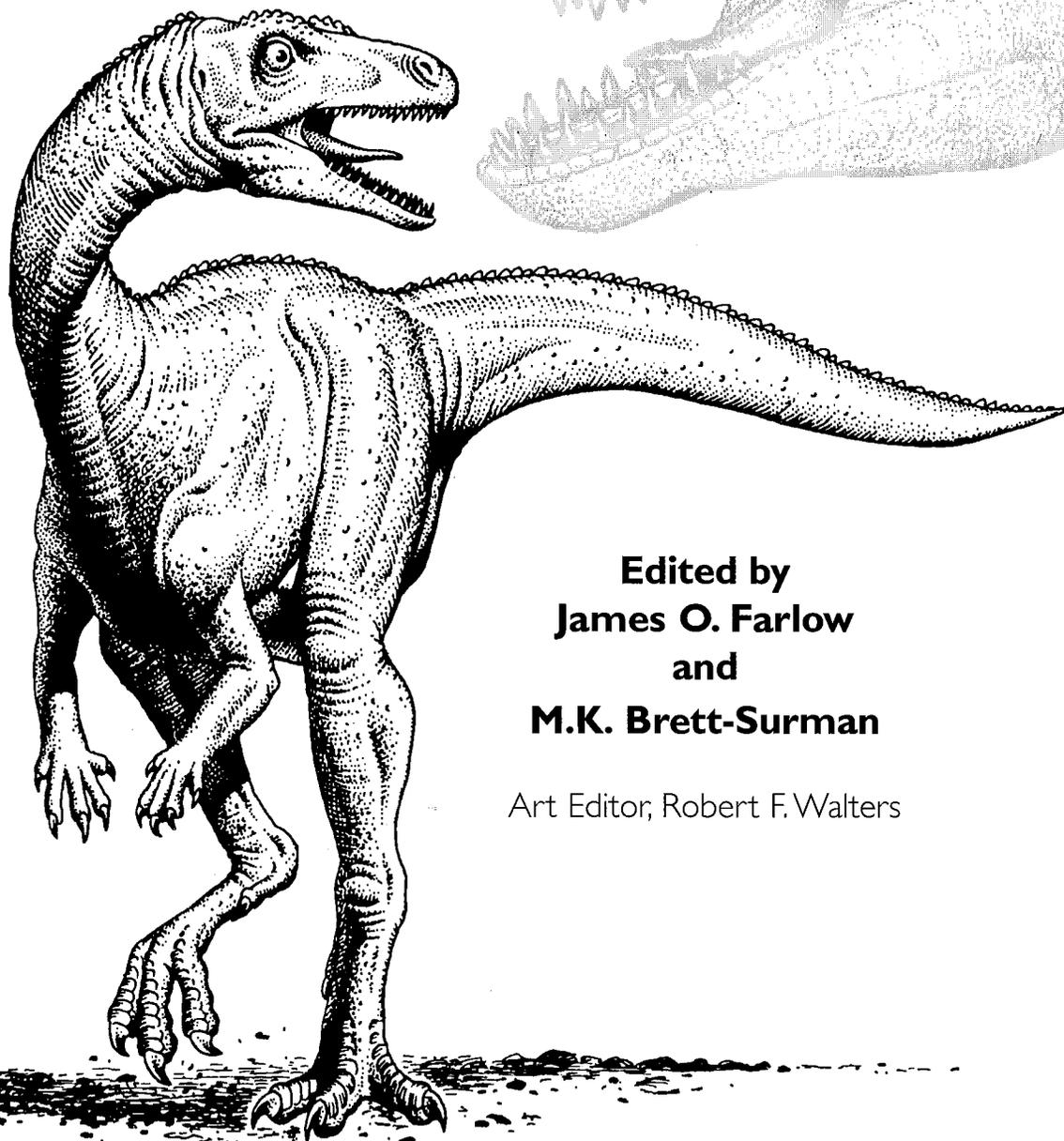


**THE**  
*Complete*  
**DINOSAUR**



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# Appendix: A Chronological History of Dinosaur Paleontology

*M. K. Brett-Surman*

This appendix is compiled from numerous sources, and summarizes some of the key personalities, events, and discoveries that have shaped our understanding of dinosaur paleontology. The appendix consists of two parts. Part 1 presents a chronological list of some of the more important historical developments in dinosaur paleontology. Part 2 synthesizes this information by organizing the history of dinosaur studies into a series of “ages,” each characterized by certain defining features of the sciences at that time.

## **Part 1: A Chronology of Dinosaur Studies**

**300 B.C.E. (date approximate)** Chang Qu writes about dinosaur (“dragon”) bones in Wucheng (Sichuan), China.

**1677** The first report of a “human thigh bone of one of the giants mentioned in the Bible” by Reverend Plot of England.

**1763** R. Brookes publishes a figure referred to *Scrotum humanum* based on Reverend Plot’s 1676 figure. This specimen, believed to be the distal end of a femur, is now referred to a megalosaurid.

**1787** First dinosaur found in Gloucester County, New Jersey, by Matlack (Matelock?) and Caspar Wistar of Philadelphia. A description is read before the American Philosophical Society on October 5, 1787, but it will not be published for 75 years. It is reported at a meeting with Ben Franklin at Franklin’s house. The specimen is believed to be at the Academy of Natural Sciences in Philadelphia.

**1800** Pliny Moody (a student at Williams College) locates fossils on his farm in Connecticut. These dinosaur footprints were called “footprints of Noah’s Raven” at the time by Harvard and Yale scientists, even though they were 1 foot long.

