

PALEO: THE STORY OF LIFE



Life on Earth has not always existed as it currently does. The fact that life began on Earth in the first place is miraculous due to the environmental factors needed for its beginnings and sustainability. The relentless pursuit of life over billions of years from small living molecules to complex creatures roaming, flying and swimming throughout the Earth has culminated into the current state of life's existence as we know it on the planet we call home.

Paleo: The Story of Life is a 3,000-square-foot exhibit, spanning 4.6 billion years in scope. The exhibit presents casts of 128 rare fossils, including Lucy, Archaeopteryx and T rex, among many others.

Drawn from the world's foremost fossil collections, the Paleo exhibit showcases casts of rare fossils from the Americas, Europe, Asia, Africa and Australia – skeletons, skulls, claws and eggs gathered from prestigious museums, including the Smithsonian Institution, American Museum of Natural History, Royal Ontario Museum and Carnegie Museum, among others. Rarely available for viewing outside of their respective museums, these compelling artifacts are presented exclusively in *Paleo: The Story of Life*.

Fossils range from the earliest invertebrate marine life through the Triassic, Jurassic and Cretaceous dinosaurs to mammals and prehistoric humans. *Paleo: The Story of Life* explores the comprehensive story of prehistoric life on Earth.

The Paleo exhibit is a visiting exhibit and will be on display through Thursday, May 31, 2018. It is located in the Horowitz Traveling Exhibit Area.

The MOST presents *Paleo: The Story of Life* in association with the International Museum Institute, Inc.



Information edited by S. Newman, Science Educator

Drawn from the world's foremost fossil collections, the unprecedented treasury of fossil casts known as *Paleo: The Story of Life* brings together into one exhibition some of the most exciting finds in the history of paleontology from over a century of worldwide excavations, exhibited as sculptural works of art.

Spanning 4.6 billion years in scope, from the earliest invertebrate marine life through the Triassic, Jurassic, and Cretaceous dinosaurs to mammals and prehistoric humans, this internationally acclaimed, comprehensive collection dramatically illustrates the awesome story of prehistoric life on Earth.

Displaying casts of rare fossils from the Americas, Europe, Asia, Africa, and Australia, this prestigious collection includes skeletons, skulls, claws, and eggs gathered from such revered museums as the Smithsonian Institution, the American Museum of Natural History, The Royal Ontario Museum, and the Carnegie Museum, as well as many others.

This famed traveling exhibition is now available direct from its celebrated showings at the World Trade Centers in Boston, San Juan, and Taichung, the Fernbank Museum of Natural History in Atlanta, the Dinosaur Discovery Center at Colorado National Monument, and the Natural History Museum of El Paso, where it was admired by millions of people. These compelling natural artifacts, rarely seen outside of their respective museums, are on view together exclusively in *Paleo* and its touring collections.

FLOOR PIECES

A. *Chasmosaurus belli*
Late Cretaceous, Alberta



Large openings in the frill reduced the weight of the bone mass. It had 2 small horns over the brows and one on its parrot-beaked snout. Living in **large, migrating herds** and measuring over 16 feet in length, these herbivorous grazers have been found in Alberta, New Mexico, and Texas. Though not as well-equipped as its descendant, *Triceratops*, *Chasmosaurus* was capable of warding off attacks by fierce tyrannosaurs. This impressive creature was **one of the first dinosaurs to be found along with an impression of its skin**, the patterns of its large mosaic scales suggesting contrasting color patterns.

B. *Protoceratops andrewsi*
Late Cretaceous, Mongolia

Regarded as the earliest known horned dinosaur (although it only possessed small crests where the great horns of its giant descendants would be), this exquisite skull of an adult individual is from the Polish-Mongolian expedition.

C. *Dromaeosaurus albertensis*
Late Cretaceous, Canada



Because Dromaeosaurs display a striking affinity to birds, particularly the Jurassic *Archaeopteryx*, there is little doubt that they were **warm-blooded**. **Its brain had unusually large cerebral hemispheres for a dinosaur, suggesting complex behavior more birdlike than reptilian**. One fossil find in Montana indicates that they hunted in packs, while a one-on-one battle to the death with a *Protoceratops* was discovered in the Gobi Desert. Their combination of intelligence, swiftness, and the sickle claw places these creatures among the most dangerous of the dinosaurs.

D. *Dimetrodon limbatus*
Early Permian, Texas



Belonging to the archaic order of finback pelycosaurs, **these early cold-blooded**

synapsids were ancestral to the mammal-like reptiles of later Permian times. Incapable of sustaining an extended chase, they probably hid in the lush vegetation, waiting for unsuspecting prey to stray too close to escape a quick surprise attack.

The creature's dorsal "sail" provided a large surface area for warming the blood when exposed to sunlight and cooling it when in the shade.

F. *Tyrannosaurus rex*
Late Cretaceous, Montana



One of the largest known predators to have walked the Earth (the females distinctly larger than the males) was this invincibly massive, ferocious carnosaur. Surpassed in size only by the South American carnosaur *Giganotosaurus*, *Tyrannosaurus rex* grew to lengths of as much as 50 feet, towering 20 feet high and weighing 5 to 7 tons. Their heads alone measured 4 to 5 feet, sporting jaws lined with long, saw-edged teeth, each one supported by ranks of replacements. Reaching maturity within 5 years, the **life spans of these enormous creatures may have surpassed 100 years.**

G. *Australopithecus afarensis*
Middle Pliocene, Ethiopia

Presumably descended from a divergent group of Miocene apes such as *Kenyapithecus*, these early species of gracile australopiths are the most primitive known. **Among the oldest and most complete remains of an erect-walking ancestral hominid ever found**, this amazing *afarensis* skeleton is dated at about 3.2 million

years. Known throughout the world as "Lucy" (from a Beatles song), it was discovered in Radar, Ethiopia in 1974 by Donald Johanson and Tom Gray. Lucy was **3-and-a-half feet tall and about 25 years old** when she died. Possessing smaller canines than their quadrupedal ancestors, they **presumably foraged in family groups for fruits and seeds** along the vanished lakes and streams of Ethiopia and Tanzania, possibly sleeping in high tree branches to avoid predators.

