

# TIME WALK - PART III

## TRIASSIC PARK - DINOSAURS OF YORK AND ADAMS COUNTIES, PENNSYLVANIA

**WHAT IS TIME WALK?** TIME WALK is a series of 30-minute videos that looks at different aspects of the geology of York and surrounding counties. The series began in 1995 with “Geology of York County.” This video introduces the viewer to some of the key geologic sites in the county and how geologists interpret the exposures to gain additional information on the Earth’s history. This video was made possible by Baker Refractories, Thomasville Stone & Lime Company, York Building Products, Global Stone Pennroc, and Codorus Stone Company. The second video, produced in 1996, “The Delta Story”, deals with the famous slate resources once mined in the southeastern corner of York County. Not only are the many quarries fascinating, but the rich heritage that remains in the small community is overwhelming. “Triassic Park” is the third of the series and is adopted for mainly the children to recognize that dinosaurs did not live far away, but right in their backyards. Thanks to our sponsors National Ronald McDonald House Charities, Ronald McDonald House Charities of Central Pennsylvania, Kreutz Creek Preservation Society, C. W. Kondor Teleproductions, Jones Geological Services and Global Stone Pennroc.

---

**WHY DINOSAURS:** For many years, dinosaurs have been one of the most popular science subjects talked about by today’s youth. All you have to do is walk through any major toy store and see the many dino toys and models available. More than this, in the many presentations I do annually, I am amazed how many students know the names of the popular species. When people think of dinosaur finds, they envision those mighty beasts like Tyrannosaurus rex or the Triceratops, which lived during the Cretaceous Period (144 - 66 million years ago). These are the most famous dinosaurs that lived during the end of their existence during this period. Actually, what happened in the Earth’s history to make the dinosaurs extinct is not completely known. Presently, it is believed by many that a comet or asteroid collision with the Earth causing a “dusty” atmosphere which killed the vegetation. Since most dinosaurs were plant eaters, their food supply thus became depleted. In any case, these dinosaurs like the Tyrannosaurus were near the end of a long line of dinosaurs and reptilian animals that roamed the Earth during the Mesozoic Era (245 - 66 mya). The dinosaurs that are discussed in this video are some of the earliest known of their clan living during the Late Triassic Period (220 - 200 mya).

---

**WHAT IS THE TRIASSIC PERIOD?:** The Triassic Period is one of eighteen time spans during the Earth’s history. Basically, the periods are divided according to the type of life based on the fossil record. Remembering that the Earth is believed to be about 4.6 billion years old, the oldest fossil (algae) only dates back to about 3.8 billion years old. This algae was found in Greenland. The Triassic Period ranges from 245 - 208 mya and is the earliest third of what is known as the Mesozoic Era, a wide subdivision of time. The other two periods making up the Mesozoic Era is the Jurassic Period (208 - 144 mya) and the Cretaceous Period (144-66 mya). The Mesozoic Era is nicknamed “The Age of the Dinosaurs.”

---

**THE TRIASSIC PERIOD IN YORK AND ADAMS COUNTIES:** It is obvious that Triassic-aged rocks must be found in our area if the remains or evidence of the earliest dinosaurs known have been found in southern Pennsylvania. The examination of a Pennsylvania geologic map shows the region where these rocks are found in western and northern Adams County, and northern York County. Matter of fact, land features or political boundaries do not interrupt the geology, these Triassic rocks pass through every county in southeastern Pennsylvania. Again, ignoring political boundaries, these Triassic rocks run northward from Pennsylvania through New Jersey, New York, Connecticut, and Massachusetts, and southward into Maryland, Virginia, North Carolina and South Carolina. In fact, these rocks have been also seen in drill cores from South Carolina, Georgia and Alabama. Geologists refer to these areas as Triassic Basins, since their origin seems to point toward a basin type of deposit, and not running continuous the entire length of the East Coast. Much can be said of the Triassic Basins, but due to restraints on space here, the materials will only be those needed to understand why the dinosaurs roamed this region.

