



"May be next time when you go for pilgrimage along the mighty rivers of Narmada or Godawari, be careful, you may stumble with a fossil of Indian dinosaur."

Science and fiction both played important role in imparting interest and excitement about extinct **world of dinosaurs**. Movies like *Jurassic Park*, *The Lost world* and *Jurassic Park III* by the eminent author Michael Crichton and movie director Steven Spielberg helped us to visualize the world of Dinosaurs. These are excellent pieces of fiction but not the real science. Though they took help of palaeontologists such as Robert T. Bakker and Jack Horner to create near real dinosaurs, but the fiction was prevailed over science. For example, no *Stegosaurus* or *Apatosaurus* (Brontosaurus) could see the *Tyrannosaurus rex* as by the time *T. rex* appeared (about 80 million years ago) their bones were well fossilized or *T. rex* supposedly running at about 50 mph etc. Here we will talk about something which is purely science about the dinosaurs. We will mainly explore the world of **INDIAN DINOSAURS** – their appearance, evolution, and extinction. The environment and geographic settings, where they lived and died, associated plants and animals and about the geologic timeline. May be next time when you go for pilgrimage along the mighty rivers of Narmada or Godawari, be careful, you may stumble with a fossil of Indian dinosaur.

Before entering into the mysterious world of dinosaurs, we will discuss the geological time scale since we would be referring these terms quite frequently. The 4,570 million years old Earth witnessed the appearance of dinosaurs during Mesozoic Era. The Mesozoic Era (245 to 65 million years) is the time between two mass extinctions, when nearly two third of the biological world destroyed. The **Permian extinction** marked the end of Paleozoic Era when a palaeontologist described 'the day when Earth nearly died and the beginning of the Mesozoic Era. Among the survivors were the thecodonts which, within a span of 30 m.y., gave rise to the first dinosaurs. Mesozoic is divided into three periods-Triassic (245-208 Ma), Jurassic (208-146 Ma) and Cretaceous (146-65Ma). The Cretaceous Period ended with another mass extinction, which eliminated these giant reptiles from the earth.

Discovery of Dinosaurs

Now, we will take a tour to know the interesting history of discovery of these most spectacular animals of any age. William Buckland, an Oxford naturalist, obtained some teeth and the lower jaw of a giant carnivorous reptile near the university in 1818. The specimen was named by James Perkinson as *Megalosaurus* (great lizard) in 1822. This is the first dinosaur named. Few years later, Gideon Mantell, a physician, described an herbivorous named *Iguanodon* (iguana-tooth), discovered by his wife Mary Ann from gravel pile from the roadside in Brighton, England. In 1833, Mantell described another herbivorous-*Hylaeosaurus* (woodland lizard) from Sussex, England. And then, number of fossils of this

giant reptile was unearthed at several parts of England. It created a worldwide sensation. In 1836 Edward Hitchcock reported on the discovery of what he believed to be the tracks of giant birds. The largest of these earliest footprint finds was a magnificent natural cast of a three toed track, he named *Orinithichnites giganteus* from what is now the north side of Holyoke, Massachusetts on the east bank of Connecticut River - at the still accessible Dinosaur Footprint Preserve. Later this track was renamed *Eubrontes giganteus*. It was the first dinosaur track to be described anywhere.

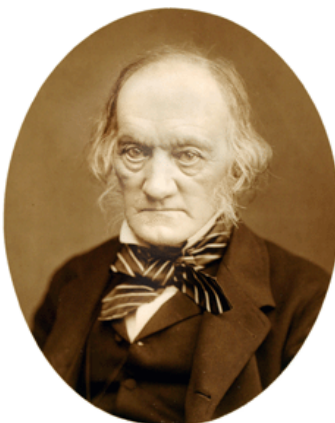


Mary Ann



Edward Hitchcock

Sir Richard Owen (1804 - 1892) was a comparative anatomist and founder of the British Museum of Natural History in London. Both Mantell and Buckland communicated with Owen and Owen developed a great interest in their discoveries. In 1842, Owen delivered a lecture to the Geological Society of London and put *Iguanodon*, *Megalosaurus*, and *Hylaeosaurus* in a group he named the **Dinosauria (=terrible lizards)**. Owen realized that dinosaurs were fully terrestrial, extinct, and completely distinct from other known large reptiles, such as crocodiles, plesiosaurs and mosasaurs.



