



PHMC BUREAU OF THE STATE MUSEUM OF PENNSYLVANIA

Rising from the Muck: The Marshalls Creek Mastodon

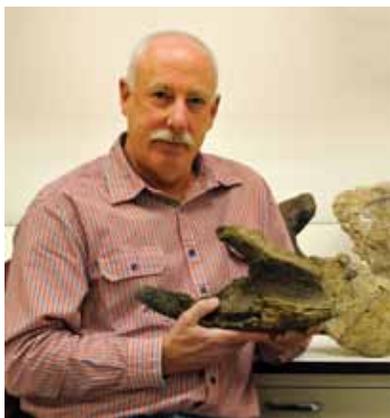


PHMC BUREAU OF THE STATE MUSEUM OF PENNSYLVANIA, PHOTO BY DON

Robert M. Sullivan

For as long as I can remember, I have known of the little village of Marshalls Creek, near East Stroudsburg, in northeastern Pennsylvania's Monroe County. My maternal grandparents, Bertha and Arthur Pflieger, rented a cottage each summer in the Poconos at the Cottage Colony, part of the Mountain Lake House, a popular resort for many New Yorkers and city dwellers during the 1940s and the 1950s. My grandparents later bought a house nearby. My parents, brothers, and I lived in Connecticut and visited my grandparents' home near Marshalls Creek during the summers. It was in my grandparents' backyard that I found my first fossil—a Devonian age brachiopod. In subsequent summers, my grandmother took me to road cuts in the Stroudsburg area where I spent hours collecting marine invertebrate fossils.

Retrieving submerged bones of the mastodon from a Monroe County peat bog were (facing page, from left) volunteer David Kohler, museum security official Robert Michaels, unidentified (but most likely the son of museum restorer and preparator Arlton C. Murray), Dr. Murray (1912–2006), and Ira F. Smith III. The Marshalls Creek mastodon (facing page) was recently conserved by Phil Fraley Productions.



Robert M. Sullivan, senior curator of paleontology and geology for The State Museum, was instrumental in the museum's restoration and reinstallation of the mastodon.

I don't recall hearing about the discovery of the Marshalls Creek mastodon. I was a senior in high school in Trumbull, Connecticut, shortly after news of the discovery broke. Decades later, when I joined the staff of The State Museum of Pennsylvania as senior curator of paleontology and geology, I was surprised to learn that a mastodon had been discovered at Marshalls Creek—the very place where I spent the summers of my youth. Coincidentally, this mastodon was in the collection for which I had been hired as curator and was, *in part*, on display at The State Museum. The emphasis is on “in part” because only half of the skeleton was on exhibit; the other half remained housed in drawers and on oversized shelves. The entire skeleton was too large to fully mount in the newly constructed Hall of Geology, so it was embedded in a fiberglass panel mount. I thought it was a shame that the entire skeleton was not on display for all to see because it deserved a much better presentation. I proposed, in 2007, to John C. Leighow Jr., then director of The State Museum, that the mastodon be remounted as part of a major exhibit renovation to the Hall of Geology. The idea was enthusiastically accepted and plans were set in motion.

The Discovery

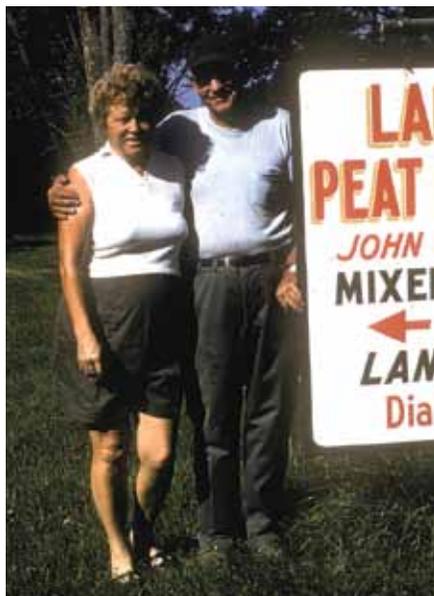
On Friday afternoon, July 5, 1968, John W. Leap, co-owner, with his wife Claire Smith Leap (right), of Lakeside Peat Humus Company, Marshalls Creek, and his employee, Paul Strausser, accidentally

