

Virginia's Dinosaurs



David Spears, *State Geologist*
Virginia Department of Energy





Most children are fascinated with dinosaurs. When I was in first grade, I drew many pictures like this.

To understand where dinosaurs fit in earth's history, we must first understand how rock strata record events in that history. The Grand Canyon is a good place to start.

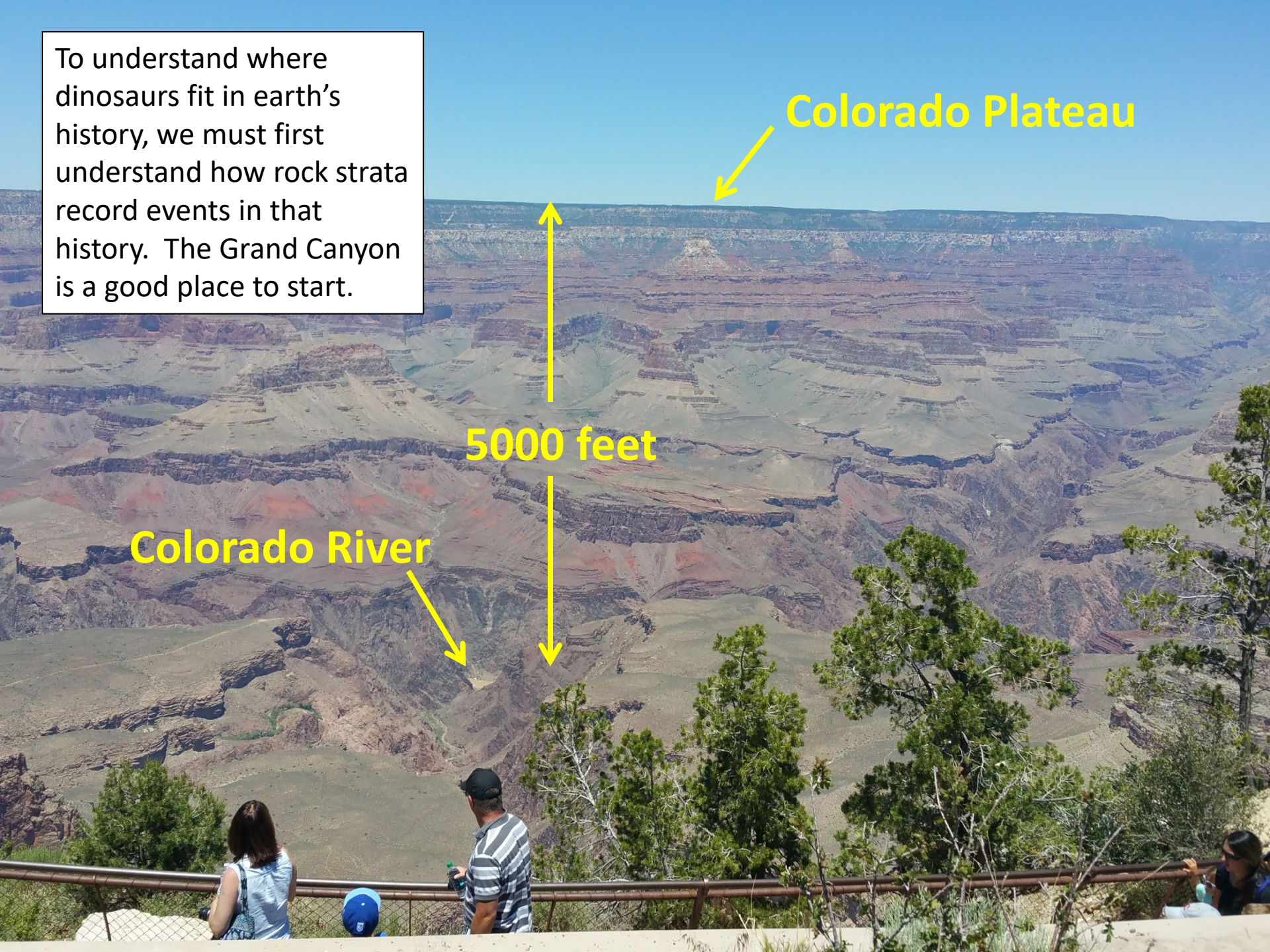
Colorado Plateau



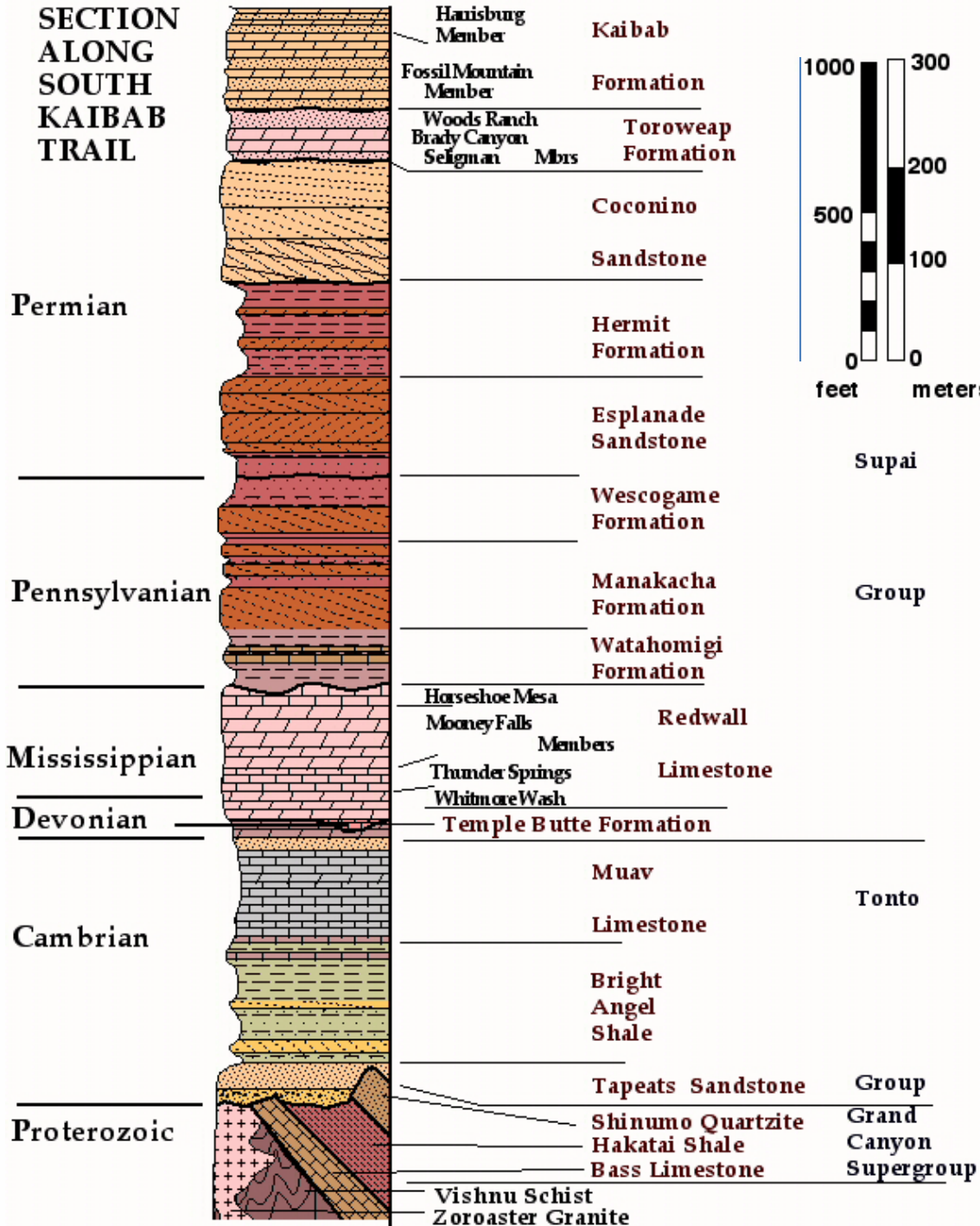
5000 feet



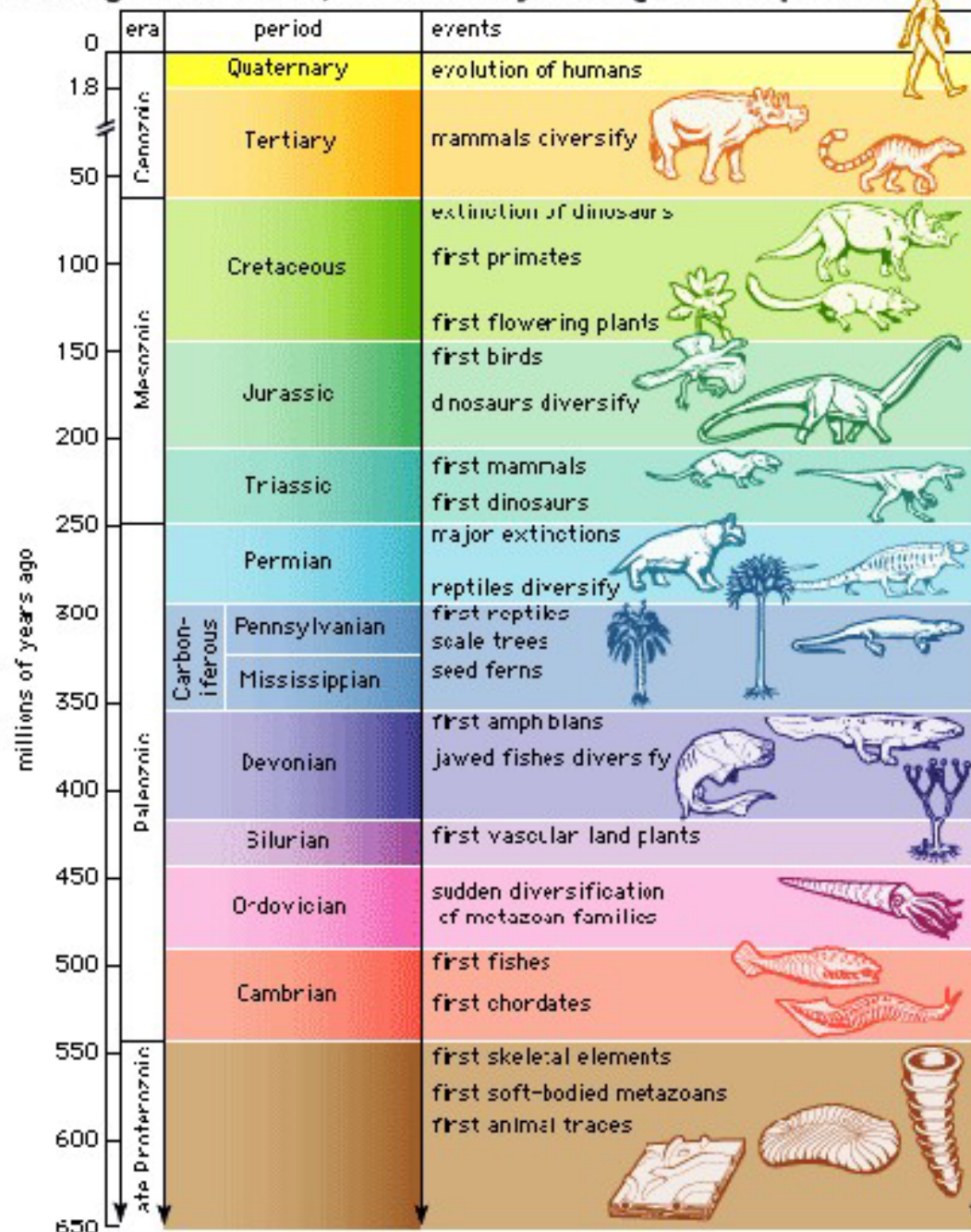
Colorado River



About 5000 feet of nearly horizontal strata are exposed in the Grand Canyon.



Geologic time scale, 650 million years ago to the present



**The Mesozoic Era –
“The Age of Dinosaurs”**

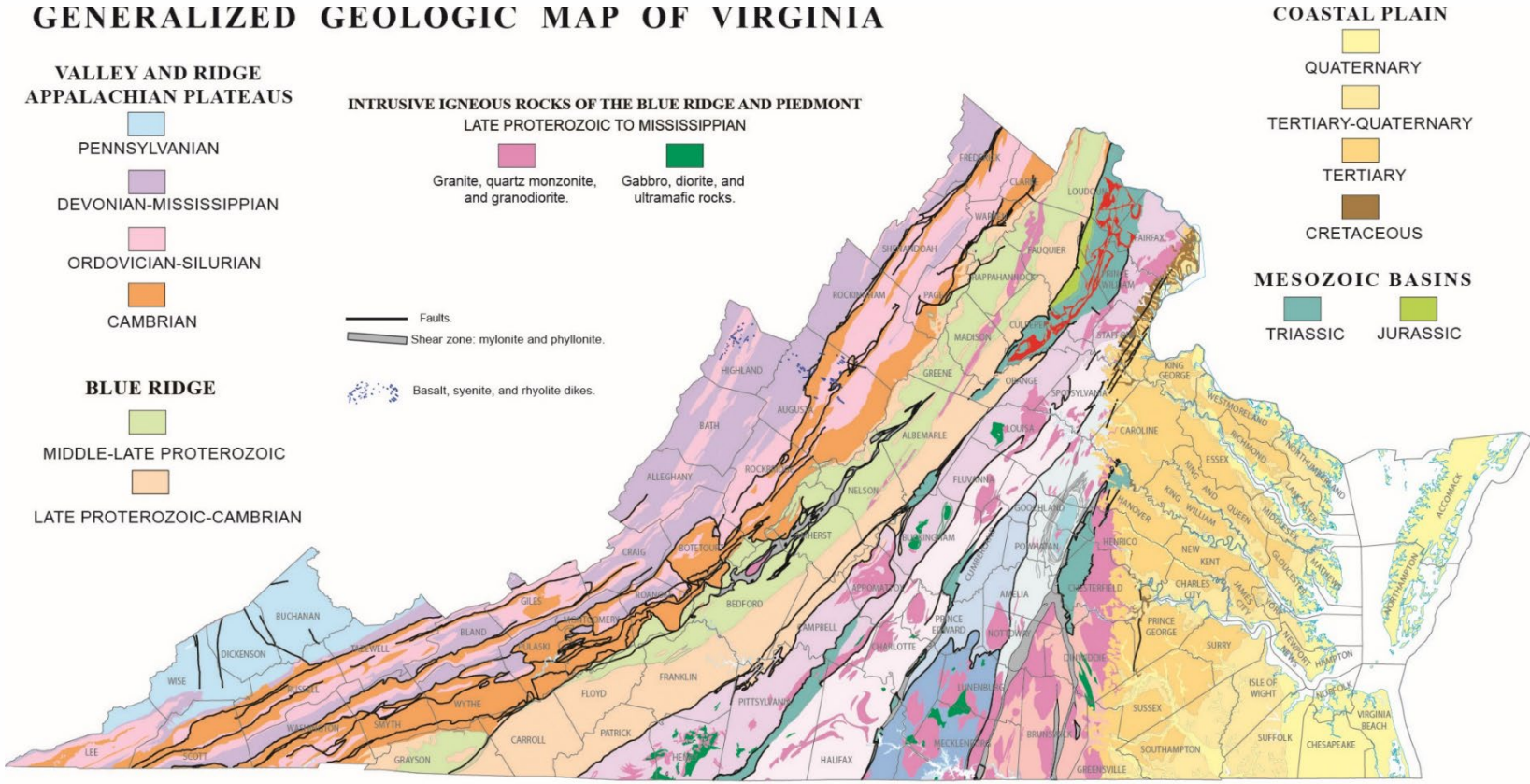
