Spike Tooth Salmon” by Kerin Claeson

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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