From the composition and features seen in the Triassic rocks and the fossil evidence, the Triassic Period was a pretty exciting time to live in southeastern Pennsylvania. As mentioned above, the Triassic rocks were deposited in basins. The basin which is found in our area is known as the Gettysburg Basin, which extends from near Harrisburg southward into Frederick, Maryland. It was during this time period that the super continent, Pangaea, was beginning to split apart into the world as we know today. The rifting that was occurring is today marked by these Triassic Basins. It is believed that a "hot spot", a stationary column of magma originating from the mantle, was located outside of New York City. As the magma came closer to the surface, the "hot spot" began to split into a "Y"-shaped configuration. The northern arm extended into Connecticut, the second arm came south into Pennsylvania and Maryland, and the third arm extended eastward, which is now called the Baltimore Canyon, off of the East Coast. As rifting continued and the landmasses started to move apart, these basins became deeper and accepted sediment.

Picture for a moment, the Everglades in southern Florida. Based on paleomagnetic evidence, it is believed that York and Adams counties were close to the latitude of southern Florida during the Triassic Period. That means the climate was subtropical, with much vegetation, meandering streams, oxbow lakes and abundant marshes. Rainfall was heavy during this time, carrying sediment from weathered bedrock predominantly from the south and southeast into this basin. Understanding the principles of stream evolution by observing them today, geologists can understand the drainage pattern during the Triassic Period, a principle we call uniformitarianism. place Triassic map from Chrastina and Jones (1989) here In York and Adams counties, two rock formations make up the Triassic area. The oldest is the New Oxford Formation, which is located in the southern half of the Gettysburg Basin. Named for its good exposures in New Oxford, this formation consists of conglomerate, shale and sandstone and is believed to be about 6,000 feet thick (Stose and Jonas, 1939). The younger, overlying rock unit is the Gettysburg Formation, named for its good exposures in the railroad cut near Gettysburg. The formation is composed of sandstone, shale and fanglomerate. Stose and Jonas (1939) calculated the thickness as 18,000 feet. Imagine 24,000 feet of sediment being washed into this basin over a period of about 80 million years. As a result of the rifting, magma intruding through the sedimentary rocks, cooled and formed diabase (an igneous rock with a similar composition as basalt, but coarser-grained). The large intrusions only occurred within the Gettysburg Formation, but dikes of diabase can be found extending to the north and south of the Triassic Basins into Paleozoic rocks. Devil's Den on the Gettysburg National Battlefield is one of the most famous diabase outcrops in eastern United States. These intrusions are considered "earliest" Jurassic in age (Froelich and Gottfried, 1999).

---

**TRIASSIC DINOSAURS:** It was on the East Coast of the United States where the first Triassic dinosaurs were found. In 1802, twelve-year-old Pliney Moody was plowing a field on his father's farm in South Hadley, Massachusetts, when he noticed some strange markings in one of the rocks. This find quickly raised the interest of both the amateur and professional collectors. Over time, geologists and collectors sought to make a "new find" with the Early Mesozoic dinosaurs. The richest source of dinosaur tracks in the world is still considered the Connecticut Valley (Weishampel and Young, 1996). Footprints have been found in every state from Connecticut southward into North Carolina.

---

**PENNSYLVANIA FINDS:** The earliest documented find in Pennsylvania occurred in 1878 at the LeCron's Copper Mine, near Emigsville, York County. Edward Cope described bones and named them *Galtonia gibbidens*. Mr. Wanner (1898) discussed both teeth and bone from the same locality. Elsewhere in Pennsylvania, and excluding York and Adams counties, the following sites and species have been reported (Weishampel and Young, 1996):

---

### **LOCALITY SPECIES FOUND**

Schwenksville, Montgomery Co. Grallator, Gwynedd

Berks Co. Atreipus

Coopersburg, Lehigh Co. Grallator, Rutiodon, Archosaurus, Chirotherium, Rhynchosauroides, Anchiosauripus

Limerick, Berks Co. Grallator, Chirotherium, Archosaurus

Reading, Berks Co. Atreipus, Grallator, Apatopus,, Batrachopus, Chirotherium, Gwyneddichnium,

Rhynchosauroides

Sanatoga, Montgomery Co. Grallator

Graterford, Montgomery Co. Grallator, Atreipus,, Gwyneddichnium,, Rhynchosauroides

Arcola, Montgomery Co. Atreipus

---

**YORK AND ADAMS COUNTY SITES:** Compared to the other counties in southeastern Pennsylvania, York and Adams counties have the highest combined number of dinosaur finds. It was the intention of "Triassic Park" to visit most of the sites to give you a glimpse of the locality. Following is a listing of each site, geologic formation, species found and any notable comments. Numbers correspond to locations on the York/Adams counties map.