The Mesozoic Era lasted from about 250 million to 66 million years ago.

It includes the Triassic, Jurassic, and Cretaceous periods.

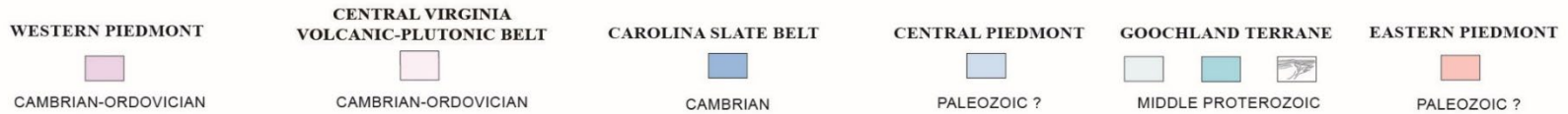


A geologic map is essential for finding strata of the right age to potentially contain dinosaur fossils.

GENERALIZED GEOLOGIC MAP OF VIRGINIA



PIEDMONT

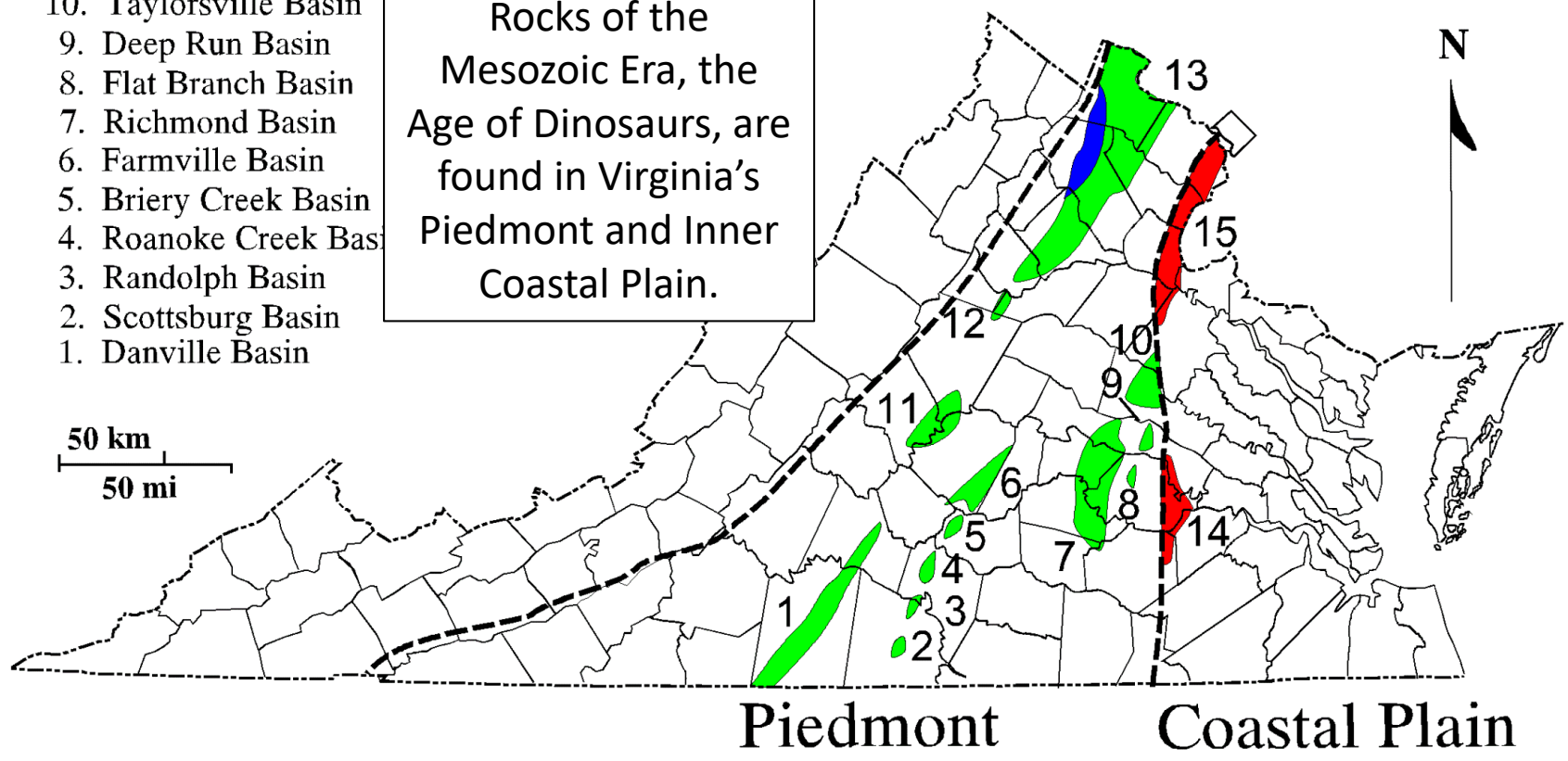


- 15. Potomac-Rappahannock oucrops
- 14. James-Appomattox oucrops
- 13. Culpeper Basin
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- 5. Briery Creek Basin
- 4. Roanoke Creek Bas
- 3. Randolph Basin
- 2. Scottsburg Basin
- 1. Danville Basin

	CRETACEOUS
	JURASSIC
	TRIASSIC

MESOZOIC

Rocks of the
Mesozoic Era, the
Age of Dinosaurs, are
found in Virginia's
Piedmont and Inner
Coastal Plain.