snagged a mastodon skull while running a dragline bucket (a scoop, or shovel, attached to a large dredging or excavating machine) through the company's fifty-acre peat bog. Within a month, news of the discovery reached the William Penn Memorial Museum (now The State Museum of Pennsylvania) and staff from the Natural Sciences Section traveled to Marshalls Creek to assess the situation and determine if more pieces of the specimen could be located and retrieved from its watery grave. After legal ownership agreements were negotiated between the museum and Leap, who accepted \$800 from the Commonwealth for the find, excavation began on Thursday, August 8.

Excavators found the specimen buried in thirty inches of peat and submerged in several feet of mucky water. Workers constructed a coffer dam so the museum scientists and field assistants could keep the water back and recover bones from the bottom of the bog. During the excavation, which took about two weeks to complete, most of the mastodon skeleton was recovered.

The bones were found separated, scattered, and encased in a dark, thick mud. Only a few of the bones were missing, including some ribs, toe bones, sternal elements, and both tusks. Other bones were damaged, such as the skull, some vertebrae, both pelvic bones, and both shoulder blades. Damaged bones would need to be restored and missing bones would have to be replaced, using casts from a similar-sized mastodon. Examination of several bones revealed that the mastodon suffered from a degenerative bone disease. These diseased (or pathological) bones are recognized by strange shapes and growths indicating that they have been altered, eroded, and reconfigured over the lifetime of the mastodon. Most of the pathologies, or the results of disease, of the Marshalls Creek mastodon are confined to the vertebrae of the tail. Tail pathologies are commonly due to injuries acquired by males as a result of combat—the retreating male battered from behind by a dominant male.

On Friday, August 16, 1968, the *Pocono Record* carried a news article about the discovery under the headline, “Poconos' own Mastodon first such find in Pennsylvania.” The mastodon was retrieved from a bog located opposite the Oak Grove House on state route 209, a popular resort in the Pocono Mountains from the 1860s until its closing in early 1960s. After the dragline bucket snared the immense skull, Strausser thought it was a rock or a stone until he and Leap