Sir Richard Owen



**British Museum of Natural History, London
(Indian section)**

In North America, though the dinosaur bones and footprints were discovered before British discovery but were misidentified. It was in 1858, when Joseph Leidy described a complete

skeleton of a duck-billed dinosaur from New Jersey. It was now the turn of Americans to look for Dinosaurs. A schoolteacher Aurther Lakes, in 1870, struck the treasury of dinosaur bones at the foothill of the Rocky Mountain, Colorado. Palaeontologists Charles Marsh, New Haven and Edward Drinker Cope, Philadelphia, studied these samples, organized expeditions and mobilized workers for extensive studies. Now all over the world there was the grate rush to discover these fossils. Africa, China, India, Mongolia, Argentina, Canada, Australia and even Antarctica proved to be bearing Dinosaur fossils. It was called **“Golden period of discovery of Dinosaurs”**.

Who were Dinosaurs?

Dinosaurs are archosaurian reptiles that walked with their legs directly under the body. They did not sprawl with their tails dragging behind them, and they did not habitually swim. The erect posture was the hallmark of early dinosaurs. To attain erect posture, all dinosaurs acquired certain anatomical traits. Their hip socket was hollow to position the thigh bone vertically. Two lower hip bones, the pubis and ischium, became long and slender for powerful muscle attachment. The ankle joint was a simple hinge to facilitate up and down movement of the foot. Dinosaurs walked on their toes, raising the heel permanently from the ground. This refined posture supported the body more efficiently on the ground and provided quick advances in speed and size. Some dinosaurs became bipedal and swift runners, as they attained balance and coordination. Others became quadrupedal, distributing their weight on four legs like vertical pillars. Contemporary reptiles did not inherit this kind of sophisticated locomotion. Their posture was sprawling like lizards and alligators. They walked flat-footed and their movement was slow and sluggish. Locomotory refinement of early dinosaurs was key to their success, and gave them a competitive edge over other reptiles. Their large size is, of course, one of their striking features, and indeed, some grew as large as a great whale. Yet, there were also dinosaurs no bigger than a chicken. New evidence indicates that many dinosaurs were actually agile, fast moving, and even social. Some parents took tender care of their babies and guarded them from intruders. Some small theropods were arboreal and intelligent; they began parachuting and gliding from treetops to become birds.

The dinosaurs have traditionally been classified into two distinct taxonomic classes, the saurischia (lizard-hipped) and ornithischia (bird-hipped). This divergence was accomplished by the close of the Triassic. The ancestors of dinosaurs were some unspecified thecodont earlier in the Triassic. The Saurischia, which includes *Dilophosaurus* and *Coelophysis*, has two main groups, the theropods and the sauropods. The theropods were bipedal carnivores that included the famous *Velociraptor* and *Tyrannosaurus rex* as well as birds. Sauropods and similar forms were quadrupedal, mostly herbivorous forms that include the giants of the Jurassic: *Apatosaurus*, *Diplodocus*, and *Brachiosaurus*. The recently discovered Arizona dinosaur *Sonorasaurus* belongs in this group as well. Ornithischians were all herbivorous, with some retaining a bipedal gait, and others returning to four legs, and included: the ornithopods (such as *Trachodon* and *Maiasaurus*), ceratopsians (such as *Triceratops*), and the stegosaurians (including *Stegosaurus* and *Ankylosaurus*). Mammals also evolved during the Triassic, at about the same time as the dinosaurs. However, Triassic mammals were small and inconsequential components of the Triassic ecosystems. Notice that most dinosaur names are taken from Greek and Latin. These are scientific names, and they describe the animals. For example, *Tyrannosaurus rex* means “tyrant reptile king”, and *Brontosaurus* means “thunder reptile”.