Weems, 2016

**Dr. Robert Weems,
U.S. Geological Survey,
has done more work
than anyone on
Virginia's dinosaurs.**



TRANSACTIONS

of the

American Philosophical Society

Held at Philadelphia for Promoting Useful Knowledge

VOLUME 77, Part 1, 1987

A Late Triassic Footprint Fauna From the Culpeper Basin Northern Virginia (U.S.A.)

ROBERT E. WEEMS

U.S. Geological Survey

THE AMERICAN PHILOSOPHICAL SOCIETY

Independence Square, Philadelphia

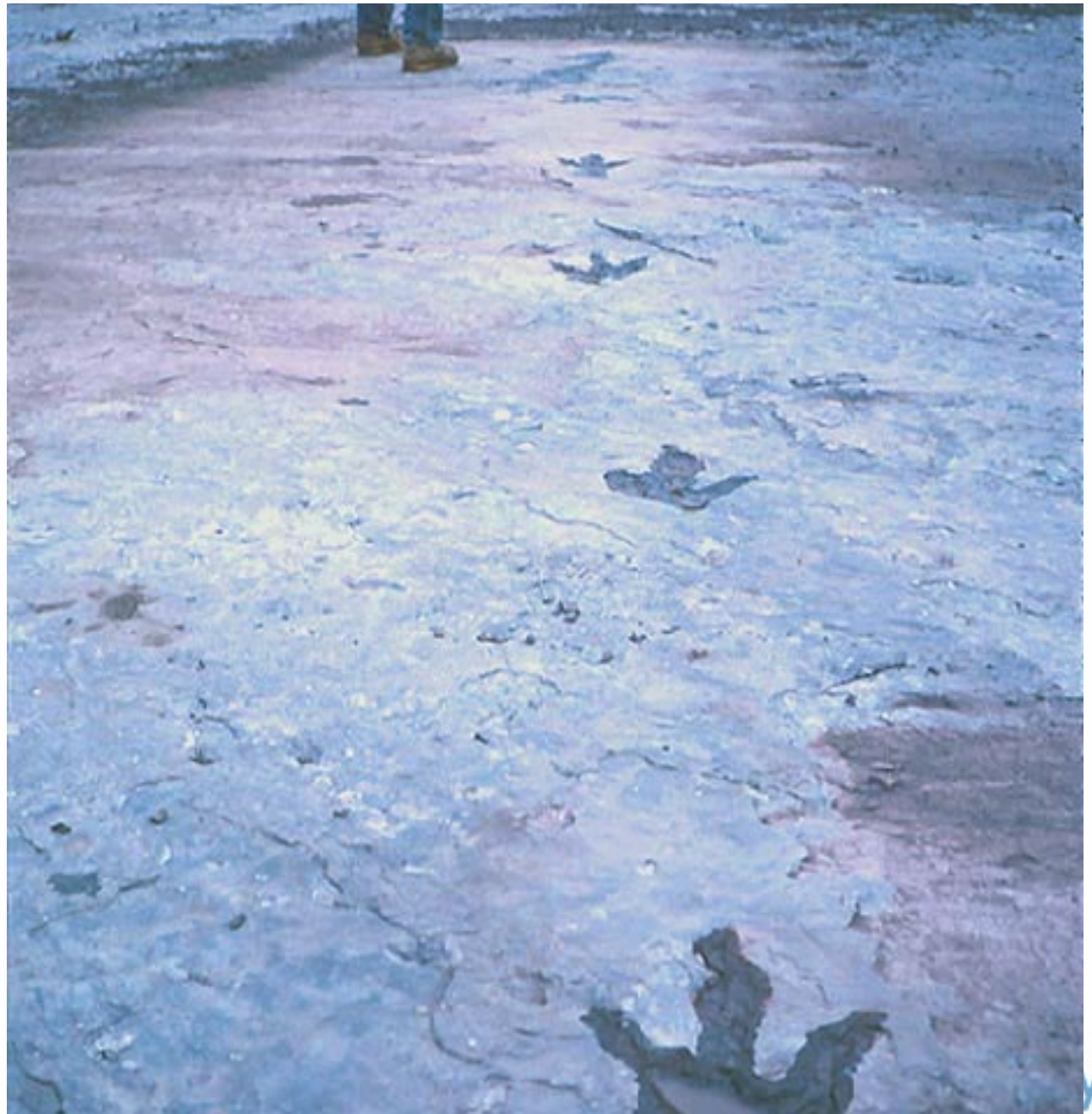
1987





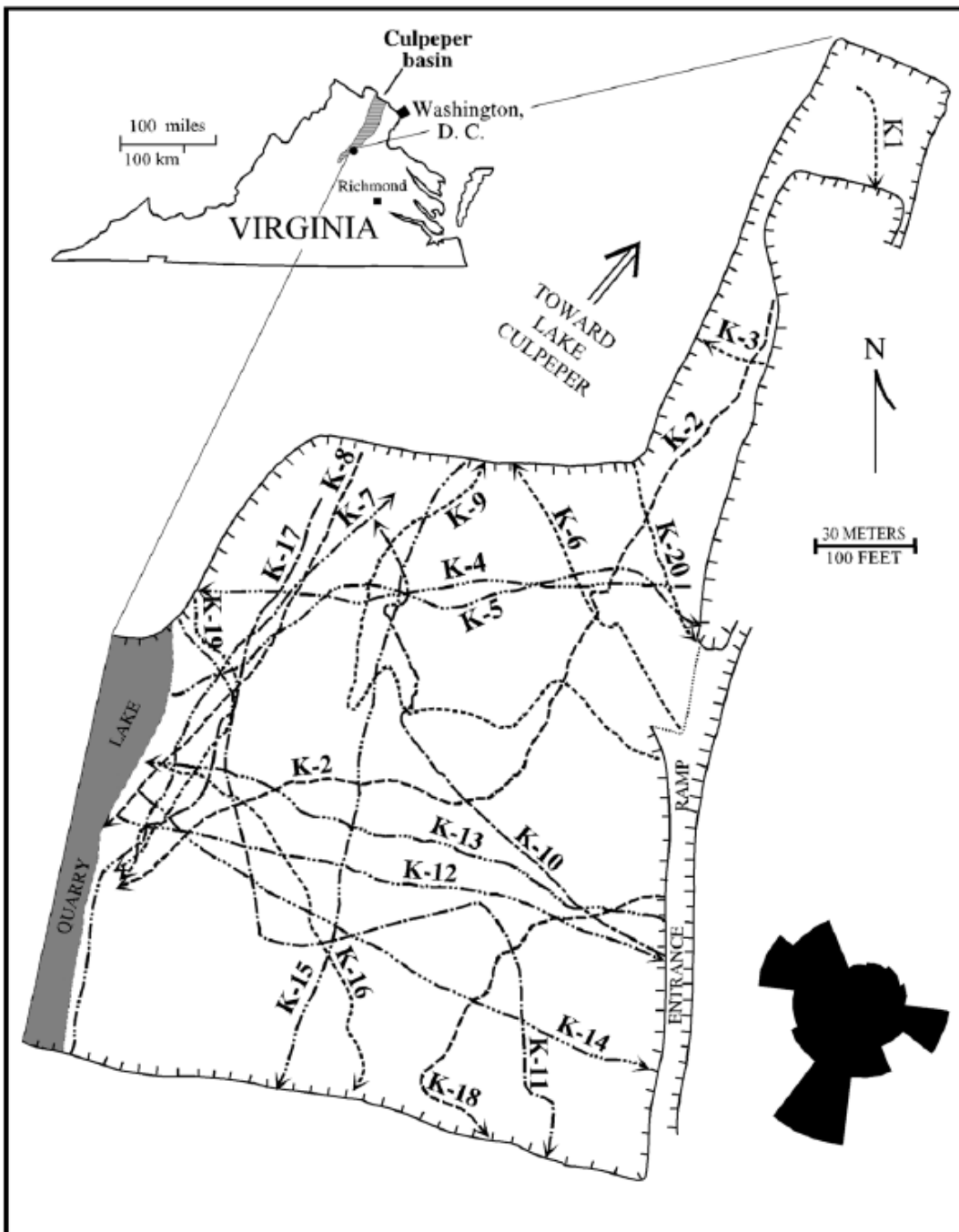
**Culpeper Stone Quarry:
Formerly Martin-Marietta,
now Luck Stone**

A dinosaur trackway at the Culpeper quarry.