**1803–1806** Lewis and Clark collect a Cretaceous fish skull later named *Saurocephalus* by Harlan. They also report a “fish rib” 3 feet long and 3 inches in circumference in an area where the Hell Creek Formation now outcrops. It is most likely a dinosaur, but the fossil cannot be found today. Benjamin Silliman and Amos Eaton of Yale University establish natural history as a profession through their popular lectures around New England. Their speaking fees help support their work.

**1818** Solomon Elsworth collects dinosaur bones from the Connecticut Valley Triassic but mistakes them for human bones. They are now in the Yale University collections.

**1822** James Parkinson publishes the name *Megalosaurus*, but without providing a description. This predates the presentation by Buckland before the Geological Society of London in 1824, where he announces the name *Megalosaurus* and provides a description.

**1824** William Buckland announces *Megalosaurus*, based on jaws and teeth, before a meeting of the Geological Society of London on February 20. This is accepted as the premiere of the name even though Parkinson published the name (without description) in 1822.

**1825** Gideon Mantell (a country doctor) names *Iguanodon* on the basis of a tooth found (at least by some accounts) by his wife while he was attending a patient. It is later named *I. anglicum* by Holl (1829). Cuvier says the tooth is that of a rhino, but Mantell publishes it as a “lizard,” and Cuvier later admits that he was wrong. Mantell’s wife subsequently leaves him. He gives up his practice, moves to London, and hunts fossils full-time. His house becomes so jammed with fossils that he later sells his entire collection to the British Museum (Natural History) for \$24,000. Mantell’s coat of arms for Maidstone (his residence) includes an *Iguanodon*.

**1829** James Louis Macie Smithson dies in Genoa, Italy. He was the illegitimate son of the Duke of Northumberland (Hugh Smithson Percy). Smithson’s will leaves everything to his nephew; however, in the case that his nephew dies without heirs, the will stipulates that the money will go “to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men.” This will finally occur in 1846.

**1830** Charles Lyell’s *Principles Of Geology* makes geology a professional science instead of a gentleman’s hobby. Lyell was taught by Reverend William Buckland (who described *Megalosaurus*). Lyell coins the word *palaeontology* (“discourse on ancient things”) and recognizes this field as its own science (1829–1833).

**1833** Mantell names *Hylaeosaurus*.

**1836** Richard Owen is appointed first Hunterian Professor of Comparative Anatomy and Physiology of the Royal College of Surgeons in London.

**1837** von Meyer names *Plateosaurus*, but it will not be recognized as a dinosaur until much later.

**1841** Owen names *Cetiosaurus* but regards it as a marine reptile. It is not transferred to the Dinosauria until 1869.

**1842** Sir Richard Owen coins the word *dinosaur* on the basis of only three partially known genera (*Megalosaurus*, *Iguanodon*, and *Hylaeosaurus*). Eight other fossil reptiles have already been named that will later be transferred to the Dinosauria.

**1850s** The geologist James Hall teaches Joseph T. Leidy and Ferdinand Vandever Hayden. They both boarded at his house in New York. Hayden is later sent to the Dakota Territories by Hall to collect fossils to compare with fossils from New York.

Hayden finds the first American dinosaur in 1854 in the Judith River deposits of the western U.S., but it remains undescribed until the time of Cope.

**1852** Mantell describes the first known dinosaur skin, from the forelimb of *Pelorosaurus becklesii*.

**1853** A dinner is held on December 31, 1853, inside Waterhouse Hawkins’s life-sized model of *Iguanodon*. Richard Owen presides.

Leidy arranges with Spencer Baird of the United States National Museum (Smithsonian Institution) to have all government survey fossils sent to him at the Philadelphia Academy of Natural Sciences so that he can study them. He does so from 1847 to 1866, after which (in the 1870s) Cope and Marsh push him out of the field. Leidy gets Ferdinand Vanderveer Hayden appointed to head up the early government surveys out west. Hayden also explores the Indian lands for the War Department.

**1854** The exhibit of Crystal Palace dinosaurs, based on Waterhouse Hawkins's sculptures, moves to Sydenham, England.

**1855** Ferdinand Vanderveer Hayden discovers dinosaur remains in the Montana territories. They will be named in 1856 by Leidy as the first American dinosaurs.

The first skeleton of *Archaeopteryx* is found in Germany. The specimen will not be recognized as a bird until 1970.

**1856** *Trachodon*, *Paleoscincus*, *Troodon*, and *Deinodon* are named.

Owen becomes superintendent of the Natural History Section of the British Museum.

**1858** Edward Hitchcock publishes his monograph on the Triassic and Jurassic footprints of the Connecticut Valley.

*Hadrosaurus* is named. It is the first dinosaur skeleton more than 50 percent complete to be excavated in the United States.

Joseph Leidy's restoration of *Hadrosaurus* as a biped is the first dinosaur restored in this stance, and it causes a furor. This helps Cope to decide to become a paleontologist.

**1859** Darwin publishes *The Origin of Species*, outlining his theory of evolution by natural selection.

**1860** Cope (age 19) goes to the Smithsonian, where he publishes thirty-one papers in a single year!

While Cope and Marsh are still friends, Cope names a fish after Marsh: *Ptyonius marshii*.

The first specimen of a feather of *Archaeopteryx* is found.

**1861** The second specimen of *Archaeopteryx* is found. It is virtually complete, and will become known as the "London specimen."

**1863** Marsh studies in Europe. He meets Cope in Berlin.

**1866** Marsh asks his Uncle, George Peabody, if he will endow a museum at Yale. Marsh writes to Silliman at Yale University, saying that his Uncle George Peabody will give \$150,000 for a museum. He also lobbies for a chair of paleontology for himself. The Peabody Museum of Natural History at Yale University is founded.