Saurischia:

Theropoda:

Carnosauria
Coelurosauria
Deinonychosauria
Ornithomimosauria
Segnosauria

Sauropodomorpha:

Prosauropoda
Sauropoda

Ornithischia:

Ornithopoda
Pachycephalosauria
Stegosauria
Ankylosauria
Ceratopsia

Dinosaur life spans probably varied in length from tens of years to hundreds of years. Most scientific estimates are between 50 and 300 years. The smallest dinosaurs were just slightly larger than a chicken. Compsognathus was 1 m (3 ft) long and weighed about 2.5 kg (about 6.5 lb). The largest complete dinosaur we know was Brachiosaurus. It was 23 m in length and 12 m in height (about the length of two large school buses and the height of a four-story building). Dinosaurs most likely communicated both vocally and visually. Some dinosaurs such as Parasaurolophus and Corythosaurus had chambered headcrests which could have been used to amplify grunts or bellows. Although definite skin color is unknown, paleontologists think that some dinosaurs likely had protective coloration, such as pale undersides to reduce shadows, irregular color patterns ("camouflage") to make them less visible in vegetation, and so on. Those dinosaurs that had enough armor, such as the stegosaurs and ceratopsians, may not have needed protective coloration, and may have been brightly colored as a warning to predators. Most believe dinosaurs probably were most likely brightly colored as modern lizards, snakes, or birds. The earliest dinosaurs were carnivorous like their ancestors and herbivorous dinosaurs evolved later. The largest dinosaurs were herbivorous who were thirty times more than carnivorous dinosaurs.

Indian Dinosaur

In India Dinosaur bones were first reported from Jabalpur Cantonment (Madhya Pradesh) by Captain W.H. Sleeman in year 1828. This discovery was just four years after the discovery of *Megalosaurus* by Buckland. Some of his collections were kept at the British Museum, London, and helped Sir Owen to erect "Dinosauria". However, first systematic study of Indian Dinosaurs was by Lydekker (in 1877, *Titanosaurus*). His work was continued by Mather between 1921 and 1933 after nearly four decades. British explorers also discovered dinosaur remains from Cretaceous lake deposits of Dongargaon-Pisdura area, south of Nagpur. Following him, little happened until the early 1960's. Later, workers from the Indian Statistical Institute and Geological Survey of India described Titanosaurid bones and fossil dung. Most occurrences are in central and southern India.



Triassic deposits include the Maleri Formation, which has yielded temnospondyls, rhynchosaurs, phytosaurs, cynodonts and the small theropod *Alwalkeria*, and the Dharmaram Formation which contains several unidentified dinosaurs including 2 prosauropods. Early Jurassic remains are confined largely to the Kota Formation. As well as crossopterygians, pterosaurs, teleosaurids and symmetrodonts it contains a possible ornithopod and 2 sauropods, *Barapasaurus* and *Kotasaurus*. The most diverse and best known Indian fossils are from the Cretaceous, mainly from the late Maastrichtian Lameta Formation. It is dominated by sauropods (*Titanosaurus*, *Jainosaurus*, *Laplatasaurus* and many titanosaurid eggs) and theropods (*Indosuchus*, *Indosaurus*, *Compsosuchus*, *Jubbulpuria*, *Laavisuchus*, *Dryptosauroides*, *Coeluroides* and *Ornithomimoides*) with a few ornithischians (*Lametasaurus* and *Brachypodosaurus*). The creature, whose fossilised bones were scattered along the Narmada River in the western state of Gujarat, has been named *Rajasaurus narmadensis*, or the regal reptile from Narmada. The age of the bones mean *Rajasaurus* was a contemporary of *Tyrannosaurus rex* and therefore one of the last species to live before the dinosaurs were wiped out. The scientists believe the *Rajasaurus* is related to a family of large carnivorous dinosaurs, most of which had horns, that roamed the Southern Hemisphere land masses of present Madagascar, Africa, and South America.

An Indian born scholar and pioneer Prof. Shankar Chatterjee, Texas Tech University, USA, extensively explored and studied dinosaur fossils of India, China, Europe, Antarctica and America. Born in Calcutta (1943) and postgraduate from Jadavpur University and Ph.D. from Calcutta University, he discovered world's first full skeleton of the short-legged, beaked *rhynchosaurus* from Godawari valley, India in 1974. Prof. Chatterjee made a major discovery when he found *Protoavis texensis* (the first bird from Texas), the world's oldest known bird species considered to be the ancestor to modern birds. *Protoavis* looked half-dinosaur, half-bird, reinforcing the hypothesis that birds evolved from dinosaurs.

About the Author

Dr. Satish C. Tripathi is a senior geologist with the Geological Survey of India, Lucknow. He has extensively studied dinosaur fossil bearing Cretaceous rock formations of Narmada valley on account of their geology, environment of deposition and environment at the end of Cretaceous when Dinosaurs died.

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