H. Cro-Magnon Artifacts
Late Pleistocene, Western Europe



By 19,000 to 15,000 years ago, lifelike representations of game painted on cave walls began to appear, such as "The Hall of Bulls" at Lascaux cave in France.

THE PRECAMBRIAN ERA
Artifacts 1-12

4.6 billion to 540 million years ago

1. *Cryptozoon proliferum*
Late Cambrian, New York



Exposed by glacial activity, this spectacular form of *Cryptozoon* ("Secret Life") grew along the barrier reefs of an ancient island now known as the Adirondack Mountains.

2. *Collenia versiformis*

Early Precambrian, Minnesota

The oldest known visible structures produced by living organisms, stromatolites are the **fossilized remains of slimy mounds or mats** formed by the cementing of calcium carbonate sediments to the filmy secretions of cyanobacteria.

3. *Rugoconites tenuriugosus*

Late Precambrian, South Australia



Among the oldest and most primitive cnidarians are the primordial jellyfish of the Precambrian, whose colorful **modern descendants are virtually unchanged**.

4. *Kimberella quadrata*

Late Precambrian, South Australia



Commonly known as sea-wasps, this extant form of deadly, long-tentacled jellyfish is the most venomous predator on Earth, capable of inflicting instantaneous death.

5. *Ediacaria Flindersi*

Late Precambrian, South Australia



May have lived a sedentary existence on the sea floor with its short tentacles extended upwards.

6. *Dickinsonia costata*

Late Precambrian, South Australia



Already a diverse group by the end of the Precambrian, the annelid worms **presumably gave rise to the segmented arthropods**.

7. *Spriggina floundersi*

Late Precambrian, South Australia



Well-documented in the fossil record, *Spriggina* attests to the diversity of the early annelids, **whose descendants (including earthworms and leeches) are still alive today**.

8. *Tribrachidium heraldicum*

Late Precambrian, South Australia

Within this group, the origin of the chordates, the soft-spined ancestors of the vertebrates, is theorized to have occurred. If *Tribrachidium* is an echinoderm, then it may be evidence of the presence of the ancestors of the vertebrates in the oldest known seas.

9. *Charniodiscus opositus*

Late Precambrian, South Australia
Pennatulaceans: rise like delicate seaweed plumes from the bulbous holdfasts anchoring them to the substrate and swaying with the currents of early oceans

10. *Charniodiscus arboreus*

Late Precambrian, South Australia
Sea pens, or Pennatulaceans, are soft corals that live a **benthic existence attached to the sea floor**. Those of the earliest inhabited seas were large, frondosa structures that **lived by filtering tiny particles of food** from the warm waters of the shallow tidal flats.

11. *Glaessnerina grandis*

Late Precambrian, South Australia
The last of such featherlike creatures to be found in the Late Ediacaran deposits, *Glaessnerina* was the nearest to modern forms of sea pens.

12. *Cyclomedusa davidi*

Late Precambrian, South Australia



Long regarded as ancestral jellyfish, the discoidal Cyclomedusae are **now considered by the Australian scientists who have studied them for years to have been the holdfasts of other animals** that lived attached to the substrate, the sea pens.

THE EARLY TO MIDDLE PALEOZOIC ERA

Artifacts 13-52

540 million years ago to 345 mya

13. *Ptychagnostus*

Middle Cambrian, Utah



Although most agnostids (“Unaware Ones”) were not equipped with eyes, these early creatures, less than half an inch in size, **persisted for some 135 million years**.

14. *Gogia Kitchnerensis*

Middle Cambrian, Utah



The origin of the first chordates (ancestors of the vertebrates) appears to have occurred within the early echinoderm group.

15. *Olenoides serratus*

Middle Cambrian, British Columbia



Although its soft parts were protected by a sturdy exoskeleton, it was a **passive and defenseless scavenger that lived by filtering tiny particles of food from the muddy sea floor.**

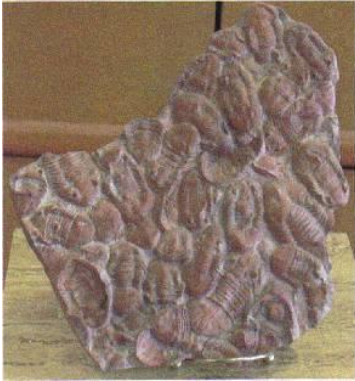
16. *Sidneyia inexpectans*

Middle Cambrian, British Columbia

The digested remains of tiny trilobites have been found in the guts of some specimens.

17. *Homotelus bromidensis*

Ordovician, Oklahoma



These were simple scavengers, dwelling on the muddy sea bottoms and grubbing for food, **periodically shedding their sturdy exoskeletons as their softer internal parts outgrew them.**

18. *Dalmanites*

Early Silurian, Tennessee



Though some trilobites were sightless, most were equipped with either single-lens or compound eyes. **Trilobites were the first creatures on Earth to develop complex eyes,** some of which were composed of over 10,000 individual lenses.

19. *Phacops africanus*

Devonian, Morocco



This giant phacopid trilobite, with its excellently preserved compound eyes, each composed of over 100 individual lenses, is characterized by its large eyes, a granularly decorated face, and the ability to enroll.

TRILOBITES

21. *Bristolia bristolensis*

Early Cambrian, California



Among the oldest and most primitive of trilobites, a spined, bottom-dwelling scavenger capable of both swimming and crawling.

22. *Olenoides superbus*

Middle Cambrian, Utah



A common representative of the corynexochid order, with medium-sized eyes and enlarged tail.