Cope names his first dinosaur: *Laelaps*. The name is already taken by another animal (preoccupied), so Marsh renames it *Dryptosaurus*.

**1867** Both Cope and Marsh publish papers noting the similarity of dinosaurs to birds. Huxley later picks up on this. They publish again on this subject in 1871.

**1868** Benjamin Waterhouse Hawkins comes to the United States to build a "Paleozoic Museum." He erects a cast of *Hadrosaurus*, the first dinosaur in North America to be free-mounted, assisted by Cope and Leidy. The first real (not a cast) dinosaur skeleton will not be mounted until 1901.

**1869** The American Museum of Natural History is created through the efforts of Albert S. Bickmore and Samuel Tilden.

Marsh exposes the Cardiff Giant hoax, and John Wellesley Powell conquers the Colorado River. Both are headline news features around the world, and cause the federal government to increase funding for surveys of the West.

U. S. Grant is a good friend of General Dodge, the Union Pacific engineer who is also a good friend of Hayden. Two months after Grant is elected president, the Hayden Survey becomes the core of the future United States Geological Survey, with an annual federal budget of \$10,000.

Dinosaur bones are found at Garden Park, Colorado.

**1874** The American Museum begins construction of its building at Central Park West in New York. President Grant lays the cornerstone.

G. M. Dawson collects dinosaur bones from Saskatchewan and Alberta. Cope later publishes these finds. These are the first-discovered Canadian dinosaurs.

**1876** The Peabody Museum of Natural History opens its doors to the public.

**1877** The American Museum opens in New York City.

The first bone from the Morrison area in Colorado is named "*Poicilopleuron*" (later changed to *Poikilopleuron*) by Leidy, on the basis of a partial caudal vertebra collected by the Hayden Survey.

Arthur Lakes (originally from England), a local teacher (and a painter), sends bones that he finds at the Dakota Hogback in Colorado to Marsh, but when he gets no reply, he writes to Cope. When Marsh finds out about the letter to Cope, he sends Benjamin Mudge to Colorado. Marsh outbids Cope. A few weeks later, Marsh is already publishing some results based on this scrappy material! *Atlantosaurus montanus* is based on two and a half caudal vertebrae.

Oramel Lucas (a graduate of Oberlin College and a schoolteacher at Canyon City) sends bones to both Marsh and Cope (at 10 cents per pound), but Cope hires Lucas immediately. Cope names this material *Camarasaurus supremus*.

Marsh hears about Canyon City and sends Mudge and Samuel W. Williston there to dig in the same beds (at \$40 a month). Marsh then sends Williston to Como Bluff, Wyoming, to investigate stories about bones there too, based on letters from two men named Reed and Carlin (who use the pseudonyms "Harlow & Edwards"). Marsh hires Reed and Carlin to dig at Como for \$90 a month. Como Bluff is near the famous Virginian Saloon at Medicine Bow. Reed is a section foreman for the Union Pacific Railroad, and later becomes curator at the University of Wyoming Museum.

On the basis of only samples from Reed and Carlin, Marsh names *Stegosaurus*, *Apatosaurus*, *Allosaurus*, and *Nanosaurus*!

Marsh believes that Como Bluff is 7 million years old, and that sauropods could rear up on their hind legs like kangaroos. Cope is getting better material at Garden Park, Colorado, than Marsh is getting at Morrison, so Mudge asks Marsh to send Williston to Garden Park and abandon Morrison. Williston later goes to Como to check out the stories based on letters by Reed and Carlin. Several hours after Williston arrives, he writes Marsh about a bonebed 7 miles long! Carlin and Frank Williston (S. W. Williston's brother) later sell out and go over to Cope.

The third, and most famous, specimen of *Archaeopteryx* is found. It will become known as the "Berlin specimen."

**1878** Dinosaurs are discovered in the Fosse Sainte-Barbe coal mine near the town of Bernissart in Belgium. Thirty-nine articulated skeletons of

*Iguanodon* are discovered at a depth of 1056 feet. The mine will be closed for three years to allow the dinosaurs to be dug out—with the full cooperation of the management! They will be studied by Louis Dollo for most of the rest of his life. Dollo removes the spike from the dinosaur's nose, where Waterhouse Hawkins had mistakenly placed it, and correctly makes it a thumb spike. He also reconstructs *Iguanodon* as a biped like Leidy's *Hadrosaurus*.

Arthur Lakes arrives at Como Bluff, Wyoming, from Morrison, Colorado.

**1879** Lakes and Reed, at Como Bluff, often feud because Lakes draws maps and pictures and does not dig all the time like Reed. *Stegosaurus* and *Camptosaurus* are found at the newly discovered Quarry 13 at Como Bluff, while "*Brontosaurus*" (today correctly called *Apatosaurus*) is found at Quarries 10 and 11.

**1880s** Marsh rides into a Sioux council meeting (with a few terrified graduate students). He meets Red Cloud, Crazy Horse, Sitting Bull, and Gall. He gives a feast for them, and tells them that he is looking for the "thunder horses" or "ghost horses" (fossils). After the field season, he comes back to their camp to show them his fossils, and to prove to them that he was not collecting gold. Red Cloud trusts him ever after. Later Marsh and his friends at the New York *Herald* blow the whistle on the corruption in the Bureau of Indian Affairs. Red Cloud comes to Yale, and even addresses Congress!

**1881** Reed's brother is killed while swimming in the Little Medicine Bow River. Marsh sends \$100 for burial costs. Reed begins to lose interest in digging dinosaurs.