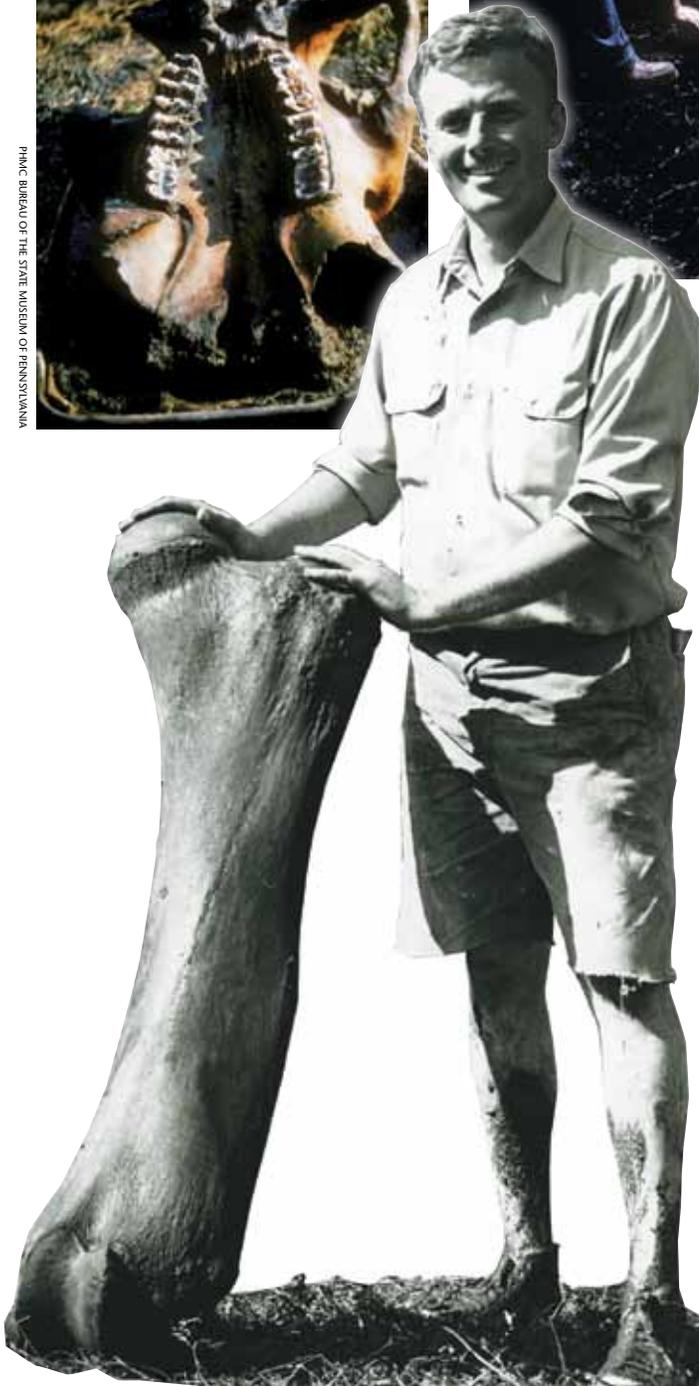


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The skull of the mastodon, resting upside down, reveals the teeth of its upper jaw (far left). Crew members removing the mastodon's lower jaw from the murky peat bog (left).

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Donald T. Hoff, assistant curator of the museum's Natural History Section, proudly displays the mastodon's massive femur at the discovery site in Marshalls Creek, Monroe County, in August 1968.

probed it with a pipe. The *Reading Eagle* carried more news of the discovery on Tuesday, August 27. "I was digging peat in the bog on July 5 with Paul Strausser when we found the first bone," Leap said. "I've been digging here since 1938 and all we ever found were some Indian arrow heads."

According to the newspaper, "After the discovery Leap called the *East Stroudsburg Daily Record*, which contacted Dr. James Yolton, a geologist from Upsala College in East Orange, N.J., who arrived that same day and unearthed about five pieces of the skull." Leap then contacted Donald T. Hoff, assistant curator of the museum's Natural Science Section. Museum professionals who assisted Hoff with the excavation included Albert Mehring, chief of the Natural Science Section, Arlton C. Murray, restorer and preparator of the Archaeology Department, John E. Schreffler, preparator; David Heintzelman, ornithology specialist assisting as mammalogist; Robert Michaels, security official; and David Kohler and Michael Murray, young volunteers. Leap and Strausser assisted by operating the heavy equipment on site.

In an article he wrote for the February 1969 edition of *Pennsylvania Game News*, Hoff recounted the painstaking excavation process. "A corrugated steel pipe, four feet in diameter and four feet high, was chained to the dragline and lowered into the murky bog. With the pipe firmly seated in the bog sediments, a crew member lowered himself into the pipe, bailed out the water, and then dug down into the muck to search for bones. All hopes soon were fulfilled; the fourth placing of the pipe and probing from a rowboat located portions of a huge mastodon skeleton.

"To isolate the skeletal area from the remainder of the bog, a dam was constructed. The water was then pumped from the excavation site and position of the mastodon was further outlined by carefully digging through the muck with hand tools. Mr. Leap then dragline-excavated many tons of ooze from around the skeleton

so as to leave it on a pedestal for removal—a time-saving operation."

Before the excavation ended on Thursday, August 22, the crew recovered 90 percent of the mastodon's skeletal remains. The tusks were missing, most likely lost before the immense creature ventured into the immediate area.