23. *Hemirhodon amphipyge*
Middle Cambrian, Utah



A member of the ogygopsid family, characterized by medium-sized eyes and a broad, fused tail, well-developed for burrowing.

24. *Wanneria walcottana*
Late Cambrian, Pennsylvania



Characterized by medium-sized eyes and spiny ribs. A scavenger adapted for crawling on the muddy sea floor.

25. *Eoceraurus trapezoidalis*
Ordovician, Oklahoma



The spines of these peculiar trilobites were special adaptations for the widest possible distribution of body weight on the soft sea floor, where its life was spent crawling in the mud. **Distinguished by its highly complex eyes.**

26. *Lonchodomas mcgeheeii*
Ordovician, Oklahoma



This unusual and highly specialized triloite was a **sightless, lightly built swimmer**, protected from predators by its long spines.

27. *Amphyxina bellatula*
Ordovician, Missouri



Tiny, gregarious ptychopariids, an extremely diverse order which gave rise to most of the trilobites that appeared after the Cambrian

28. *Cryptolithus laelus*
Ordovician, Pennsylvania



This tiny, sightless trilobite possessed a broad, perforated brim along the head and long spines, which supported its body on the soft sea floor on which it lived.

29. *Kanoshia kanoshensis*
Late Ordovician, Utah



A typical example of trilobite behavior, this early form of phacopid commonly **protected itself from danger by rolling up when threatened.**

30. *Fragiscutum glebalis*
Silurian, Oklahoma



A tiny and uniquely specialized member of the longstanding proetid order, capable of enrolling and distinguished by its **unusual eyes positioned at the ends of short stalks.**

31. *Arctinurus boltoni*
Silurian, New York



A broad, flattened form well suited for a life spent crawling on the sea floor, filtering organic food particles from the mud

32. *Diacalymene clavicula*
Silurian, Oklahoma



A variant form of phacopid with smaller, simpler eyes than its more specialized relatives

33. *Huntonia oklahomae*
Early Devonian, California



This unusually specialized phacopid was well-adapted for plowing in the sand and burrowing, lying with only its head exposed, watching with its compound eyes and waiting for tiny prey to crawl or drift by.

34. *Dicramurus hamatus*
Early Devonian, Oklahoma



This trilobite was equipped with a pair of horns and long, prickly spines extending from every part of its body, an effective defense against the **growing number of marine predators.**

35. *Leonaspis williamsii*
Early Devonian, Oklahoma



This small, bizarrely barbed trilobite had tiny eyes positioned on the tips of short, stiff stalks.

36. *Breviphillipsia sampsonii*
Mississippian, Missouri



A member of the diverse phillipsid family, representative of the far-ranging proetid order which flourished from the Ordovician to the end of the Paleozoic.

37. *Ditomopyge parvulus*
Pennsylvanian, Oklahoma



This cluster of tiny, pyritized proetids may represent moltings rather than the actual remains of the animals themselves, which periodically shed their exoskeletons as they grew.

38. *Delaria antiqua*
Permian, Texas



Descended from the primitive ptychopariids and characterized by its large eyes and tail, this late proetid was **among the very last of the trilobites.**

39. *Dunkleosteus terrelli*
Devonian, Ohio



The earliest known giant vertebrate, *Dunkleosteus* grew to lengths of over 16 feet and weighed up to 5 tons. Possessing no teeth, its powerful jaws were equipped with **razor-sharp blades of bone** which enabled it to slash and crush the armor of its prey. This monstrous fish **hunted everything from sharks and other placoderms to large invertebrates.**

40. *Bothriolepis canadensis*
Late Devonian, Canada



Their paired and spiny pectoral appendages may have served as anchors against currents as they gleaned for food on the muddy river bottoms. **The 2 pockets stemming from the throat may have served as lungs, temporarily allowing *Bothriolepis* to breathe air when stranded on shoals by the tide.**

41. *Cephalaspis lyelli*
Early Devonian, Scotland



Presumably a bottom dweller, it fed by filtering particles of food from mud sucked into its small, jawless mouth. Between its 2 upward-looking eyes lay the **pineal body, or “Third eye,”** a photosensitive organ which distinguished light from shade.

42. *Palaeoscorpius devonicus*
Late Devonian, Germany



Among the very first creatures to abandon the aquatic environment and invade the land, an event which took place during the Late Silurian, were the scorpions.

43. *Eurypterus remipes*
Eurypterus lacustris
Pterygotus macrophthalmus
Late Silurian, New York



Armed with pincers and a spiked fantail *Pterygotus* was a ferocious predator. Numerous fossilized trilobites bear scars left by the fearsome pincers of such creatures.

44. *Neuropteris rodgersi*
Pennsylvanian, Pennsylvania



Unlike the more primitive true ferns which reproduce from spores, these large, non-flowering, tree-like plants were crowned with seed-bearing fronds.

45. *Essexella asherae*
Pennsylvanian, Illinois



Lacking a central nervous system, these simple marine organisms are **actually colonial animals composed of hundreds of specialized individual creatures**, each fulfilling a separate function such as flotation, stinging, feeding, or digestion.

46. **Paleozoic Sea Floor**

Crinoids
Brachiopods
Coral
Trilobite
Trilobite trackway
 Mississippian, Indiana



Dominated by a fossilized crinoid and flecked with tiny brachiopod shells, coral, and even a half-buried trilobite, this slab has preserved a cross-section of a once thriving marine ecosystem.

47-50. *Ulrichcrinus coryphaeus*
Actinocrinites gibsoni
Dorycrinus gouldi
Taxodrinus coletti
Sarocrinus nitidus
Agaricocrinites americanus
 Late Mississippian, Indiana



Most of the crinoids died out at the close of the Paleozoic; however a few species still survive today.