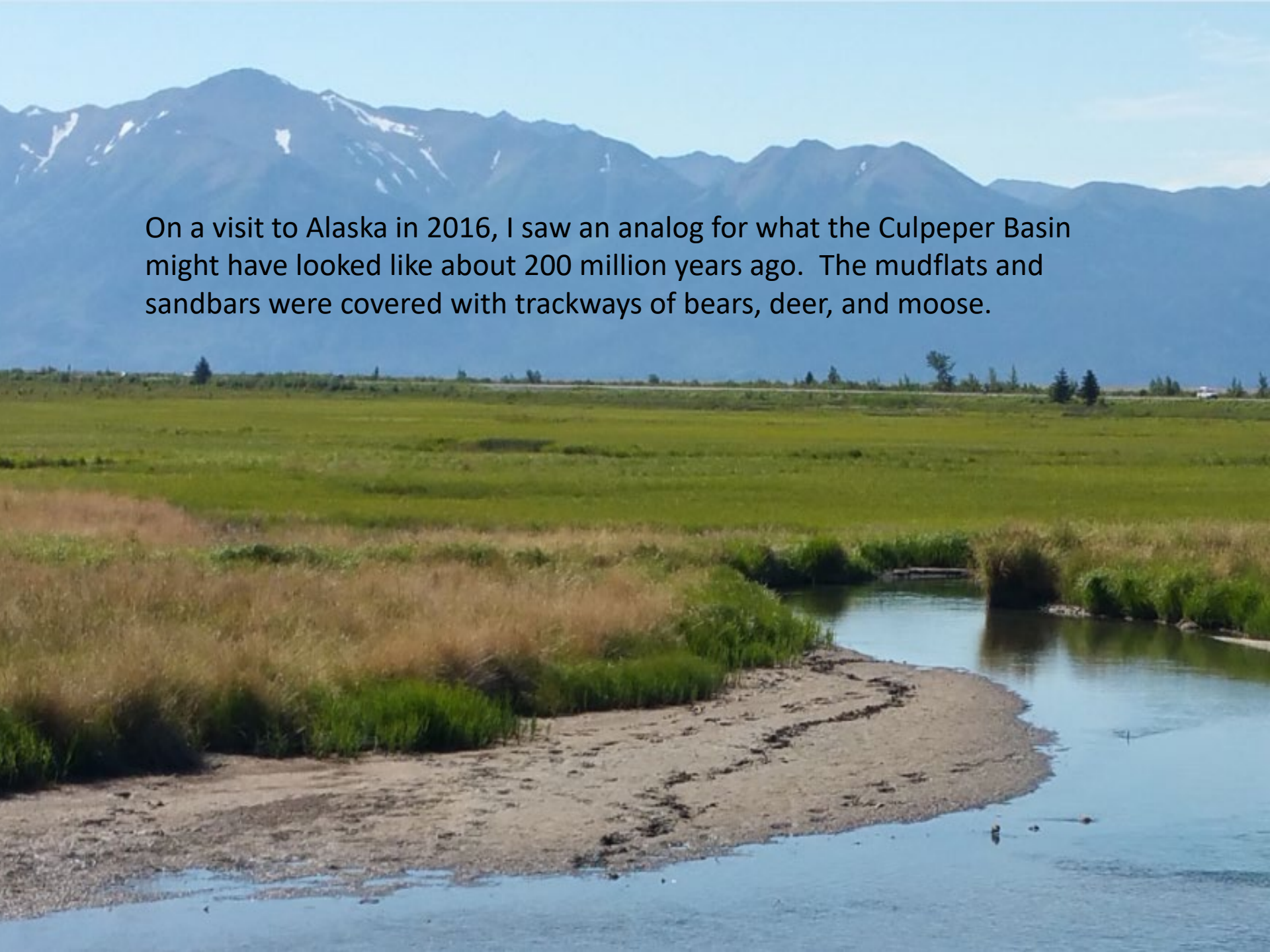
The quarry is normally closed to the public, but once a year, Luck Stone partners with the Museum of Culpeper History to host a day for the public to view the trackways.




Exposed trackways in Culpeper Quarry include over 1800 individual footprints!

(from Weems, 1987)

On a visit to Alaska in 2016, I saw an analog for what the Culpeper Basin might have looked like about 200 million years ago. The mudflats and sandbars were covered with trackways of bears, deer, and moose.





As the river rose, tracks would become covered in mud and therefore preserved. Burial beneath hundreds or thousands of such layers would eventually result in the fossilization of the tracks.

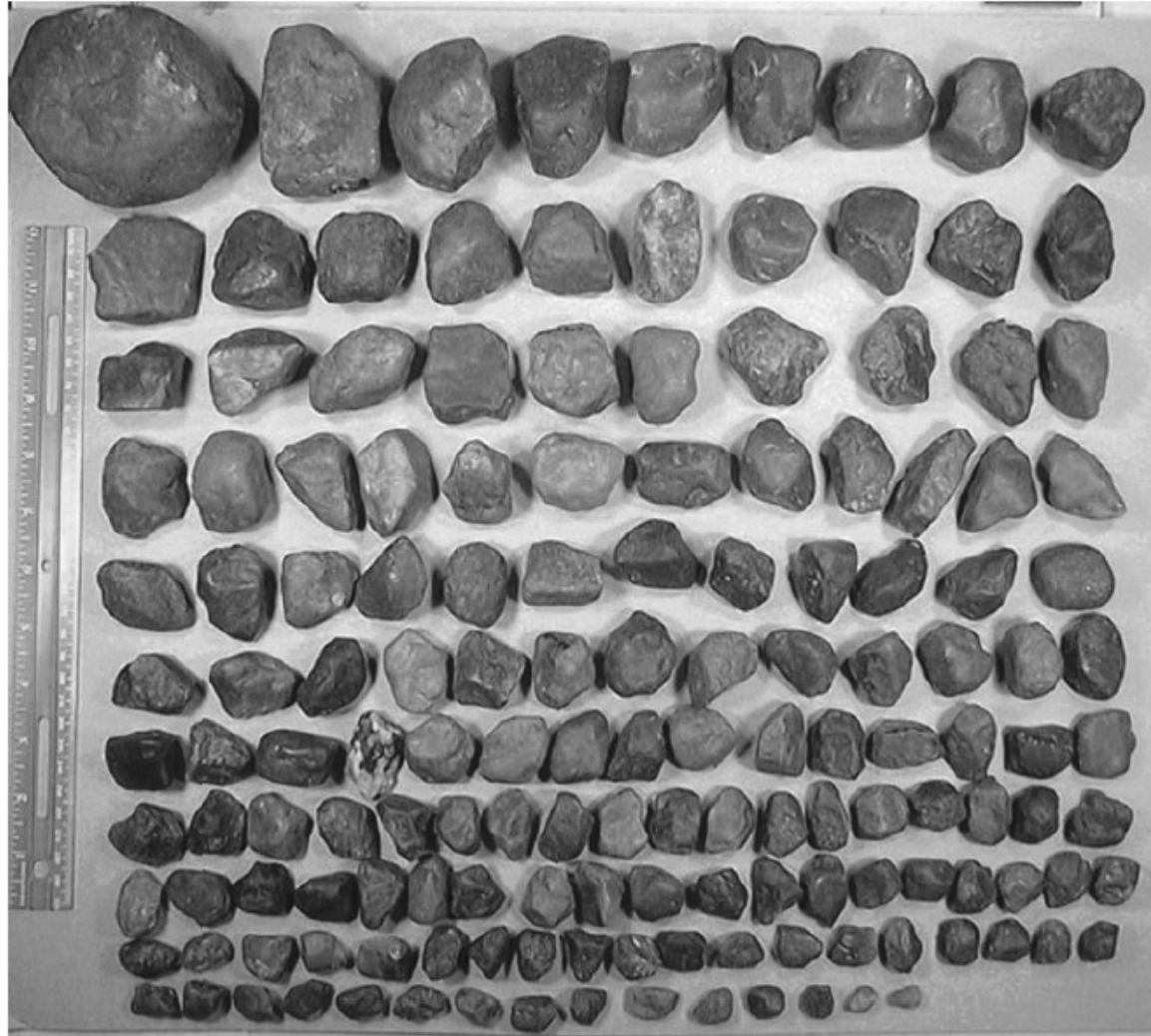
Liliensternus, a possible candidate for the maker of *Kayentapus* tracks in the Culpeper Quarry.



https://en.wikipedia.org/wiki/Liliensternus#/media/File:Liliensternus_NT.jpg



Gastroliths are polished stones thought to have been ingested by dinosaurs to help pulverize their food, just as birds peck gravel nowadays.



Gastroliths from the Upper Triassic in the Culpeper Basin (Weems et al, 2007)



Weems & Bachman began discovering Cretaceous-age tracks near Fredericksburg in the 1990s.

The Lower Cretaceous Patuxent Formation Ichnofauna of Virginia

Robert E. Weems¹ and Jon M. Bachman²

¹Calvert Marine Museum, Solomons, Maryland, USA

²Stratford Hall Plantation, Stratford, Virginia, USA

...a diverse tetrapod ichnofauna...that includes...theropods, sauropods, ankylosaurs, and ornithopods.

The vertebrate fauna from the Lower Cretaceous Patuxent Formation of Virginia is composed of a single partial fish impression from the James River at Dutch Gap and a diverse tetrapod ichnofauna from near Fredericksburg that includes trace fossils made by frogs, turtles, theropods, sauropods, ankylosaurs, and ornithopods. The footprints occur on overbank deposits preserved locally within a fluvial braided-stream sequence that formed near the western border of the Early Cretaceous Atlantic Coastal Plain.