Dismantling, Restoration, and New Mount

For more than thirty-five years, only half of the Marshalls Creek mastodon was exhibited at The State Museum of Pennsylvania for visitors to see; the other half (the right side) of the skeleton was stored in the museum's collections. The entire skeleton is now together for the first time in a new state-of-the-art mount. Restored in a life-like pose, and properly conserved, the skeleton ranks as one of the most important mastodon specimens known from North America.

In fall of 2007, after speaking with our museum director at the time, Jack Leighow, I contacted Phil Fraley of Phil Fraley Productions Inc., a museum exhibit fabrication company based in Hoboken, New Jersey, to inquire about the possibility of contracting his company to dismantle, conserve, design, and remount the mastodon in a new life-like pose. Established in 1999, the firm is best known for its innovative hand-forged armatures that securely cradle each bone of large dinosaur skeletons. Clients include the Los Angeles County Museum of Natural History, Chicago's Field Museum, and the American Museum of Natural History in New York City. Fraley and his team had recently finished designing, restoring, and mounting dinosaur skeletons at Pittsburgh's Carnegie Museum of Natural History and were enthusiastic about taking on the project for The State Museum. We began drafting plans for the new exhibit.

A complete inventory of the skeleton was made and missing and broken elements were identified. Daniel Fisher, vertebrate paleontologist at the University of Michigan and noted prehistoric proboscidean researcher, provided casts of missing bones from another specimen. Dr. Fisher was instrumental in helping design a pose and consulting on the placement and spacing of individual bones.

Fraley's crew, led by Keny Marshall, deputy director of museum operations for the firm, began dismantling and packing the skeleton in June 2008. The bones of the right side of the skeleton, stored in the paleontology section of The State Museum, were inventoried and crated. The team then dismantled the left side of the skeleton embedded in the panel mount in the Hall of Geology. Many of the bones, especially



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Phil Fraley Productions, a nationally recognized museum exhibition fabrication company, restored the mastodon vertebrae and specifically designed armatures to cradle each section.

the vertebrae, had to be cut out of their fiberglass cradle. Sections of vertebrae were removed along with the fiberglass backing for shipping to the studio where conservators carefully separated the bones from their fiberglass housing. The long bones, ribs, and other elements were carefully crated, and a special steel cage was constructed with braces and clamps for the skull. The entire specimen was shipped to Fraley's satellite studio in Turtle Creek, Allegheny County, just southeast of Pittsburgh, for cleaning, restoration, and remounting.

The mount (armature) was designed so that individual bones could be removed for future study or conservation. The armature, made of carbon steel, wraps around or cradles each bone, rather than using invasive pinning usually seen in most skeletal mounts. This cradling of individual bones is considered to be a state-of-the-art method offering flexible access to each skeletal element. The main vertical supports in the front and the back of the skeleton are thick-walled structural tubing. The skull mount was engineered, cantilever style, eliminating the need for a separate vertical tube to hold the skull. The skull, lower jaw, and steel weigh nearly 500 pounds (including both tusks, which are lightweight casts), so the armature had to be specially engineered to support the head of the mastodon. The Marshalls Creek mastodon is the first mastodon skeleton to be mounted in this way.

Aside from being unique with regards to its cantilevered skull, the mount had to be life-like, recreating the movement and stance of the prehistoric beast. Consulting with Fisher, and using modern-day film footage of elephants walking, Fraley's team paid special attention to the positioning of the feet, movement of the tail, arching of the back, and orientation of the head in order to recreate the authentic posture of the prehistoric proboscidean.



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Keny Marshall (left) and Pete Spynda (right), Phil Fraley Productions technicians, painstakingly remove the mastodon from the old fiberglass panel mount in which it had been embedded for thirty-five years.



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Paleontologist Robert M. Sullivan (top, right) and Phil Fraley Productions technician Joe Johnson inspect the newly fabricated steel armature prior to the mounting of the mastodon. Matt Tuite (above), also of Phil Fraley Productions, works on the tail vertebrae of the mastodon during its assembly at The State Museum of Pennsylvania.