51. *Ichthyostega*
 Late Devonian, Greenland



Had a **sturdy backbone and 4 short limbs, each equipped with 7 digits**, enabling it to waddle about on dry land for limited periods of time before having to return to water. *Ichthyostega* lacked notches for ears, so it likely couldn't hear. This important creature is **believed to have given rise to all of the diverse and prolific groups of reptiles, birds, and mammals which followed.**

52. *Eusthenopteron foordi*
 Late Devonian, Canada



With tear ducts to keep its eyes moist and lungs derived from a simple air bladder originally employed to keep the bodies of fish right side up, *Eusthenopteron* was **able to breathe out of the water during times of drought and stagnation** while other fish suffered asphyxiation. **The apparent progenitor of all terrestrial vertebrates**, it was extinct by the dawn of the Permian.

THE LATE PALEOZOIC ERA

Artifacts 53-67

345 mya to 250 mya

53-55. *Diplocaulus magnicomis*
Early Permian, Texas



Among the most bizarre of the Permian amphibians is *Diplocaulus*, a flattened, bottom-dwelling predator of streams and ponds. Ranging from 1 to 3 feet in length and **lying in wait in the murky bottom, *Diplocaulus* fed by ambushing its prey, its upward-looking eyes positioned on top of its boomerang-shaped head.**

56. *Eryops megacephalus*
Early Permian, Texas



Eryops was largely an aquatic creature **like the modern alligator**. Unlike the early fish, these amphibians were **able to listen for their prey due to their well-developed eardrums**, evolved from degenerate skull bones inherited from their fish ancestors.

57. *Seymouria baylorensis*
Early Permian, Texas



Because related forms document the passage of a **gilled larval stage, a characteristic thoroughly eliminating them from the reptilian class**, *Seymouria* is now placed among the anthracosaurs by most authorities.

58. *Cephalerpeton ventriarmatum*
Pennsylvanian, Illinois



Revolutionary ability to **deposit their eggs on dry land, bypassing the gilled larval stage of their immediate ancestors**. As the first vertebrates to become entirely independent of the water, their ability to exploit the terrestrial habitat led to a rapid radiation of diversely specialized reptile groups which included the **ancestors of birds and mammals**.

59. *Urogomphus giganteus*
Late Jurassic, Germany



Primitive wingless insects gradually gave rise to such magnificently winged creatures as the **ancestral dragonflies with 30 inch wingspans** that subsequently inhabited the coal swamps.

60. *Mylacris*
Pennsylvanian, Kansas



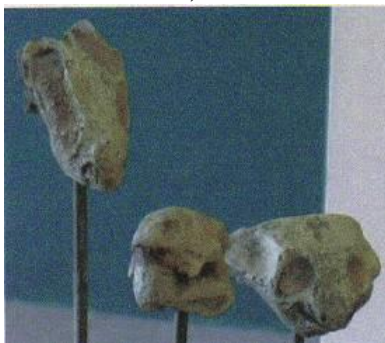
The most successful group in the animal kingdom, insects proliferated with the spread of the Carboniferous forests. Unlike the dragonflies, whose outstretched wings made hiding from predators difficult, **these newly evolved insects with wings that folded backwards rapidly flourished.**

61. *Euparkeria capensis*
Early Triassic, South Africa



A **predator** whose advantage over its prey was its swiftness, *Euparkeria* was **extremely close to the immediate ancestry of the dinosaurs.**

62-63. *Dicynodon grimbeeki*
Middle to Late Permian, South Africa



Although they were probably the first successful group of herbivores among the vertebrates, equipped with horny beaks and tusk-like upper canines, by the end of the Permian Period the herds of *Dicynodons* had dwindled to extinction.

64. *Mesosaurus brasiliensis*
Early Permian, Brazil



Because the remains of this creature have been found only in Brazil and South Africa, *Mesosaurus* is one of the very strong links in the chain of evidence for shifting continents.

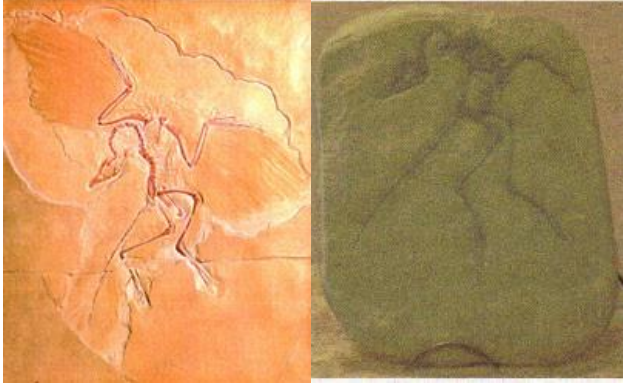
65. *Aerosaurus wellesi*
Early Permian, New Mexico



The most primitive of the early synapsid reptile groups, the pelycosaurs may have led a **somewhat amphibious existence**, similar to that of alligators. Catching and killing its prey in jaws lined with sharp teeth, *Aerosaurus* was an aggressive predator.

Although cold-blooded, because of their bone structure the archaic synapsid reptiles are **considered to be the ancestors of the therapsids**, the later and more advanced reptile group that subsequently gave rise to warm-blooded mammals.

66. *Archaeopteryx lithographica*
Late Jurassic, Germany



Although adapted for gliding and presumably for limited flight, these primitive ancestral birds still retained **efficient, grasping claws on each wing**, as well as a long bony tail and jaws lined with sharp archosaurian teeth. Because its remains have only been found in deposits of shallow marine lagoons rich in fossilized fish and squid, **some believe *Archaeopteryx* was capable of diving for aquatic prey.**

67. *Compsognathus longipes*
Late Jurassic, Germany



This tiny coelurosaur was a relative of such giant creatures as the *Tyrannosaurus rex* of a later age.

The smaller bones exposed within the rib cage of this well-known specimen have been identified as the undigested skeleton of *Bavarisaurus*, a tiny lizard that was devoured just before the predator died.