G. M. Dawson and R. G. McConnell find dinosaur bones on the Red Deer River and near Lethbridge, both in Alberta, Canada.

Richard Owen opens the British Museum (Natural History) in South Kensington, London, after many years of lobbying the British government and Queen Victoria.

**1882** A fully mounted skeleton of *Iguanodon* is completed at Bernissart. Marsh publishes his classification of the dinosaurs. It is the first classification, and forms the early basis of the modern classification.

Marsh is appointed the official vertebrate paleontologist of the U.S. Geological Survey. He is given about \$15,000 per year in salary, plus money for thirty-five collectors, nine preparators, eight assistants, and freight charges for shipping fossils back from the field.

**1883** Reed resigns at Como Bluff, and a man named Kenny takes over until 1885. Fred Brown then runs the operation until 1889, when all work at Como Bluff stops.

Felch finds the first nearly complete skeletons of *Allosaurus* and *Ceratops* at Canyon City, Colorado.

Marsh spends both government money and his own money on the excavations at Garden Park.

**1884** J. B. Tyrrell finds "*Laelaps*" (Cope) in western Canada, a dinosaur which is later named *Albertosaurus sarcophagus* by Osborn.

Upon his retirement, Richard Owen is knighted by Queen Victoria.

**1886** Marsh's field crews at Canyon City, led by Felch, discover the first complete *Stegosaurus stenops*. It has an uncrushed skull and shows that the dorsal armor plates were held in a series of alternating plates in two rows. The skeleton will wind up at the Smithsonian Institution, displayed as it

was found in the field (hence earning the nickname “the roadkill”). This will be the most complete specimen of *Stegosaurus* known until 1992.

**1887** H. G. Seeley names the two orders of dinosaurs, the Ornithischia and Saurischia, on the basis of features in the pelvis.

**1888** Dinosaur bones found only miles away from Pliny Moody’s farm in Connecticut are labeled a “giant killed in Noah’s Flood.”

T. C. Weston reports large numbers of dinosaur bones along the Red Deer River in Alberta, and collects another *Albertosaurus* skull from the Edmonton Formation.

Marsh names the first of the horned dinosaurs, “*Bison*” *alticornus*, on the basis of a pair of horns from the Denver Formation in Colorado. This will later become part of *Triceratops*.

**1889** Cope is ordered to turn all his fossils from the Hayden Survey over to the government. He thinks they will all wind up at Yale because Marsh is the official paleontologist of the U.S. Geological Survey. Cope calls the New York *Herald* and “blows the whistle” on Marsh, making many accusations. Not all of his charges are substantiated, and some are false, but Cope’s actions set off a national scandal. Marsh replies in the same newspaper one week later.

T. C. Weston finds many skeletons along the Red Deer River.

John Bell Hatcher, who works for Marsh, begins his legendary collecting of *Triceratops* in the Lance Creek Formation of Wyoming.

**1890** On January 12, 1890, Cope charges Marsh with collusion with John W. Powell and the U.S. Geological Survey. On January 19, Marsh, in response to Cope’s charges in the New York *Herald*, fills an entire page of the newspaper with an account of Cope’s professional blunders, and attributes all of Cope’s accusations against him to envy.

Two young paleontologists, H. F. Osborn and W. B. Scott, go to Yale to see fossils. Marsh thinks they are spies for Cope, so he hides the good stuff and has a student show them only mediocre material. Marsh hides behind crates, giving hand signals to his technician to guide the visitors through the collections without letting them see any good fossils.

In October, Osborn joins the staff of the American Museum in New York. Initially he draws no salary and he pays the AMNH \$1,500 to do field work!

**1890s** J. B. Hatcher’s brother-in-law is Oscar A. Peterson! They both move from Princeton to the Carnegie Museum in Pittsburgh in 1899. Elmer Riggs is William Berryman Scott’s student!

G. Jepsen is Sinclair’s student.

C. H. Sternberg invents the Rice-goo-and-burlap bandage for fossils. Marsh uses plaster of paris as a bandage.

George Baur says that *Ceratosaurus* has a pathological fusion of the metatarsals. This was known to Marsh, but he deliberately didn’t mention it, and instead describes the condition in *Ceratosaurus* as normal fusion of the bones, in order to justify the dinosaur’s unique nature and make it closer to birds in morphology. Baur’s statement is one of the first citations of paleopathology in the literature before the work of Moodie.

**1891** Osborn starts work at the American Museum and founds its Department of Vertebrate Paleontology; he also has an appointment at Columbia University. Williston recommends his star student, Barnum Brown, for a job at the American Museum; Brown will become the greatest dinosaur field collector of the twentieth century. Cope similarly recommends Jacob Wortman. Walter Granger starts work for the museum as a taxidermist!

**1893** Religious fundamentalists and an Arizona senator get funding cut off to the U.S. Geological Survey for doing "silly research on birds with teeth." Marsh has to resign from the survey and give up fossil material collected under its aegis to the United States National Museum (Smithsonian).

Osborn pioneers the modern museum concept by selling postcards and photos, using free-mounts instead of wall-mounts and bare glass cases. He hires Charles Knight (in 1897) and E. Christman to do accurate artwork of prehistoric animals for scientific papers and the popular galleries.

W. B. Scott of Princeton University hires the legendary collector J. B. Hatcher away from Yale University.

**1896** The Carnegie Museum of Natural History is founded in Pittsburgh.

**1897** Charles Knight paints *Laelaps (Dryptosaurus)* in the "fighting cock" pose, a painting that becomes famous as the first to depict dinosaurs as fully "warm-blooded."