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Fraley technicians Joe Johnson (above, left) and Pete Spynda assemble the back vertebrae of the mastodon at The State Museum, while Matt Tuite (left) makes final adjustments to a fore foot.

Return to The State Museum

On December 1, 2009, the mastodon returned to The State Museum in much the same way which it left: disarticulated and in boxes and crates. This time, however, the bones were professionally cleaned, restored, and properly conserved. Each bone was individually wrapped and numbered. Since each cradle was fabricated for a specific bone, the corresponding steel cradle was also numbered, allowing for proper assembly. The smaller individual bones, such as the vertebrae, were laid out on tables with their respective cradles. The pelvis was the first element to be mounted, followed by the neck and back vertebrae, hind and forelimbs, skull, lower jaws, feet, tail, and, finally, the tusks. A rich mahogany base, designed in interlocking sections, was fitted with an internal fiber optic up-lighting system, which completed the installation. The result is a state-of-the art mount by virtue of its cantilevered skull. The walking pose of the Marshalls Creek mastodon adds another dimension, one not seen in most mastodon mounts. Not only is the mount scientifically accurate, with respect to how these animals walked, but from an aesthetic

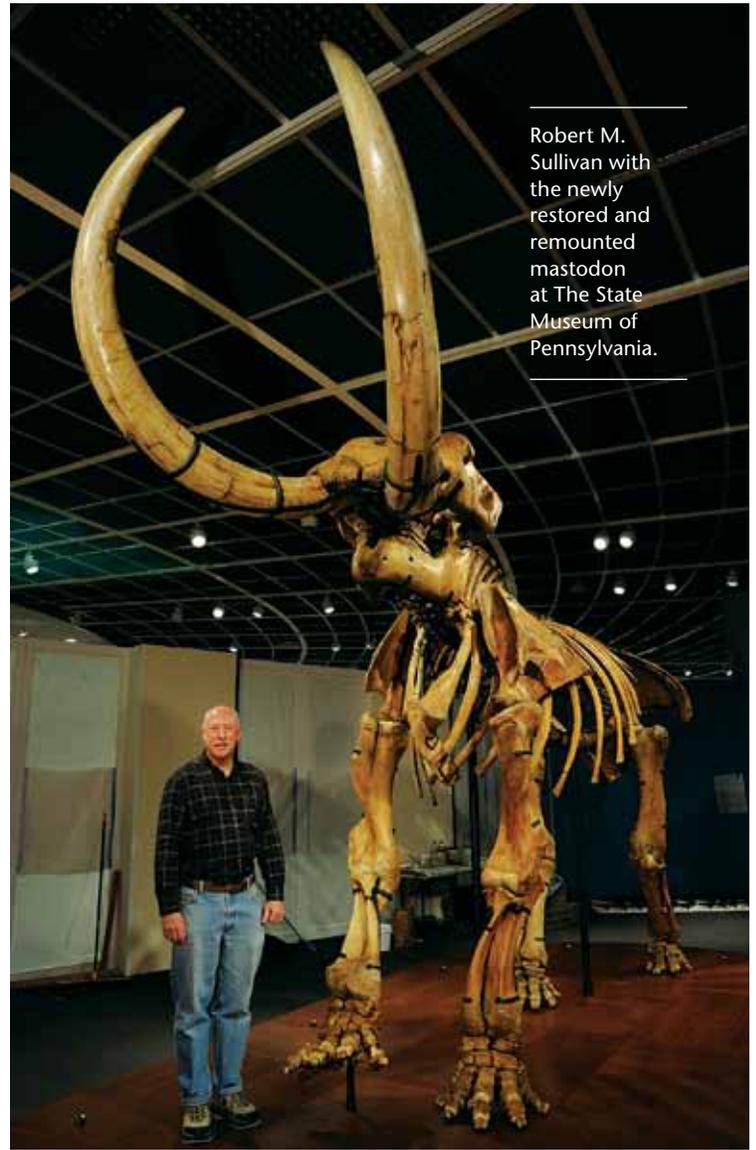


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Joe Johnson (left) and Kery Marshall (right) examine the mastodon's ribs prior to assembling it for exhibit. Technicians (below) insert tusks, cast from another specimen because the originals were not found, into the mastodon's skull.