THE TRIASSIC PERIOD

Artifacts 68-71

230 mya to 200 mya

68-69. *Thrinaxodon liorhinus*
Early Triassic, South Africa



Although exhibiting tiny pits in their skulls which appear to have held whiskers and possessing a palate separating the nasal passages from the mouth, **distinctly mammalian features**, the primitive reptilian jaw structure of cynodonts **retained certain prominent bones that became greatly reduced in mammals** and incorporated into the inner ear.

70. **Dinosaur trackway**
Grallator
Late Triassic, Connecticut



This little theropod, with its serpentine neck and lightweight, hollow bones, is believed to have been swift and agile, chasing prey and tearing it with sharp claws and teeth. **Such behavior strongly suggests a warm-blooded metabolism.**

71. *Hadrokkosaurus bradyi*
Late Triassic, Arizona



The pronounced indentation between the eyes, the **pineal opening**, sensitive to light and shade, was used as a “third eye” by early bottom-dwelling fish and amphibians. Derived from an

ancient lineage of marine ancestors, the once photosensitive pineal body is still **retained as a vestigial organ** within the brains of all modern vertebrates.

THE JURASSIC PERIOD

Artifacts 72-83

200 mya to 145 mya

72. *Pterodactylus kochi*
Late Jurassic, Germany



Their hollow, lightweight bones enabled them to venture significant distances over the shallower waters. Have been found with impressions of their furry coats.

Once presumed to have been limited to gliding from high perches, they are now believed to have been **thoroughly agile in flight**. They were quite **vulnerable to marine predators**, judging by the numerous pterosaur bones found in the stomachs of ichthyosaurs.

73. *Rhamphorynchus gemmingi*
Late Jurassic, Germany



Growing to lengths of up to 2 feet, its average wingspan was about 4 feet. Capable of sustained flight as well as aerial acrobatics, *Rhamphorynchus* was **probably furry and warm-blooded**.

74. *Othnielia rex*
Late Jurassic, Utah



Agile sprinters when threatened or chasing prey, the omnivorous hypsilophodonts **possibly flourished for longer than any other dinosaurs**, about 100 million years.

75. *Mesolimulus walchi*
Late Jurassic, Germany



Virtually unchanged since the Permian, these arthropods dig along the beaches for worms and other small prey, often burying themselves in the sand.

76. *Stenopterygius quadricissus*
Jurassic, Germany



Growing up to 15 feet in length, they apparently evolved from land-dwelling creatures, possibly the pelycosaurs. From the limbs of their terrestrial ancestors, the ichthyosaurs evolved their strong, broad paddles.

77. *Ichthyosaurus megacephalus*
Jurassic Germany



From fossils, these **air-breathing, dolphin-like creatures** are known to have **fed on pterosaurs and fish**, and rather than laying eggs, and gave birth to live young.

78. *Apatosaurus ajax*
Late Jurassic, Utah



The regal, long-necked sauropods were by far **the largest land animals that ever lived**. With a long, sloping skull and a single nostril situated on top of its skull, *Apatosaurus* was a member of the diplodocid family. **Measuring 70 ft. in length and weighing 33 tons**, these gigantic herbivores possessed long, serpentine necks and even longer whiplike tails.

79. *Hypselosaurus priscum*
Cretaceous, France



This 40 foot long sauropod, characterized by its short, blunt head and small teeth, laid the largest eggs known, about 12 inches in length. The folded embryo within would have hatched to a size twice the length of the egg.

80. *Camarasaurus lentus*
Late Jurassic, Utah



Sauropod footprints indicate that these gentle herbivores **cared for their young**, guarding them on all sides as they wandered together, feeding on the highest tree branches.

81. *Stegosaurus stenops*
Late Jurassic, Utah



Discovered in Colorado in 1877, *Stegosaurus* (“Plate Lizard”) grew to a length of up to 30 feet and weighed up to 2 tons. The bony armored plates guarding the neck, back and tail of the huge Jurassic herbivore were **attached to powerful skin muscles, and were probably capable of being raised and lowered** to protect the spine or the flanks.

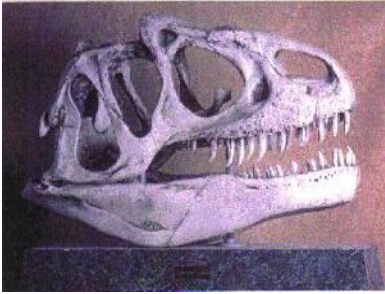
Aiding in the precision of the movement of the enormous hind-quarters and spiked tail, an **enlargement of the spinal cord at the pelvis, much larger than the creature’s brain, was long believed to be its “second brain.”**

82. *Anatosaurus annectens*
Late Cretaceous, Montana



This fibular fragment with a splendidly preserved skin impression is from a partially mummified duckbilled dinosaur found in the Hell Creek Formation. Private collection.

83. *Allosaurus fragilis*
Late Jurassic, Utah



Its massive, yet open, lightweight skull a marvel of engineering, the fearsome *Allosaurus* (“Different Lizard”) was the predominant carnivore in North America during the Late Jurassic, **and probably fed on such herbivorous dinosaurs as *Apatosaurus* and *Stegosaurus*, its flexible skull capable of expanding to accommodate oversized chunks of food.**

THE CRETACEOUS PERIOD

Artifacts 84-93

145 mya to 65 mya

84. *Quetzalcoatlus northropi*
Late Cretaceous, Texas



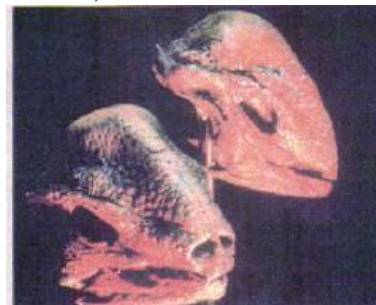
Named for the ancient Mexican feathered serpent-god Quetzalcoatl, the giant *Quetzalcoatlus* was estimated at **twice the size of the largest known pterosaurs known at the time**, the *Pteranodons* of the Kansas Chalk. Only one wing was found, indicating a wingspan of 36 to 39 feet with a weight of 190 to 220 pounds, **making it the largest known flying creature.**

85. *Oviraptor philoceratops*
Late Cretaceous, Mongolia



Discovered in 1922: several nests of *Oviraptor* eggs, the **first dinosaur eggs ever located**, in what must have been a large nesting ground.