Keywords Patuxent Formation, Lower Cretaceous, Virginia, Dinosaur footprints, Paleoclimate

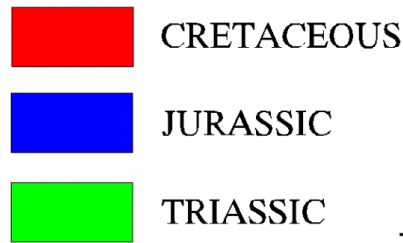
INTRODUCTION

In Virginia and Maryland, the Patuxent Formation is exposed only in the vicinity of the Tidewater Fall Line (Weems, 1998), which forms the western border of the contiguous Atlantic Coastal Plain (Fig. 1). Although its surface expression is limited, the Patuxent is widespread in the subsur-

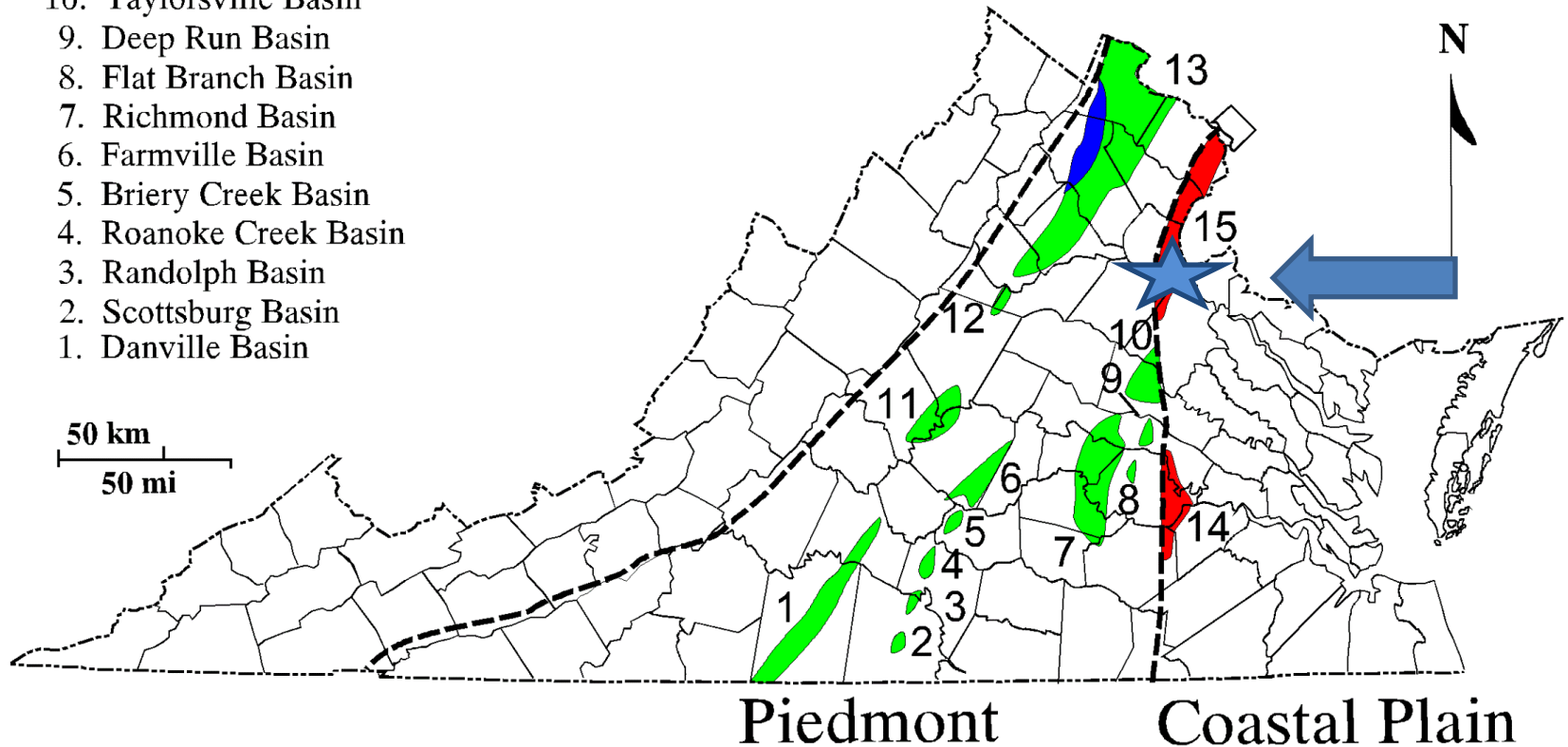
body fossil known is an incomplete impression of a fish (Berry, 1911) found in Chesterfield County at or near Dutch Gap canal on the James River (Fig. 1). This specimen (Fig. 3), in the collections of the United States National Museum, is similar to the albuloid teleost *Paraelops cearensis* from the Early Cretaceous Santana Formation of Brazil (Maisey and Blum, 1991). Footprints also are generally rare, except for an exceptional area in Stafford and Spotsylvania counties (Fig. 1) where Patuxent fluvial, braided-stream sandstones occasionally preserve small areas of overbank deposits that were not entirely cut out and redeposited by penecontemporaneous migrating stream channels. Four such overbank deposits have been found that preserve fossil footprints of anurans (frogs), chelonians, and dinosaurs. A report of dinosaur and frog footprints from Stafford County (Weems and Bachman, 1997) is the only published report on any of these Patuxent footprints, except for a preliminary announcement of the specimens described here (Weems and Bachman, 2004). A summary of the upper Aptian–lower Albian vertebrate body fossils and



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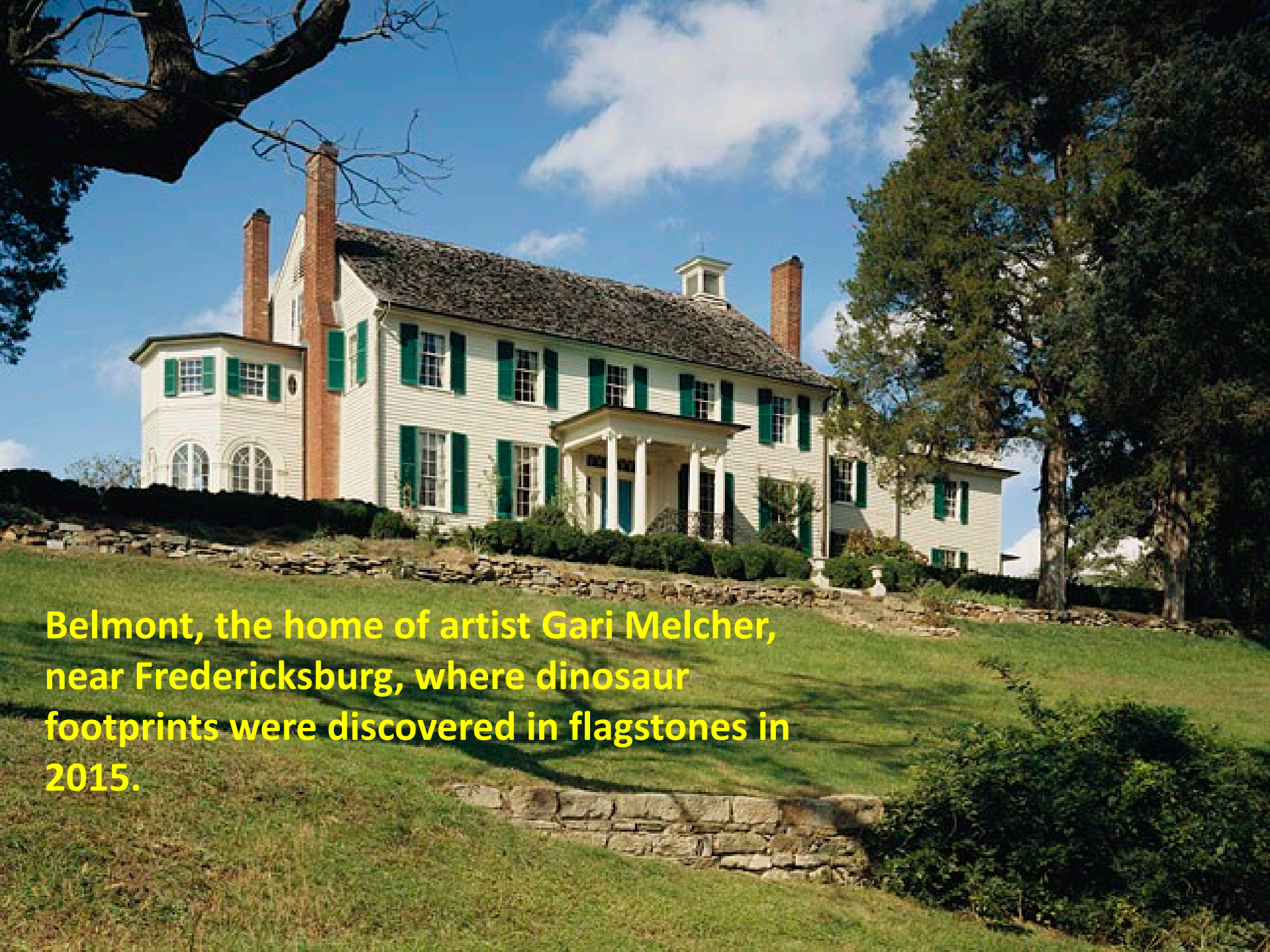
MESOZOIC



Weems, 2016

Cretaceous footprint sites so far discovered in Virginia mostly are in poorly accessible areas on or near the Rappahannock River east of Fredericksburg.

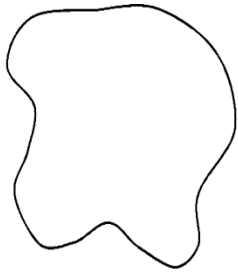




**Belmont, the home of artist Gari Melcher,
near Fredericksburg, where dinosaur
footprints were discovered in flagstones in
2015.**

A dinosaur footprint in one of the flagstones at Belmont, near Fredericksburg, VA.