#### **1. LeCron's Copper Mine - New Oxford Formation - *Galtonia gibbidens***

First described by Edward Cope in 1878, teeth and bones of this dinosaur were not only the earliest reports of dinosaurs in Pennsylvania, but remains today, the only site in the Gettysburg Basin where skeletal remains have been found. Similar specimens were identified in 1898 by Wanner from the same site. The materials were found in the bottom of a vertical shaft where low-grade copper ore was being removed.

#### **2. Zion's View Site - New Oxford Formation - *Rutiodon carolinensis* and *Buettneria perfecta***

Dr. Robert Stahle discovered the site in 1909 and continued to collect specimens between 1910 and 1912. Under the leadership of Donald Hoff, a second phase of collecting took place in 1972 by The Pennsylvania State Museum. Specimens collected by Stahle and others are at the Academy of Natural Sciences in Philadelphia and at the Princeton University Collection of Yale Peabody Museum, New Haven, Connecticut. The specimens collected by Hoff are curated at The State Museum in Harrisburg.

Probably considered the most significant site in Pennsylvania, the phytosaur *Rutiodon* and a metoposaurid amphibian *Buettneria* are the highlighted species. The phytosaurs were an extinct group of crocodile-like reptiles and were up to fifteen feet in length. The metoposaurs were one of the last families of an extinct group of ancient amphibians. This animal resembled a salamander and were up to six feet long. They were probably fish eaters. Skulls, teeth and other bone material were identified from Zion's View. Other fossils found here, which is dated as Late Triassic, include clam shrimp, unionid pelecypods, primitive bony fishes and vertebrate coprolites.

**3. Little Conewago Creek Site** - New Oxford Formation - phytosaur and fish Wanner ( 1921) described this site near the confluence of the Little Conewago and Big Conewago Creeks. Reportedly, teeth and scales were identified here.

**4. Yocumtown Quarry Site** - Gettysburg Formation - *Grallator* and *Atreipus*

These footprints were found in several sandstone blocks in a small quarry and were described by William Hickok and Bradford Willard (1933). The quarry is now located beneath a housing development. These tracks were discovered in the summer of 1932 by J. Carroll Hayes who informed Dr. George H. Ashley, State Geologist. Hickok, who was investigating the Triassic rocks of the New Cumberland area, independently discovered these tracks several weeks later in the course of his fieldwork. Later, the tracks discovered by Hickok were found to be those previously found by Hayes.

Specimens were collected by Hickok, F. T. Moyer and M. N. Shaffner, of the Pennsylvania Geologic Survey. Bradford Willard visited the site with Shaffner and collected additional specimens. The better specimens were mounted and displayed at the Pennsylvania State Farm Show in Harrisburg in January, 1933. Specimens were also donated to The State Museum in Harrisburg. A specimen is also found today at the Pennsylvania State University's Museum of Minerals in State College.

**5. Goldsboro Quarry Site** - Gettysburg Formation - *Grallator* and *Atreipus*

The site was located in a small quarry dug into the side of a hill just west of Goldsboro Road. The footprints were found in 1889. The matrix is sandstone and closely resembles the Yocumtown site. Quarry is still visible but is located on private property.

**6. New Cumberland Roadcut** - Gettysburg Formation - *Grallator*

Bradford Willard of the Pennsylvania Geologic Survey is credited for this find in 1934 as a widening project for U. S. Route 111 near the Capital City Airport. A single dinosaur track was found on a slab of red shale, along with mud cracks, raindrop impressions, and the prints of plant stems.

## 7. Trostle's Quarry - Gettysburg Formation - *Atreipus*, *Anchisauripus*, *Otozoum* and reptilian tracks

These tracks were located in a limestone quarry along the Bermudian Creek in 1937 by Elmer R. Haile, Jr. Tracks are considered Late Triassic in age. Also found in the thinly-laminated siltstones, fine-grained sandstones or calcareous siltstone were primitive archosaurian reptile tracks known as *Brachychirotherium* and *Rhynchosauroides*. Tracks are locally in the collection of The State Museum in Harrisburg and the Mineral Museum of the Pennsylvania State University in State College. In May, 198, Dr. Roger Cuffey of the Pennsylvania State University and the author visited the site, and collected a slab of siltstone thought to have come from the fossil horizon. Dr. Cuffey believes that an unidentified print was present in that slab. Rock from this quarry was used to construct the stone bridges on the Gettysburg National Battlefield. One bridge located over Plum Creek near Big Roundtop, contains rock that shows an *Atreipus* footprint along with mudcracks and ripple marks, and other obscure footprints (*Anchisauripus* and *Otozoum*).