86. *Stegoceras validus*
Late Cretaceous, Alberta



Among the rarest of dinosaur remains, the enigmatic boneheads are known mostly from fragments of skulls and skeletons. Possessing sharp teeth, this slow-moving, bipedal creature is believed to have fed on insects, fruits, and leaves. Roaming in herds that ranged throughout the hills of eastern Asia and western North America, the boneheads **apparently had lifestyles similar to those of modern sheep and goats.**

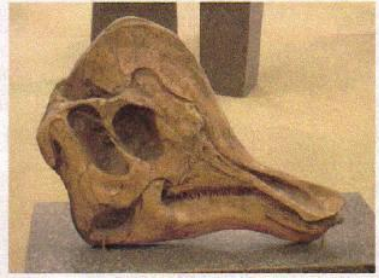
87. *Camptosaurus browni*
Late Jurassic, Utah



Short but sturdy, its 5-fingered **forelimbs were adapted to bearing weight**, although fossilized footprints indicate that it was also thoroughly

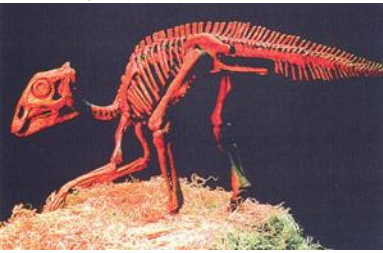
capable of walking bipedally on its 4-toed hind legs.

88. *Corythosaurus casuarius*
Late Cretaceous, Alberta



Growing to lengths of 33 feet and weighing over 4 tons, these **peaceful herbivores ranged north of the Arctic Circle in search of food and migrated south during the long winters**, which were less cold in Late Cretaceous times than they are now. Known for **protecting and feeding their young**, these duckbills may have relied upon their prominent head crests for recognition during their mating season. Although they possessed no significant defense against predators, **their keen sense of vision, hearing, and smell** served to warn them of approaching danger.

89. *Maiasaura peeblesorum*
Late Cretaceous, Montana



Juveniles and hatchlings of varying ages have been found in these nests, exhibiting **evidence of prolonged parental care**. The eggs were carefully arranged in regular patterns in large, dug-out mounds, each an adult body length from the next.

90. **Coprolites**
Hadrosaur
Cretaceous, Canada



These coprolites were discovered in association with the fossilized remains of duck-billed dinosaur nests in Saskatchewan.

91. *Tyrannosaurus rex*
Late Cretaceous, Montana



Presumed to have dealt mostly with the animal's senses, the brain of *Tyrannosaurus rex* was not small for a dinosaur although compared to the size of the creature's body it was remarkably diminutive. (**cranial endocast**)

92. *Tyrannosaurus rex*
Late Cretaceous, Montana



Fossil evidence of their actual metabolism is magnificently preserved in the sequential rings of growth-spurts which scar the teeth.

93. Meteorite
Meteor Crater, Arizona



Most meteorites come from the vicinity of the asteroid belt, the orbiting fragments of metal and rock which are the remnants of a failed planet and of the actual creation of our solar system some 4.6 billion years ago. About 22,000 years ago this meteorite, composed of 95% pure iron, left a crater over 3,600 feet wide and 525 feet deep. A fragment of the original meteorite, this pristine relic of the formation of the solar system was found in the famous depression of Meteor Crater, Arizona.

95. *Propalaetherium messensis*
Middle Eocene, Germany



Among the earliest known descendants of Eohippus, this tiny **ancestral horse** only reached the size of a fox. With an arched back and elevated hindquarters, this diminutive ancestor of the horse **probably lived in small herds, running in leaps like a deer**, with most of its weight resting on the padded soles of its feet rather than on the hooves.

96. *Knightsia humilis*
Eocene, Wyoming



Descended from the primitive Agnatha of the Paleozoic and distinguished by their bony internal skeletons and symmetrical tails, these are among the most advanced of fossil fish.

97. *Rhynchaeytes messelensis*
Eocene, Germany



Insulated by feathers derived from the scales of their theropod ancestors, **these warm-blooded creatures are the only surviving descendants of the dinosaurs.**

Wading along the beaches of central Europe at

THE CENOZOIC ERA
Artifacts 94-99
65 mya to the present

94. *Merycoidodon culbertsoni*
Late Eocene, South Dakota



These gentle little sheeplike creatures, with their short limbs and 4-toed feet, roamed the forests and plains of North America in great herds 25 to 30 million years ago. This primitive cloven-hoofed animal, related to camels and swine, **was one of the most abundant and well-known of the early North American mammals.**

low tide and digging for prey in the sand, the long-limbed snipe *Rhynchaeytes* was **specially adapted to life as a shorebird.**

98. *Icaronycteris index*
Early Eocene, Wyoming



The last of only 4 animal groups to develop the power of flight, the early bats gave rise to fruit-eating varieties equipped with powerful vision and unreliant upon echolocation.

99. *Ginkgo adiantoides*
Paleocene, South Dakota



Sexually distinct, these ancient trees reproduce through pollination by males of the pitted ovules grown by females.

EVOLUTION OF MAN

100. *Adapis parisiensis*
Middle to Late Eocene, France



Among the oldest groups of placental mammals, the first primates evolved from primeval insectivores about 70 mya. Its forward-facing eyes, evolved for focusing on single objects, enabled it to leap from branch to branch with an accuracy of **depth perception** superior to that of earlier mammals.