Megalosauropus



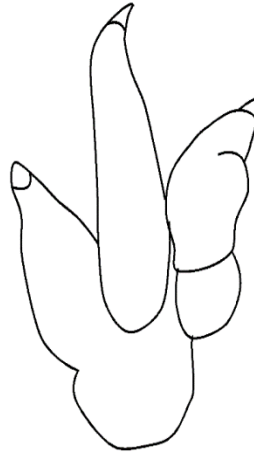
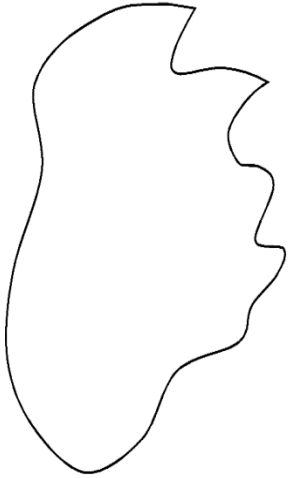
Hypsiloichnus



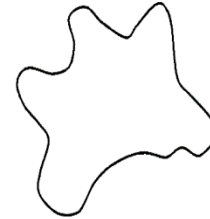
Caririchnium



Amblydactylus



"Acrocanthosauripus"



Tetrapodosaurus



Gypsichnites



Ornithomimipus

Nine kinds of *Brontopodus* dinosaurs footprints have been found in Cretaceous strata near Fredericksburg (so far)



The most common
Cretaceous
footprints of
dinosaur found in
the Fredericksburg
region were made
by herbivores.



lifeandhidayuki.blogspot.com



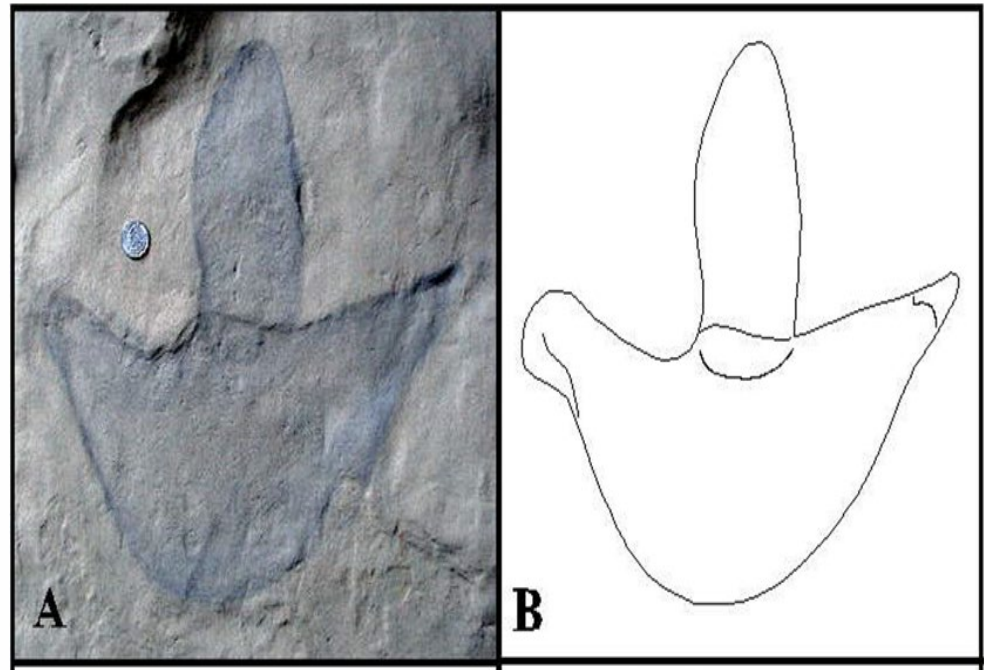
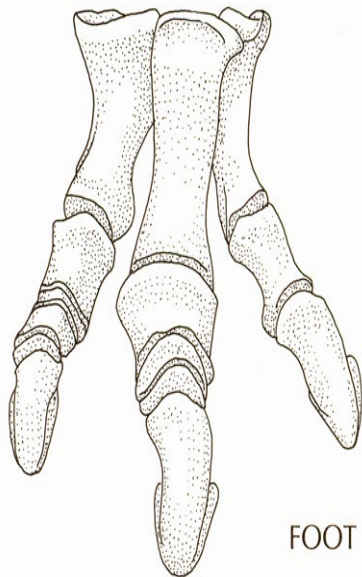
Among these are rare *Caririchnium* footprints, which were made by a large iguanodontid.



researchgate.net



A second type of iguanodontid footprint called *Gypsichnites* also is present in the fauna.



Gypsichnites tracks likely were made by
Tenontosaurus.



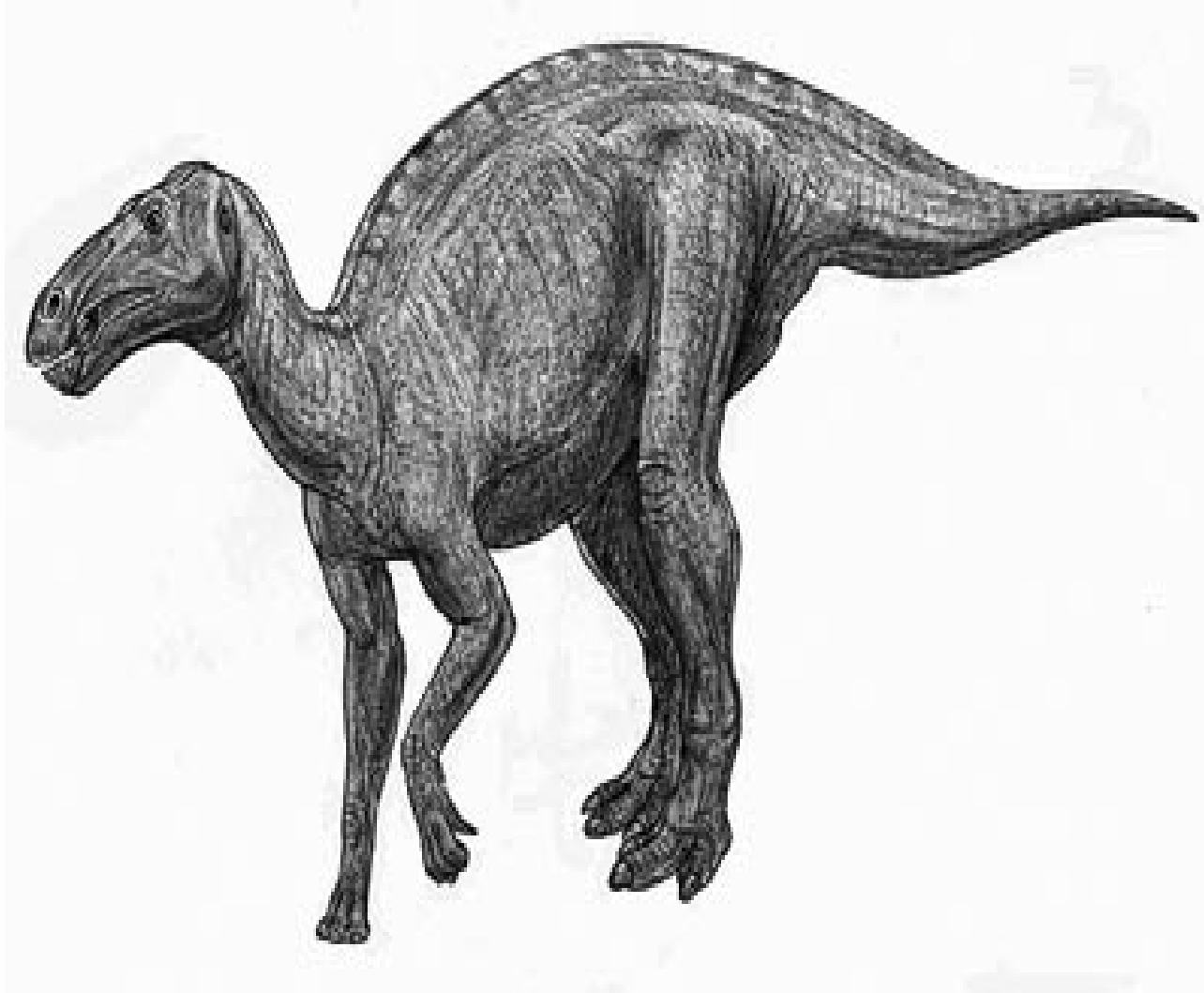
ucmp.berkeley.edu



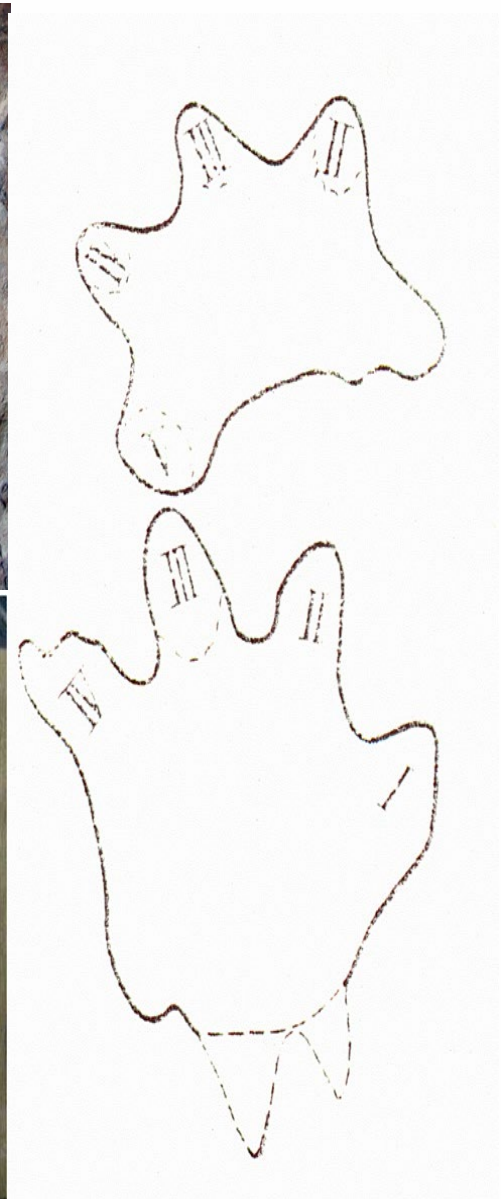
Amblydactylus footprints are common and at one locality all go in the same direction, which strongly indicates they herded.



Amblydactylus footprints probably were made by the nearly contemporaneous *Eolambia*.