Lawrence Lambe starts collecting dinosaurs along the Red Deer River. This is the first systematic collection of dinosaurs by a vertebrate paleontologist in Canada.

Brown, Granger, and Wortman of the American Museum of Natural History in New York explore the Medicine Bow area of Wyoming. They decide to explore the next day "by that cabin on the hill." As they approach it, they realize that it is made from bones! The surrounding area becomes the site of the famous Bone Cabin Quarry, and it yields 490 specimens of Morrison dinosaurs.

**1898** Excavations begin at Bone Cabin Quarry.

**1900** Hatcher and Utterback reopen the Marsh quarries at Garden Park, Colorado.

*Brachiosaurus* is found at Grand Junction, Colorado, by Elmer Riggs of the Field Museum in Chicago.

H. F. Osborn and museum director H. C. Bumpus of the American Museum establish the *American Museum Journal*, which will later become the magazine *Natural History*. This is the first museum journal for natural history aimed at public education. Osborn and Bumpus also establish guidebooks and leaflets for their exhibits.

**1901** Beecher at Yale University's Peabody Museum of Natural History mounts *Edmontosaurus* (then called "*Claosaurus annectens*") in a fully erect, bipedal stance, posed in full run. This again shows dinosaurs as very active animals, and is the first skeleton of real dinosaur bone to be mounted in the Western Hemisphere.

**1902** Barnum Brown discovers the first *Tyrannosaurus rex* skeleton in the Hell Creek area of Montana. This specimen becomes the type of the species and is later traded to the Carnegie Museum in Pittsburgh, where it is now on exhibit.

Lawrence Lambe publishes the results of his Red Deer River collections.

J. P. Morgan commissions Charles Knight to paint murals at the American Museum depicting ancient life.

**1903** Charles Whitney Gilmore joins the staff of the Smithsonian Institution.

Elmer Riggs of the Field Museum in Chicago officially establishes the name *Apatosaurus* as the correct name for "*Brontosaurus*."

**1905** The American Museum mounts the first "*Brontosaurus*" skeleton

in history. Although the name "*Brontosaurus*" was discarded in favor of the more correct name *Apatosaurus* two years earlier, the museum labels will not be corrected for decades.

The Carnegie Museum distributes casts of its famous *Diplodocus* skeleton to various museums all over the world. The first one mounted is for the British Museum in London. It causes a sensation all over the Western world, and results in fifty scientific papers. *Diplodocus* becomes the most famous dinosaur until "dethroned" by *Tyrannosaurus*.

**1906** H. F. Osborn is offered the job of secretary of the Smithsonian Institution, but he rejects it. Osborn's friend and benefactor J. P. Morgan establishes a fund for vertebrate paleontology at the American Museum. Morgan also contributes to the purchase of the Cope Collection.

**1907** Eberhard Fraas of the Stuttgart Museum collects at Tendaguru in Tanzania (then known as Tanganyika).

The skeleton of an *Allosaurus* feeding on the carcass of an *Apatosaurus* is mounted at the American Museum.

**1908** Barnum Brown collects a third (and fairly complete) *T. rex* skeleton in the Hell Creek area. This specimen will be put on exhibit in New York, and will become the most famous mount of all the dinosaurs.

H. F. Osborn becomes president of the American Museum.

C. H. Sternberg finds the famous "duckbill mummy" (now referred to *Edmontosaurus*). The specimen is on display at the American Museum.

**1909** A rancher in Alberta tells Barnum Brown about the many dinosaurs on his ranch on the Red Deer River.

On August 17, Earl Douglass, who works for the Carnegie Museum, finds articulated *Apatosaurus* dorsals at Split Mountain, north of Jensen, Utah. This very same *Apatosaurus* is now on display in the Carnegie Museum. It takes Douglass and his helpers six years to get the skeleton out of the rock and mount it at the Carnegie. It takes seven years to excavate the west half of the quarry, and six more years to do the east half. Douglass works the quarry for Carnegie from 1909 to 1922. He then spends two years working it for the University of Utah and the Smithsonian Institution. The Smithsonian's mounted *Diplodocus* is collected during this time. These excavations touch only the top and sides of the famous hogback ridge where the quarry face of Dinosaur National Monument is now situated. The present quarry and visitor's center covers only the middle-lower-central part. Famous workers in the "golden age" at the quarry are Earl Douglass, J. Leroy Kaye, Golden York, Jacob Kay, and George Goodrich (the bearded gentleman seen in an oft-reproduced photograph of the site). Beginning in the 1950s, legendary preparators Tobe Wilkins and Jim Adams worked at the monument with paleontologist Ted White, followed by Russell King in the 1970s, and Dan Chure from the 1980s to the present time.

**1910** From 1910 until 1917, Barnum Brown collects along the Red Deer River, with very friendly "competition" from the Sternbergs. They all get excellent skeletons and help each other.

The American Museum mounts the first skeleton of *Tyrannosaurus rex*. Photographs of this mount will appear in countless dinosaur books. The skeleton will be remounted, to reflect modern thinking about the dinosaur's stance, in the 1990s.

**1912** The work at Tendaguru comes to an end.

**1915** On October 4, President Woodrow Wilson declares the Earl Doug-

lass Quarry (80 acres) as Dinosaur National Monument. This is also intended to keep it free from homesteaders and mining operations.

**1916** The British ship *Mt. Temple* is sunk by a German U-boat. Part of the cargo was two specimens of *Corythosaurus* that had been collected by Charles Sternberg.

**1917** Yale's old Peabody Museum of Natural History is demolished to make way for a new building.

**1919** The most complete sauropod ever found, a juvenile *Camarasaurus*, is collected for the Carnegie Museum at Dinosaur National Monument.