101. *Rooneyia viejaensis*
Early Oligocene, Texas



Resembling tarsiers, earlier species appear to have been insectivorous, whereas the relatively late *Rooneyia* was **probably a frugivore.**

102. *Aegyptopithecus zeuxis*
Middle Oligocene, Egypt



Commonly known as the "Dawn Ape", this tiny tree dwelling primate, **no longer than a cat**, probably fed on insects, fruit, and nuts. Possessing a short tail and primitive snout, its **forward-facing eyes** and 32 teeth link it with such later Miocene apes as *Proconsul*.

103. *Proconsul africanus*
Miocene, Africa



As the climate shifted and grasslands replaced the forests, some primates spread to the savannas, learning to **stand upright** and evolving **cooperative societies** for protection from the dangers that lurked in the tall grass. Sometime during the Miocene epoch the **ancestral line of the hominids diverged from that of the apes**. With limbs adapted for crawling through trees, the quadrupedal *Proconsul* is largely regarded as being ancestral to apes and hominids, possessing characteristics of both.

104. *Carcharodon megalodon*
Miocene, South Carolina



Descended from primitive Devonian sharks, true sharks appeared during the Jurassic. **Following the extinction of the marine reptiles, sharks became (and remain) the dominant predators of the seas.** The extinct Miocene *Carcharodon megalodon* of 20 million years ago may have reached lengths of 45 to 50 feet.

105. *Kenyapithecus wickeri*
Early to Middle Miocene, Kenya



These jaw fragments are the only known remains of what appears to be an early hominoid species that inhabited the early to Middle Miocene forests of Kenya from about 14.4 to 12.5 million years ago. This African genus **may well have produced the australopithecine strain that led to humankind.**

106. *Sivapithecus indicus*
Late Miocene, Pakistan



Since the subsequent consolidation of “Ramapithecus” with the earlier known *Sivapithecus*, the discovery of more complete facial skeletons in Turkey and Pakistan ultimately revealed this genus as the **ancestor of the Southeast Asian orangutans**.

107. *Australopithecus sp.*
Early Pliocene, Kenya

Discovered at the Lothagam site in 1967 and dated at 5.5 million years, the older mandible is **the earliest known evidence of the hominid line**.

108. *Australopithecus afarensis*
Middle Pliocene, Ethiopia



Presumably descended from a divergent group of Miocene apes such as *Kenyapithecus*, these early species of gracile australopiths are the most primitive known.

109. *Australopithecus afarensis*
Middle Pliocene, Ethiopia



Popularly known as the “First Family,” this extraordinary find is **evidence that even the earliest hominids lived in bands** (or tribes). Ranging from 3 to 5 feet in height and weighing from 60 to 90 pounds, *afarensis* had long arms with slightly curved finger and toe bones, **suggesting at least a partially arboreal life**. These **composites of a male skull and hand** are reconstructed from the incomplete remains of several individuals.

110. *Australopithecus africanus*
Late Pliocene, South Africa



Using their hands for gathering and carrying, *Australopithecus africanus* walked erect, presumably foraging for roots and seeds and

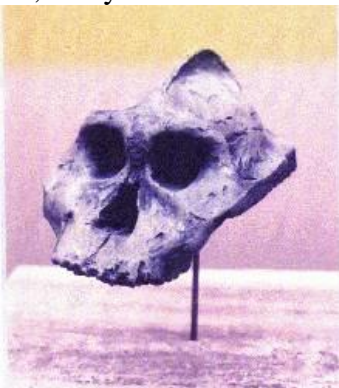
perhaps even **scavenging remains** from carnivore kills in small groups throughout the tropical savannas of eastern and southern Africa. From 3 to 4 feet tall and weighing 45 to 90 pounds, these small apelike creatures ranged throughout the grasslands of Kenya, Ethiopia, Tanzania, and South Africa, living alongside their evolutionary descendants for over a million years.

111. *Australopithecus africanus transvaalensis*
Late Pliocene, South Africa



This extraordinary specimen of a 3-year-old gracile australopith is **the first ancestral hominid fossil ever to be found**. The opening for the spinal nerves, located at the bottom of the skull rather than near the back, indicates this young hominid stood erect and walked on 2 feet, a fact reinforced by the subsequent discovery of humanlike *africanus* pelvic bones.

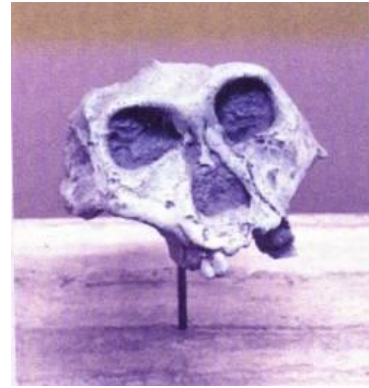
112. *Australopithecus aethiopicus*
Late Pliocene, Kenya



The age of *aethiopicus*, with its massive teeth and sagittal crest, implies that it, and not the gracile *africanus*, is the intermediate stage between *afarensis* and the robust australopiths, thus giving credence to the standing of

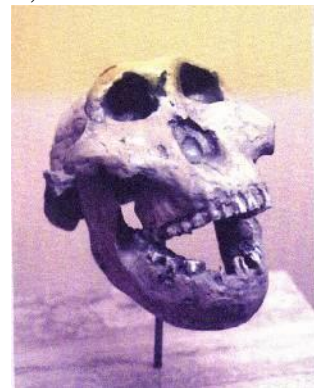
africanus as the transitional species between *afarensis* and *Homo*, a more plausible scheme according to many paleoanthropologists. Possessing the **smallest brain of any known hominid**, this profoundly controversial fossil provoked a complete redrawing of humankind's family tree.