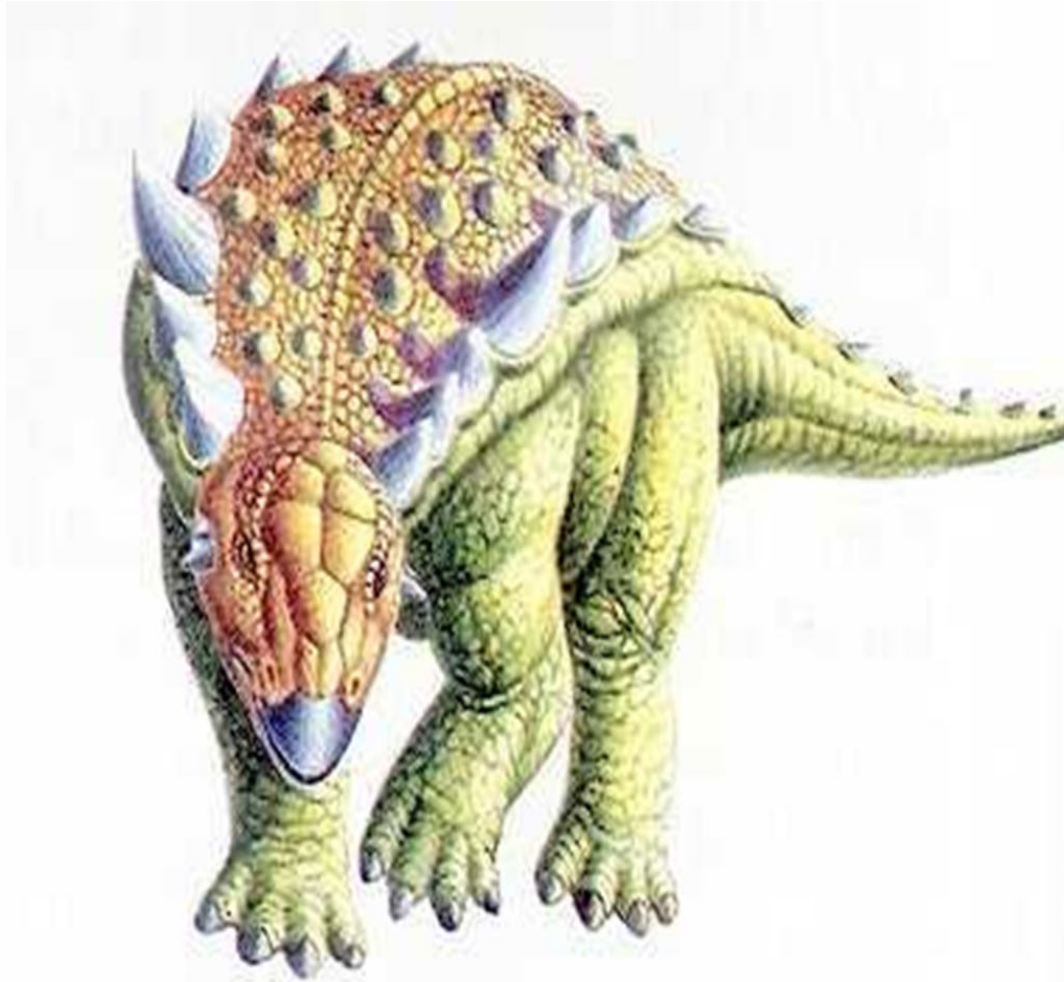
Footprints of a large armored ankylosaurian dinosaur also are present.



Tetrapodosaurus borealis



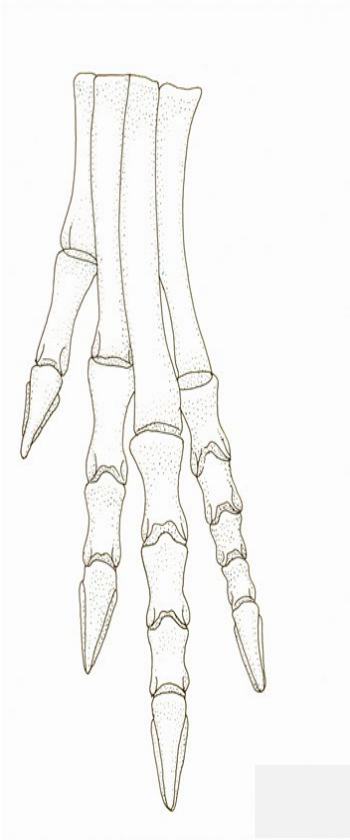
A possible maker of these tracks was the contemporary nodosaurid *Sauropelta*



from Pure Illusion Fantasy DinoWorld



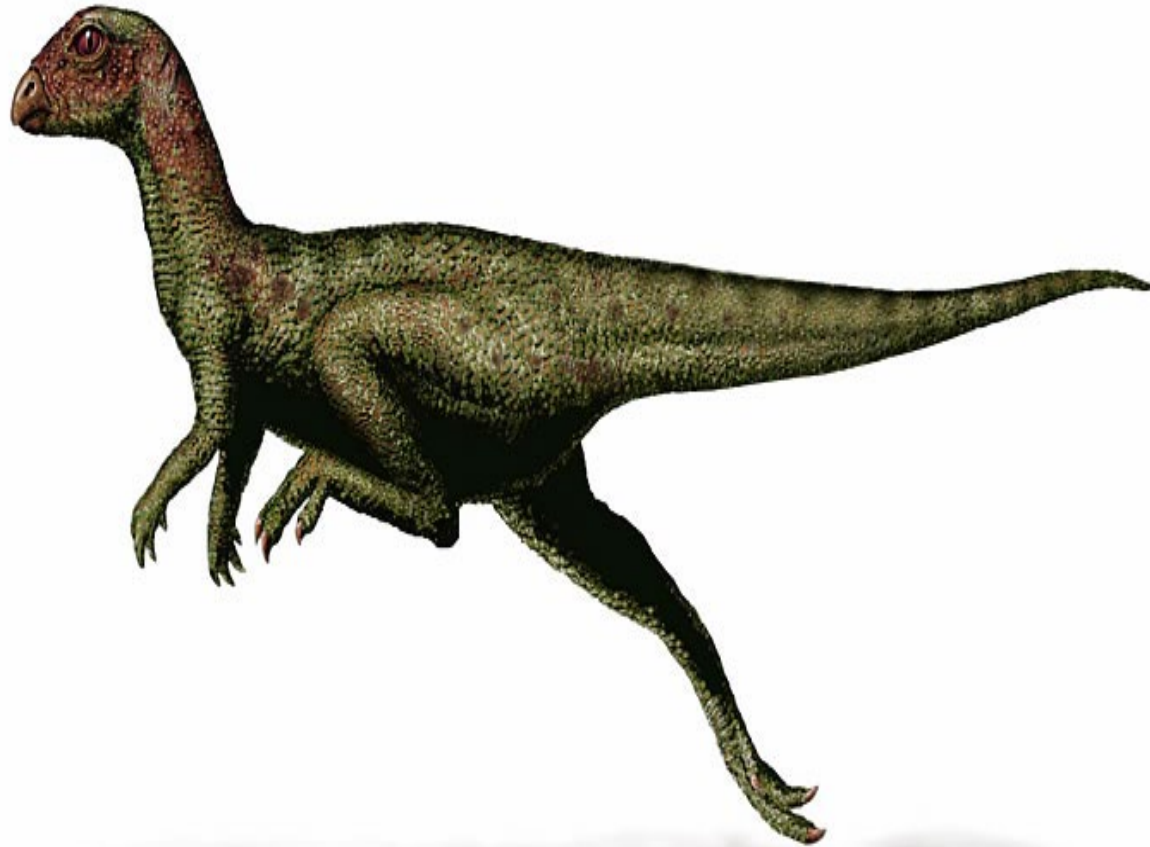
A small herbivore track
(*Hypsiloichnus*) also is present.



Hypsilophodon footprint



The likely maker of this track was *Zephyrosaurus*.



VIRGINIA
Energy

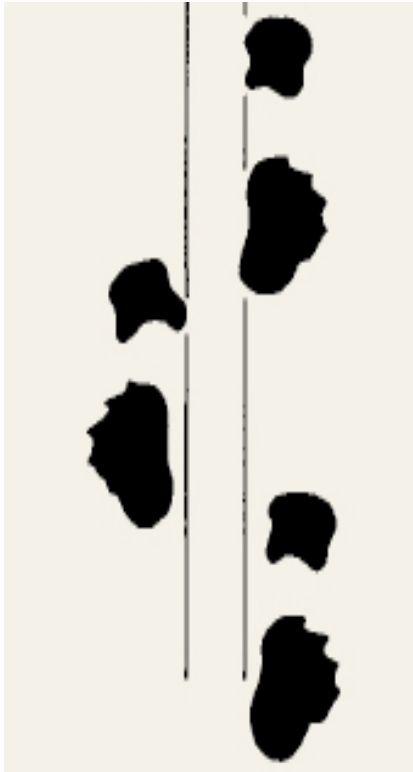
One *Ornithomimipus*
track has been found,
made
by an ornithomimid
("ostrich-mimic")
dinosaur.



Archaeornithomimus
is the likely maker of
this track type.



Brontopodus footprints are the largest known tracks; they were made by a sauropod dinosaur up to 70 feet long.



The dinosaur that made these footprints probably was *Astrodon johnstoni*.



Dmitry Bogdanov - dmitrchel@mail.ru



The abundant footprints of herbivores, many from very large animals, indicate that there was abundant food for carnivorous dinosaurs.