**1921** The Museum of Paleontology at the University of California, Berkeley, is founded. It will become a major center for research and will produce some of the most famous vertebrate paleontologists.

**1922** The American Museum starts its Central Asiatic Expeditions in Mongolia and the Gobi Desert. The expedition is led by Roy Chapman Andrews.

**1923** The American Museum's Gobi Expedition finds *Protoceratops* and the first dinosaur nests at the Flaming Cliffs. They also find the first skull of *Velociraptor*.

**1924** Osborn names *Velociraptor* and many other dinosaurs found in Mongolia by the American Museum expeditions.

**1925** This is the last year the American Museum will find dinosaurs in the Gobi Desert (until operations resume some sixty years later).

The present building of the Peabody Museum of Natural History opens to the public.

**1927** C. C. Young (Yang Zhong-jian) becomes China's first professional vertebrate paleontologist.

The Cleveland-Lloyd dinosaur quarry in Utah is found. It is one of the largest Jurassic predator traps known, and contains the remains of numerous individuals of *Allosaurus*.

W. D. Matthew founds the Department of Paleontology at the University of California, Berkeley. It is the only separate university department in the world devoted to paleontology.

**1929** The first center for vertebrate paleontology in China is founded by C. C. Young.

Carl Wiman describes the first Chinese sauropod, *Euhelopus* (originally *Helopus*).

The first dinosaur footprint is excavated in Shanxi Province, China.

**1932** The Howe Quarry (containing the skeletons of several Morrison Formation dinosaurs) is discovered on Barker Howe's Ranch near Shell, Wyoming, during a visit by Barnum Brown.

**1934** The American Museum of Natural History in New York begins excavations at the Howe Quarry.

**1935** H. F. Osborn dies.

**1938** R. T. Bird of the American Museum learns of Cretaceous dinosaur footprint sites in the bed of the Paluxy River near Glen Rose, Texas.

**1940** The Society of Vertebrate Paleontology is founded by A. S. Romer. There are approximately forty members. The first meeting is held at Harvard University.

**1941** Barnum Brown retires from the American Museum in New York, but continues to work. He is the greatest collector of dinosaurs of all time, and was employed by the museum for sixty-six years.

**1942** Rudolf Zallinger begins the *Age of Reptiles* mural at the Yale Peabody Museum.

*Dilophosaurus* and what will later be named *Nanotyrannus* are found.

**1943** Raymond Cowles proposes that dinosaurs became extinct as a result of overheating. Cowles was a student of Charles Bogert, and helped Bogert and Colbert with an influential early paper on dinosaur physiology.

Allied bombers destroy the type of "*Dysalatosaurus*" *lettow-verbecki* in the Humboldt Museum in Berlin.

**1944** G. G. Simpson publishes the first textbook to integrate the new "Synthetic Theory" of evolution and vertebrate paleontology.

Allied bombers destroy the types of *Aegyptosaurus*, *Carcharodontosaurus*, *Bahariasaurus*, and *Spinosaurus*. They were housed in the Bavarian State Museum in Munich, Germany.

**1947** George Whitaker and E. H. Colbert discover *Coelophysis* at the famous Ghost Ranch Quarry in New Mexico. This is the largest mass accumulation of well-preserved theropod skeletons anywhere in the world.

Rudolf Zallinger completes the *Age of Reptiles* mural at the Yale Peabody Museum.

**1948** The two most famous skeletons of *Coelophysis* are found at Ghost Ranch by George Whitaker and Carl Sorenson of the American Museum. These skeletons have juveniles inside them, indicating that this species was cannibalistic.

*Tarbosaurus* is found by J. Eaglon of the Soviet Union.

**1949** Glen Jepsen, Ernst Mayr, and G. G. Simpson publish the second textbook for paleontologists to integrate vertebrate paleontology and evolutionary theory.

Rudolf Zallinger wins the Pulitzer Prize for his 110-foot dinosaur mural at the Yale Peabody Museum.

**1951** The first Chinese-only dinosaur expedition is inaugurated. Its members find new taxa and vast fossil deposits in the Shantung area.

The fourth specimen of *Archaeopteryx* is found.

**1953** The Jurassic hall of dinosaurs is reopened at the American Museum.

China starts the world's first journal devoted exclusively to vertebrate paleontology, *Vertebrata Palasiatica*. The Institute of Vertebrate Paleontology and Paleoanthropology is founded by C. C. Young (Yang Zhong-jian).

**1956** The fifth, or "Maxberg," specimen of *Archaeopteryx* is found.

M. W. De Laubenfels publishes a paper in the *Journal of Paleontology* hypothesizing that the dinosaurs became extinct as the result of an asteroid impact.

**1957** Enlow and Brown find Haversian Systems in dinosaur bone. This will later be used as evidence that dinosaurs were "warm-blooded."

**1958** The first dinosaur postage stamp is issued by China. It features *Lufengosaurus*.

**1959** Paleontologist Osvaldo Reig and a goat-herder named Victorino Herrera discover the second oldest dinosaur, *Herrerasaurus*, in Argentina.

**1961** Geologists from Shell Oil discover hadrosaur bones in the Colville River area of the North Slope of Alaska.

**1962** Petrified Forest National Park is created. It holds many famous Triassic fossils.

Dong Zhiming joins the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, China.

**1965** Philip Taquet begins work in Niger and discovers new dinosaurs such as *Ouranosaurus*.

**1967** The Cleveland-Lloyd dinosaur quarry in Utah is declared a National Natural Landmark.

**1969** John H. Ostrom (a former student of Colbert) says that dinosaurs may have been warm-blooded, and therefore are not good indicators of Mesozoic climate. Ostrom publishes a description of *Deinonychus*.