113. *Australopithecus robustus*
Late Pliocene, South Africa



The later robust hominid species were a little over 5 feet in height. **Walking upright throughout the savannas of eastern and southern Africa, these larger hominids were gatherers who fed on leaves, seeds, berries, and perhaps insects**, possessing little, if any, knowledge of toolmaking. Presumably descended from the gracile *afarensis*, the robust australopiths were a branch **that did not survive**.

114. *Australopithecus boisei*
Late Pliocene, Tanzania



1.8 million years old, **it was the first fossil of an australopith to be successfully dated**. Ranging in height from 5 to nearly 6 feet, they were about the size of modern humans. **Possibly killed off by the more advanced**

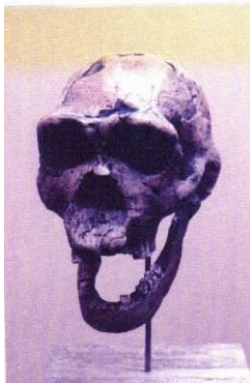
Homo habilis, whose chipped tools are sometimes found with the remains of these hominids, the species became extinct about 1 million years ago.

115. *Homo rudolfensis*
Late Pliocene, Kenya



It is currently unclear whether *rudolfensis* should be classified with *Australopithecus* or *Homo*, but either way it is a vital connecting dot in the web of human evolution. It is likely that *rudolfensis* was alive at the same time as *Homo habilis*, though it is unclear which of them may have led to future human species.

116. *Homo erectus*
Late Pliocene, Kenya



Although possessing **the thickest skull of any hominid**, the superior intelligence of *Homo erectus* (“Upright Man”) enabled this Early Stone Age hunter to venture from the ancient habitats of its African ancestors to thinly populate such diverse regions as Europe and Southern Asia, **perhaps following the migrating herds of large mammals as they hunted**. Descended from *Homo habilis* by 1.7 million years ago **and credited with the discovery of fire**, their improved hunting

methods appear to have included the **use of brush fires to drive herds of big game into ravines**.

117. *Homo sapiens neanderthalensis*
Middle Pleistocene, Israel



This short rugged subspecies, with its thick skull and heavy brow ridges, had a **larger brain than modern humans** and probably spoke a primitive language. Appearing about 200,000 years ago, their **advanced intelligence and adaptability** enabled them to survive in the harsh arctic climate of the last Ice Age. Remains of crippled individuals hint at the **compassionate nature of their society**.

118. *Smilodon fatalis*
Late Pleistocene, California



Stalking their prey silently in the open countryside until close enough to pounce, then stabbing their great dagger-like canine teeth into the ambushed victim’s neck or belly, these cats are believed by some to have been **specially adapted for preying on mammoths**. The largest and perhaps most successful of the saber-tooths, *Smilodon* **went extinct about 11,000 years ago**.

119. *Mammuthus jeffersoni exilis*
Pleistocene, California



The giant dome-headed, spiral-tusked mammoths migrated into North America over the land bridge from Asia 1.5 million years ago. With their thick coats of shaggy, reddish fur insulating them against the harsh climates of the tundra regions during the Ice Age, they **used their great tusks to sweep aside snow and permafrost while foraging for plants.**

123-125. **Cro-Magnon artifacts**

Spear point

Ornamental bear claws

Fishhooks

Engraved reindeer antler

Carved reindeer antler

Mammoth carved in bone

Bulls carved in bone

Wild horse of Vogelherd

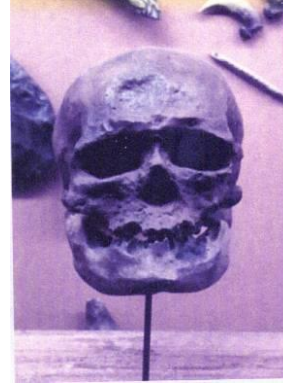
Small Venus

Late Pleistocene, Western Europe



The harpoons, spear-throwers, needles pierced with an “eye”, fishhooks, and handles invented by Cro-Magnons led the way **not only to mankind’s taming of the environment, but also to the artful recording of his abstract perception of it.** American Museum of Natural History.

122. *Homo sapiens sapiens*
Middle Pleistocene, France



This race of early *Homo sapiens sapiens* of 40,000 to 10,000 years ago were **fully modern members of our own subspecies.** Surviving the harsh climates of the Ice Age, these Late Stone Age hunters were the ancestors of present-day European Caucasoids. Cro-Magnon **culture appears to stress hunting,** as evidenced by their artful paintings, engravings and sculptures of such big game animals as reindeer, oxen, and horses. **Advanced weapons and hunting methods** enabled these people to double the hurling range of their spears in hunting big game and to introduce freshwater fish to their diets.

121. **Venus of Willendorf**

Late Pleistocene, Austria



Found in 1908 in the Danube Valley, Austria, and dated at about 40,000 years, this ancient and meticulously detailed limestone carving was probably used as a fertility fetish by Cro-Magnons.

120. **Moon Rocks**

Apollo Lunar Landing Missions

Lunar crust Apollo 15



Known as the “Genesis Rock”, this white feldspar was the first sample of lunar crust used for determining the age of the Moon. **Evidence that the Moon, like the Earth, emerged from a swirling cloud of condensing gases** during the formation of the Solar System some 4.6 billion years ago, its composition differs

(chiefly calcium aluminum silicate, a form of reflective feldspar that doesn’t occur on Earth), suggesting that the Moon was captured by the Earth’s gravity after its formation.

Lunar basalt Apollo 17

This black basaltic rock, similar to those found on Earth, is pitted with glassy holes left by the heat of escaping gases in the Moon’s vacuum atmospheric pressure. Mainly composed of iron and pyroxene (magnesium iron silicate) with occasional traces of calcium, this rock is **evidence that the Moon’s iron core was formerly molten like the Earth’s.**

Lunar basalt Apollo 12

Pitted on both sides with tiny micrometeorite craters and composed primarily of iron and magnesium, this small gray basaltic rock was evidently shifted from its original position on the lunar surface at some point in its history.