---

**SO WHAT DOES THE FOSSIL EVIDENCE TELL US?** The Phytosaur and Metoposaur from Zions View have already been fairly well described above. Both were predators, probably mainly on fish. Based on the fossils at Zions View, some 2265 million years ago, we can picture a margin of a lake, where clam shrimp, freshwater clams, and fishes lived. The *Rutiodon* was the largest animals on the landscape (Lucas and Sullivan, 1996).

The teeth of the *Galtonia*, like those found at the LeCron's Copper Mine, tell us that the animal was a small, primitive ornithischian. The teeth were only 0.18 to 0.22 inch high and broad triangular in outline. Another ornithischian dinosaur, *Atreipus*, is quite common in southeastern Pennsylvania, found only as footprints. It is interesting to note that the name "Atreipus" originated from a York City high-school principle and discover of many footprints in York County, Atreus Wanner (Weishampel and Young, 1996). These footprints have only been found from about a ten million year period - a good index fossil for the Late Triassic Period (Lucas and Sullivan, 1996). It should be noted here that different names have been used to describe the same dinosaur over the years (i.e., *Grallator*, *Anchisauriopus*, *Eubrontes* and others). Today, all of these are known as *Grallator*.

The footprint of a small theropod dinosaur, the most common foot printer in the Triassic on the East Coast, *Grallator*, is very similar to the foot print of the *Atreipus*. Scientists have closely studied the pad pattern and have learned how to separate the tracks. Based on both the front and rear prints, the size of these animals can be determined. The *Atreipus* was less than 3.3 feet high at the hips. They must have been mobile on all fours, although the size of the prints suggests that the front legs were smaller than the rear legs.

Since hind prints have only been found of the *Grallator*, it appears that these animals were hind-walkers (bipedal). Again, based on the footprint size and stride, the *Grallator* was about seven to twenty feet long. It was calculated by Robert E. Weems of the United State Geological Survey in Reston, Virginia, that the *Grallator* moved at a pace of 7.8 to 9.8 miles an hour. The prey of the *Grallator*, appears to be *Galtonia*, *Atreipus*, and their own, as well as insects, amphibians and lizards. The *Rutiodon* appears to have been hunted by the theropods as well (Weishampel and Young, 1996).

insert 3 foot track drawings here

---

## **FURTHER READINGS**

Chrastina, Paul B., and Jones, Jeri L., 1989. *Whispering Hills: Geology of York and Lancaster Counties, Pennsylvania*. Matrix Publishing, Dillsburg, Pa.

Cope, E. D., 1878. On some saurians found in the Triassic of Pennsylvania, by C. M. Wheatley. *Proceedings of the American Philosophical Society*, v. 17, p. 177.

Froelich, A. J., and Gottfried, David, 1999. Early Mesozoic - Igneous and contact metamorphic rocks in *The Geology of Pennsylvania*, Charles H. Schultz, editor. Pennsylvania Geological Survey and Pittsburgh Geological Society, Harrisburg, Pa.

Hickok, W. O., and Willard B., 1933. Dinosaur foot tracks near Yocumtown, York County, Pennsylvania. *Pennsylvania Academy of Sciences Proceedings*, vol. 7, p. 55-58.

Kochanov, W. E., and Sullivan, Robert M., 1994. Finding phytosaurs in Pennsylvania The story of Stahle, Sinclair and Zions View. *Pennsylvania Geology*, vol. 25, p. 3-8.

Lucas, Spencer G., and Sullivan, Robert M., 1996. Fossils provide a Pennsylvania standard for part of Late Triassic time. *Pennsylvania Geology*, vol. 27, no. 4, p. 8-14.

Ryan, J. Donald, 1980. Triassic fossil reptile footprints near Coopersburg, Lehigh County, Pennsylvania. *Pennsylvania Geology*, vol. 11, no. 6, p. 2-4.

Stose, George W., and Jonas, Anna I., 1939. *Geology and mineral resources of York County, Pennsylvania*. Pennsylvania Geologic Survey, 4th series, County Report 67.