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Robert M. Sullivan with the newly restored and remounted mastodon at The State Museum of Pennsylvania.

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perspective, it is truly dazzling. The new mount was recently unveiled at the museum as the centerpiece of "Tusks! Ice Age Mammoths and Mastodons," a major traveling exhibit about the evolution and extinction of mastodons and mammoths, produced by the University of Florida's Museum of Natural History in Gainesville.

In May 2010, the Marshalls Creek mastodon was painstakingly dismantled, bone by bone, and moved to the third floor of The State Museum where it was remounted for display in its permanent home in the newly designed and remodeled Cenozoic Gallery in the Hall of Geology. The mastodon is the focal point of this new gallery which also features other prehistoric beasts such as *Moeritherium* and *Platybelodon*, two earlier and more primitive elephant-like cousins to the American mastodon. The Cenozoic and new Mesozoic galleries (featuring a new *Coelophysis* and phytosaur diorama along with a number of fresh and exciting dinosaur displays) are the most ambitious exhibit renovations undertaken by the museum in the last thirty years.

Beginning in February 2011, visitors will be able to see this magnificent specimen that rose from the muck in its

complete, realistic pose. Undoubtedly, the Marshalls Creek mastodon will be a "must see" attraction at The State Museum of Pennsylvania for many years to come. 🇺🇸

*Robert M. Sullivan, Ph.D., is in his eighteenth year as senior curator of paleontology and geology at The State Museum of Pennsylvania in Harrisburg. He received his B.A. in geology from the University of New Mexico in 1973, an M.S. in vertebrate paleontology from San Diego State University in 1978, and a doctorate in geology from Michigan State University in 1980. His research interests are in the broad field of paleoherpetology focusing on the lower vertebrates, such as turtles, lizards, and crocodylians, dinosaurs, and Late Cretaceous vertebrate biochronology, as well as the controversial topic of dinosaur extinction. The author has published numerous technical articles on fossil vertebrates and is a leading authority on pachycephalosaurid dinosaurs. He recently was the lead author in describing and naming a new ceratopsian dinosaur, *Ojoceratops fowleri*, from the Upper Cretaceous rocks of New Mexico. He has collected and studied fossils not only from Pennsylvania, but also from around the world.*

ORIGIN, EVOLUTION, AND EXTINCTION OF THE PROBOSCIDEA

Origin and Evolution

Mastodons and mammoths belong to a group of mammals known as proboscideans (Order Proboscidea), elephant-like animals that lived during much of the Cenozoic Era (65.5 million years ago to present day). The group first evolved in northern Africa and diversified greatly during the Miocene Epoch (23.3–5.3 million years ago), spreading from the Northern Hemisphere of the Old World (Eurasia) to the New World (North, Central, and South Americas). Proboscideans, which include modern-day elephants, originated in the late Paleocene Epoch. Early proboscideans, such as the well-known *Moeritherium*, died out during the early Oligocene Epoch (30 million years ago), but other early members gave rise to the group known as the Elephantoida.



THE FIELD MUSEUM/ILLUSTRATION BY VELIZAR SIMEONOVSKI

Moeritherium was a "side branch" of the Order Proboscidea that lived in North Africa during the Eocene Epoch, approximately 30 million years ago. It died out during the Oligocene Epoch and left no descendants.