**1972** Jim Jensen of Brigham Young University finds the Dry Mesa Quarry in Utah. It produces some of the best sauropod material in the world, and later becomes famous when "*Supersaurus*" and "*Ultrasauros*" are named.

**1974** R. T. Bakker and P. M. Galton reunite the Saurischia and Ornithischia by resurrecting the Dinosauria as an official taxon.

**1975** *Scientific American* publishes an article by Robert T. Bakker called "Dinosaur Renaissance," summarizing Bakker's ideas about dinosaur endothermy. This sparks a new era of dinosaur paleontology.

**1976** J. O. Farlow and two engineers publish an experimental study speculating that the bony plates of *Stegosaurus* functioned as thermoregulatory devices.

**1977** Colbert's Ghost Ranch *Coelophysis* quarry is designated a National Landmark.

**1979** Dinosaur Provincial Park in Alberta (the area where Brown and the Sternbergs collected many beautiful Late Cretaceous dinosaur skeletons) is designated a UNESCO World Heritage Site.

The Dashanpu Quarries are discovered in Zigong, China. These constitute the richest Middle Jurassic dinosaur site in the world.

**1980** The American Association for the Advancement of Science publishes a symposium volume entitled *A Cold Look at the Warm-Blooded Dinosaurs*, edited by R. D. K. Thomas and E. C. Olson, that critically evaluates the idea of dinosaur endothermy.

Nobel Laureate Luis Alvarez and others publish a paper hypothesizing that an asteroid impact caused the extinctions at the end of the Cretaceous.

**1982** *Stegosaurus stenops* is named the state fossil of Colorado.

**1984** The first dinosaur-only art show takes place in Boston.

**1985** The Tyrrell Museum of Palaeontology in Drumheller, Alberta, opens on September 25, with Philip Currie as head of dinosaur research.

**1986** A Sino-Canadian agreement is reached that calls for a five-year plan to excavate dinosaurs in both countries, and for exploration and training of paleontologists.

The first symposium devoted exclusively to dinosaur systematics is held at the Tyrrell Museum of Palaeontology in Alberta. The results are published in a symposium volume in 1990, edited by Kenneth Carpenter and Philip Currie.

The first symposium dealing with the study of dinosaur trace fossils is held at the New Mexico Museum of Natural History in Albuquerque; papers from this symposium will be published in 1989, edited by David D. Gillette and Martin G. Lockley.

Paul Sereno and Jacques Gauthier publish landmark papers on the cladistic classification of the Ornithischia and the Saurischia, respectively.

John R. Horner becomes the first paleontologist to receive the coveted McArthur Foundation Award, for his work on dinosaur nesting behavior.

**1987** "Dinosaurs Past and Present" is the first international art show to tour the world, showcasing the best dinosaur art from the world's leading paleontological artists.

The Zigong Dinosaur Museum opens. It is the first museum in Asia devoted just to dinosaurs.

The sixth specimen of *Archaeopteryx* is found.

**1988** Paul Sereno discovers a complete skull and skeleton of *Herrerasaurus*.

**1989** The Department of Paleontology at the University of California, Berkeley, merges with the Biology Department to become the Department of Integrative Biology. The Paleontology Department had been the only separate department devoted to paleontology in the whole history of academe.

Robert Gaston finds a quarry of dinosaur fossils in Utah. From this pit will come *Utahraptor* and a new genus of nodosaurid.

Kevin Pope and Charles Duller of NASA discover the Chicxulub Sinkholes in Mexico. Later, Adriana Ocampo recognizes that the site has the classic characteristics of an impact site.

**1990** The Black Hills Institute finds the largest known skull and skeleton to date of *T. rex*. They nickname it "Sue" after its discoverer, Susan Hendrickson.

The first book on dinosaurs for professional paleontologists, *The Dinosauria*, edited by David Weishampel, Peter Dodson, and Halszka Osmólska, is published.

**1991** *Eoraptor* is discovered by Ricardo Martinez in Argentina.

*Utahraptor* is found by Jim Kirkland in Utah.

*Hadrosaurus foulkii* is named the official state fossil of New Jersey.

The Denver Museum of Natural History starts its "parapaleontologist" program to train amateurs in the skills of finding and collecting fossils.

**1992** The seventh specimen of *Archaeopteryx* is found.

Bryan Small of the Denver Museum of Natural History finds the most complete specimen of *Stegosaurus stenops* yet discovered at Canyon City. This specimen verifies Gilmore's interpretation, based on the Smithsonian's "roadkill" specimen, that the plates were held in two alternating rows.

An embryonic *Camptosaurus* is discovered at Dinosaur National Monument.

**1993** The American Museum of Natural History finds more than 13 troodontid skeletons, 147 mammals, and 175 mammals at Ukhaa-Tolgod, Gobi Desert. Also found is an *Oviraptor* nest with an adult in the brooding position, but this find is not announced to the public until 1995. There are also more than 100 uncollected dinosaur specimens. This is one of the greatest Cretaceous finds in history.

Mrs. Lin Spearpoint of the Isle Of Wight, England, finds the most complete skeleton of *Polacanthus* ever found.

The movie *Jurassic Park* is released. It is the first movie in decades that pictures dinosaurs as animals, not “monsters.” Using a new level of special effects, it becomes the top moneymaking movie of all time.

Paul Sereno names *Eoraptor* as the “first” dinosaur, and Jim Kirkland names *Utahraptor*.