Wanner A., 1889. The discovery of fossil tracks, algae, etc. in the Triassic of York County, Pennsylvania. *Pennsylvania Geologic Survey Annual Report for 1887*, p. 21-35.

\_\_\_\_\_, 1921. Some faunal remains from the Trias of York County, Pennsylvania. *Proceedings of the Academy of Natural Sciences, Philadelphia*, vol. 73, p. 25-37.

\_\_\_\_\_, 1926. Some additional faunal remains from the Trias of York County, Pennsylvania. *Proceedings of the Academy of Natural Sciences, Philadelphia*, vol. 78, p. 21-28.

Weishampel, David B., and Young, Luther, 1996. *Dinosaurs of the East Coast*. The John Hopkins University Press, Baltimore, Maryland.

Willard, B., 1934. Additional Triassic dinosaur tracks from Pennsylvania. *Science*, vol. 80, no. 2064, p. 73-74.

---

## **GLOSSARY**

Basalt - A dark-colored, fine-grained igneous rock formed from lava. Mainly composed of plagioclase feldspar and dark colored minerals.

Conglomerate - A sedimentary rock composed of water-worn rounded pebbles cemented together in a finer-grained groundmass.

Copper Ore - Rock containing copper minerals, i.e. native copper, azurite, malachite, etc.

Coprolite - Petrified excrement; fossilized dung.

Cretaceous Period - A last period of geologic time during the Mesozoic spanning from 144 - 65 million years ago.

Diabase - An igneous rock, generally medium-to-coarse-grained with its composition similar to basalt. Formed inside the Earth from magma.

Dinosaur - A group of animals that existed during the Mesozoic Era, many of which walked with an erect stance.

Fanglomerate - A sedimentary rock containing angular pebbles cemented into a finer-grained groundmass.

Formation - A mappable body of rock of measurable thickness and areal extent

Geologic Map - A map showing the formations, rock types and structure of a particular area.

Gettysburg Basin - One of numerous basins that were active during the Triassic and Jurassic periods, extending from near Harrisburg southward to Frederick, Maryland.

Hot Spot - A stationary column of magma intruding up through the crust and believed to be the driving force for splitting apart landmasses.

Jurassic Period - A middle period of geologic time during the Mesozoic Era existing from 200 - 145 million years ago.

Mesozoic Era - Meaning "Middle Life," a wide division of time subdivided into the Triassic, Jurassic and Cretaceous periods spanning from 245 - 65 million years ago. Also referred to as the "Age of the Dinosaurs."

Metoposaur - Type of amphibian that resembled a giant salamander. Mud Cracks - An irregular crack formed by the drying and shrinkage of clay, silt or mud.

Ornithischian - Class of dinosaur having pelvises composed of 3 bones with pubis pointing backwards and a fourth projecting forward. The "Duck-Billed" dinosaur belongs to this class.

Paleomagnetic - The study of the direction and intensity of the Earth's magnetic field through geologic time.

Pangaea - Super continent proposed by Alfred Wegener with his theory of continent drift that all of the continents were joined together approximately 245 - 220 million years ago.

Phytosaur - A class of reptile, but that is crocodile-like and adapted to life on land as well as water, developing nostrils on top of the head enabling them to breathe largely submerged.

Raindrop Impressions - Small indentation in sedimentary rocks created by rain dropping into the mud prior to the rock's lithification.

Sandstone - A sedimentary rock composed of sand-sized grains cemented together.

Shale - A sedimentary rock composed of clay-sized grains compacted together.

Stegosaurus - Known as the "plate lizard" and was about 20 feet long, living during the Jurassic Period.

Theropod - A type of dinosaur that walked largely on his hind legs, known as "beast footed." All of the Triassic theropods were carnosaurus.

Triassic Basin - A lowlands area during the Triassic Period that saw abundant sedimentation through heavy rainfall.

Triassic Period - The earliest period of geologic time during the Mesozoic Era spanning from 250 - 200 million years ago.

Tyrannosaurus rex - The largest meat eating dinosaur known, living at the end of the Mesozoic Era. The animal stood about 20-feet high and 45-feet long.

Uniformitarianism - a principle of geology that states "Every process occurring on Earth today, has been occurring on Earth for millions of years." Traditionally, referred to "The present is the key to the past."