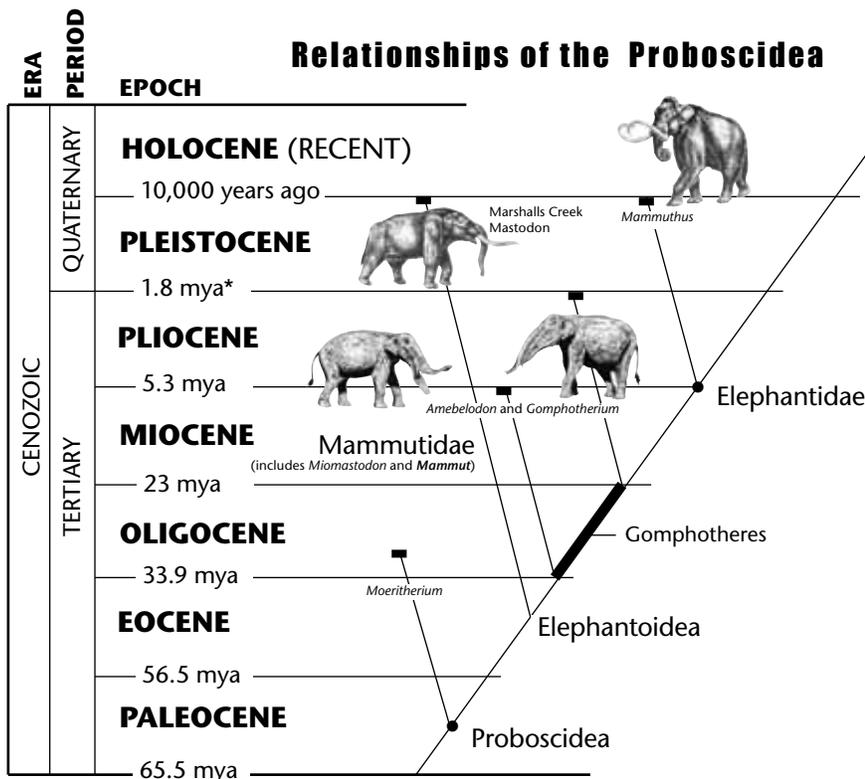
Mastodons evolved from a primitive ancestor of the first true mastodon (Family Mammutidae) in North Africa in the early Oligocene Epoch. *Miomastodon*, the first true mastodon in North America, made its appearance in the early Miocene Epoch. Mastodons lived in North America for 23 million years, and the American Mastodon, *Mammut americanum*, was the last member of this group to live.

Among these early proboscideans were a group of elephant-like herbivores called gomphotheres, precursors of modern elephants. The gomphotheres were unusual, characterized by two pairs of tusks, one set in the lower jaw and the second in the upper, which they used as large scoops for shoveling up water and mud-laden vegetation. They included well-known forms such as *Gomphotherium*, *Ambeledon* and *Platybelodon*. The gomphotheres became extinct at the close of the Pliocene Epoch (1.8 million years ago).

The family Mammutidae originated in North Africa during the early Oligocene Epoch. This family includes the genus *Mammut* (the American mastodont), which is the genus of The State Museum of Pennsylvania's Marshalls Creek mastodon. Mastodons became extinct approximately 10,000 years ago.

The family Elephantidae includes mammoths and modern-day elephants. Although mammoths became extinct at the same time as the mastodons, three species of elephants live today.

The Pleistocene Epoch is known for the Ice Age, a time when great frozen sheets advanced and covered much of the earth's Northern Hemisphere. In Pennsylvania, geologists have identified three glacial episodes, the first beginning 800,000 years ago and the last beginning about 24,000 years ago. Each episode of glacial advance was marked by erosion of the land. As the ice sheets retreated, they left behind vast deposits of glacial debris. During the glacial periods the climate was arctic-like. Between glacial periods, the climate was much like today's climate. In fact, the earth is still in an interglacial period of warming.