The Smithsonian Institution sends out its first Dinosaur Expedition since 1938, to Shell, Wyoming. It is led by Drs. M. K. Brett-Surman and Nicholas Hotton III.

**1994** The first *T. rex* skeleton in Saskatchewan is found by Robert Gebhardt.

Wyoming chooses *Triceratops* as its state fossil.

The American Museum Expedition in Mongolia discovers that the eggs long attributed to *Protoceratops* actually belong to *Oviraptor*.

The first textbook about dinosaur eggs and babies appears.

William E. Swinton, author (in 1970) of the first dinosaur textbook, dies.

The *Hadrosaurus foulkii* quarry in Haddonfield, New Jersey, is designated a National Historical Landmark.

**1995** The largest theropod dinosaur yet found, *Giganotosaurus* from Argentina, is described.

Mesozoic bird taxonomy is revised, and many new genera are described.

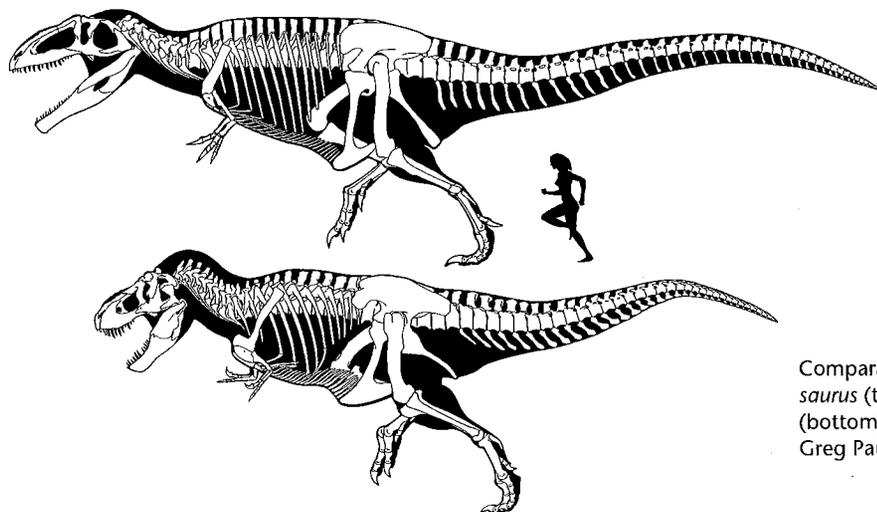
Many new Cretaceous dinosaurs are announced from Utah and Africa from stages that were previously sparsely represented.

The trial of the owners of the Black Hills Institute for Geological Research is concluded. The individuals had been prosecuted for alleged improprieties in the collection of the *Tyrannosaurus* specimen known as Sue. Many find the whole affair unpalatable.

**1996** Paul Sereno reveals the skull of an African theropod, *Carcharodontosaurus*, that rivals that of *Tyrannosaurus* in size.

The Cleveland-Lloyd Quarry in Utah is ransacked, and valuable fossils are stolen.

The earliest fossils of the family Tyrannosauridae are found in Thailand by French paleontologists.



Comparative sizes of *Giganotosaurus* (top) and *Tyrannosaurus* (bottom). Drawing © 1997 by Greg Paul.

New kinds of dinosaurs and birds are found in Madagascar.

Reports of a feathered dinosaur related to *Compsognathus* cause a sensation at the meeting of the Society of Vertebrate Paleontology at the American Museum.

**1997** A team of paleontologists and ornithologists visit China to examine the allegedly feathered theropod *Sinosauropteryx*. They confirm that the dinosaur is a compsognathid. However, they find no compelling evidence that the structures running along the dinosaur's back and the top and bottom edges of its tail are feathers. Controversy over the specimen continues.

## Part 2: The Ages of Dinosaur Paleontology

To summarize the preceding chronology in a more concise fashion, dinosaur paleontology can be divided, somewhat arbitrarily, into four distinct "ages." These ages are based on key events that started the field in new directions, whether through the direct progress of paleontologists or by happenstance.

**I. The Heroic Period (1820–1899)** Individual effort marks this period, characterized by the first "scientific publications" on a massive scale. Paleontology becomes its own science distinct from "natural history."

**II. The Classical Period (1899–1929)** (from the death of Marsh to the stock market crash) Museum efforts dominate vertebrate paleontology. Individuals can no longer afford to fund entire expeditions, and museums also need to hire specialists for specimen preparation and the construction of exhibits. Only institutions as large as museums can afford full dinosaur collecting and research programs. Museums go mainly for exhibit specimens as one of their primary goals in the field, followed by the collection of research specimens. Henry Fairfield Osborn leads the trend toward establishing specialties in collections management, field work, preparation, traveling exhibits, and adult education.

**III. The Modern Age (1933–1969)** (from the end of the "Great Depression" to Ostrom's landmark paper on the inappropriate use of dinosaurs as Mesozoic climate indicators) Macroevolution, Neo-Darwinism, plate tectonics, functional morphology, and radiometric dating become the leading scientific unifying concepts for paleontologists. University dominance of paleontology characterizes this age, as museum budgets drop as a result of the Great Depression. There is a transitional period to the next age, 1969–1975, when professionals rethink dinosaur physiology, but the public is not yet generally aware of the changes.

**IV. The Renaissance (1975–)** This age begins with Bakker's *Scientific American* article. Cladistics, paleoecology, computer-based multi-morphometric programs, eclectic/multidisciplinary theorizing, CT scanning, and a great increase in field work (with the highest rate of new genera being found) define this age. The public now embraces dinosaurs as "endothermic," but paleontologists and other scientists continue the debate. Professional dinosaur paleontologists also start to actively write for the public.