*mya: million years ago

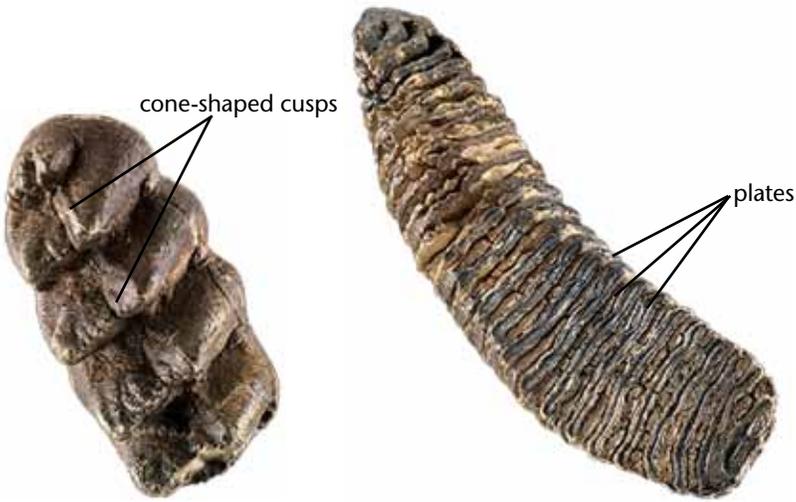
What is a Mastodon?

The term mastodon comes from the Greek words *masto*, meaning nipple or breast, and *dontos*, meaning tooth. Although mastodon is the common term used for the extinct proboscideans, the proper term is mastodont.

Mammoths and mastodons can readily be distinguished by the chewing surface of their teeth. The mastodon tooth has cone-shaped cusps (similar in shape to nipples), and the mammoth tooth has a series of enamel plates held together by cementum.

The three images from the Field Museum, Chicago, Illinois, on these pages were created for the museum's traveling exhibition entitled "Mammoths and Mastodons: Titans of the Ice Age." For more information, visit www.fieldmuseum.org on the Web.

The cones of the mastodon tooth are covered by hard enamel and were well-suited for chewing leaves and branches of trees and shrubs. The flat surface of the mammoth tooth is well-adapted for chewing highly abrasive vegetation, such as grasses. These differences in tooth structure indicate that mastodons and mammoths occupied different ecological niches.



THE FIELD MUSEUM/PHOTO BY JOHN WEINSTEIN

A typical mastodon molar tooth (left) and a mammoth tooth (right). The structure of the tooth surfaces provide clues for paleontologists about the diets of the animals.



THE FIELD MUSEUM/ILLUSTRATION BY VELIZAR SIMEONOVSKI

Gomphotherium was an early four-tusked prosocid that roamed North America thirteen to three million years ago.

Extinction

In North America, many of the large Pleistocene vertebrates, including mammoths, mastodons, and saber-tooth cats, became extinct about 10,000 years ago. Three theories for the extinction have been given: human contact, climate deterioration, and disease. However, none of these theories adequately explains why extinction occurred, and it may be that all three factors played a role. Humans entered North America from Asia approximately 14,000 years ago, but it is unclear whether they had a large impact in the extinction of these animals. Other mammals, such as deer, elk, and bison, were hunted for food and clothing, yet their populations were largely unaffected.

MARSHALLS CREEK MASTODON

Scientific name: *Mammot americanum*.

Common name: American mastodon.

Catalog number: SMP VP-13.

Significance: Most complete mastodon skeleton known from Pennsylvania.

Sex: Male.

Age at death: 25 to 30 years old.

Live weight: 8,000 to 10,000 pounds (4-5 tons).

Diet: twigs and leaves from shrubs and trees.

Geologic Age: approximately 12,000 years old (radiocarbon date obtained from associated plant remains), Pleistocene Epoch (1.6 million to 10,000 years ago).

Place: in a peat bog of the Lakeside Peat Humus Company, Marshalls Creek, Middle Smithfield Township, Monroe County, Pennsylvania.

Date: Collected August 8–22, 1968.

Collectors: Donald Hoff, curator, and professional staff members of the William Penn Memorial Museum (now The State Museum of Pennsylvania); John W. Leap, owner, and Paul Strausser, employee, Lakeside Peat Humus Company, Marshalls Creek, and volunteers.

FOR FURTHER READING

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