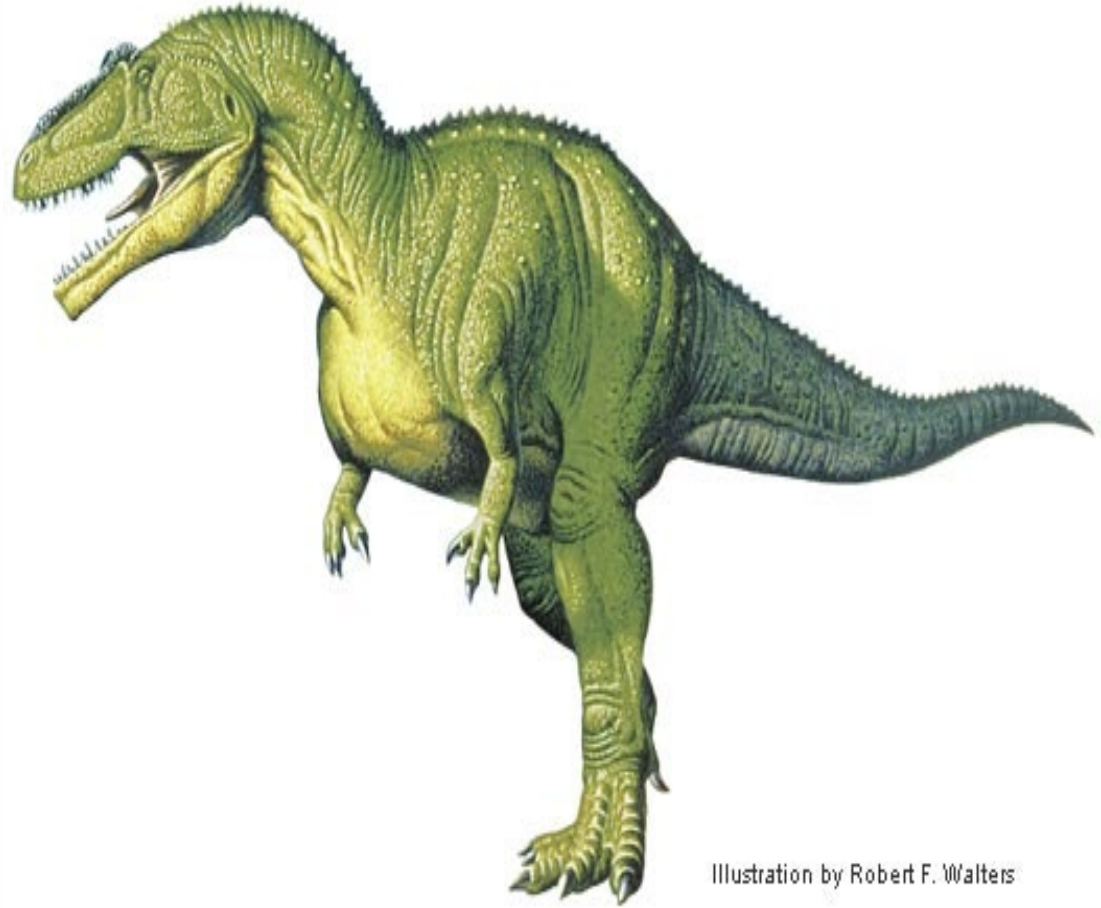


Illustration by Robert F. Walters



Single large toe prints, so far only found at Belmont, demonstrate the presence of a large carnivorous dinosaur.



Paluxy River, Texas



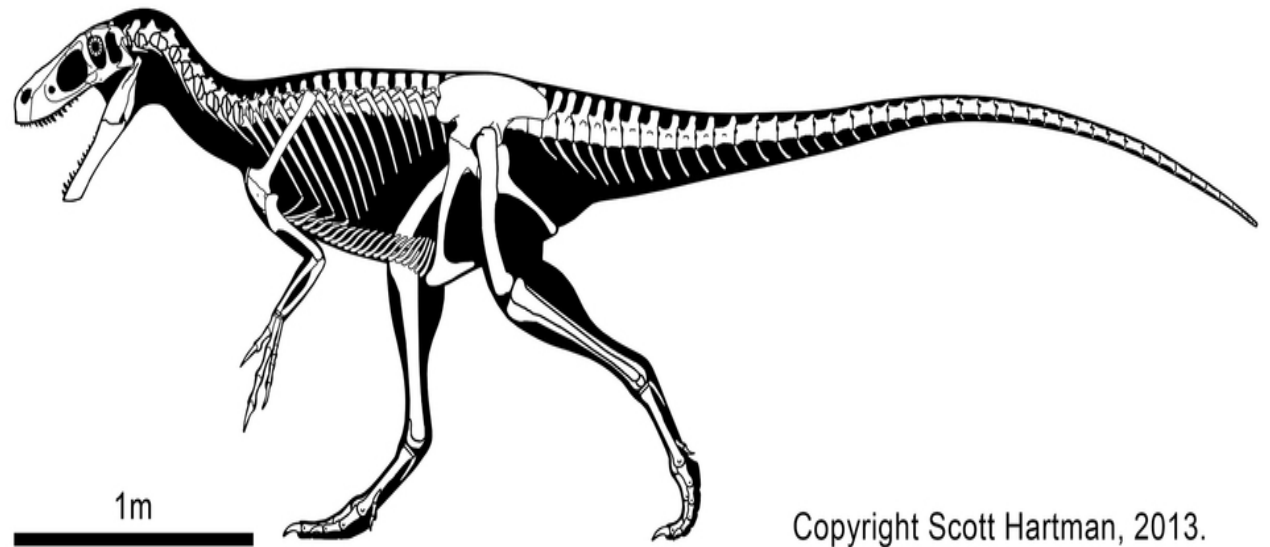
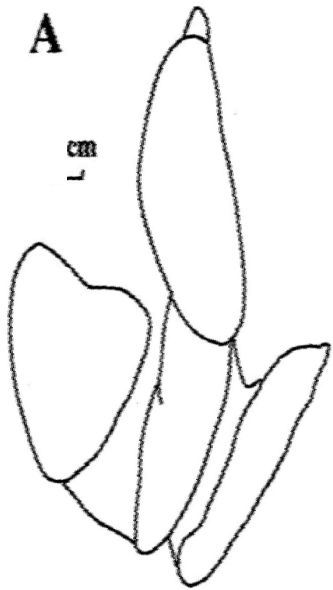
Belmont



These large carnivore footprints likely were made by the carcharodontiformid *Acrocanthosaurus*, which was the largest American carnivore known from this time interval.



Smaller carnivore footprints (*Megalosauropus*) have been found in the Fredericksburg area that were possibly made by the contemporaneous early tyrannosaurid *Eotyrannus*.



Copyright Scott Hartman, 2013.





“The World in the Triassic Period”

<https://www.nationalgeographic.com/science/article/triassic-period>



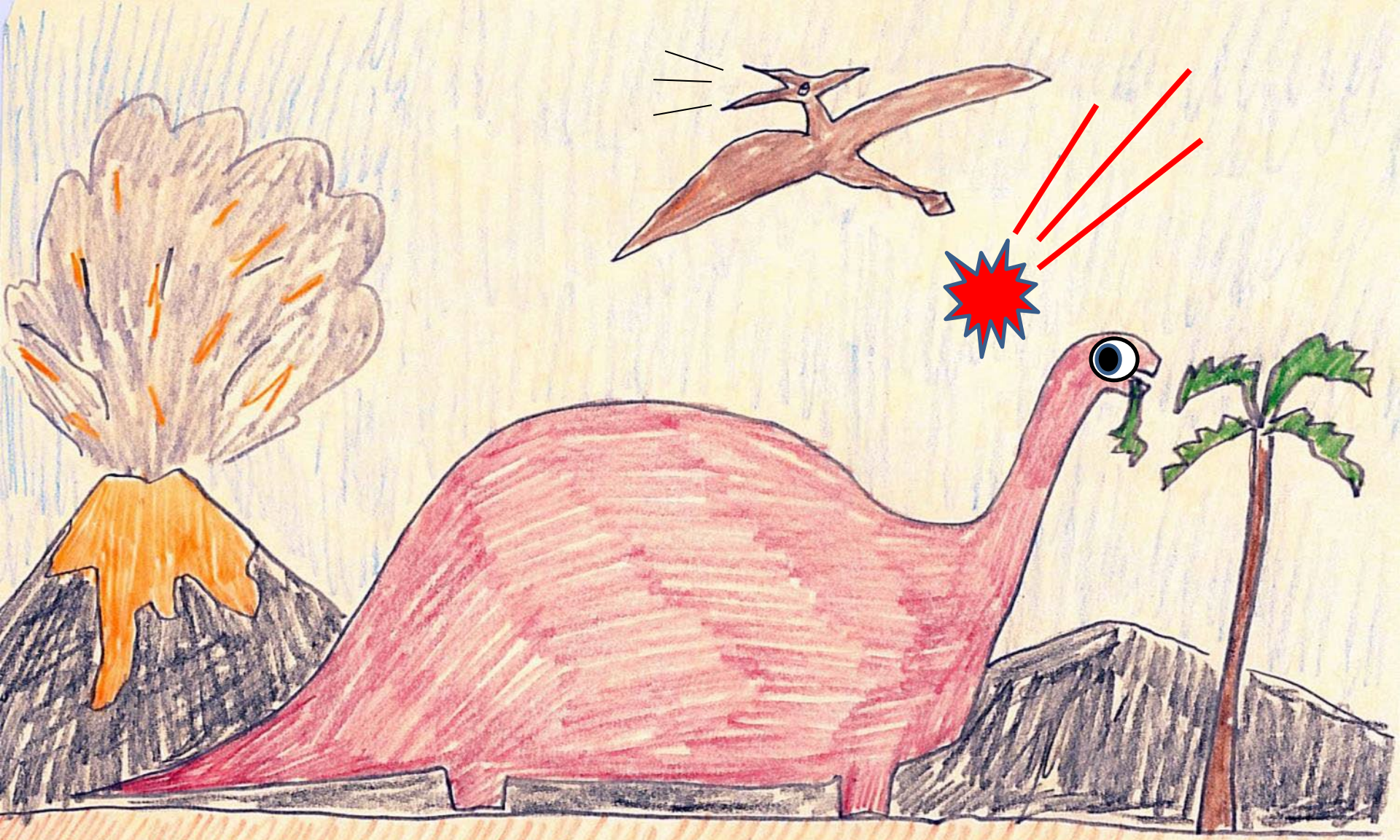


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“The World in the late Cretaceous Period”

http://planetdi.startlogic.com/age_of_the_dinosaurs/cretaceous_period.htm





What killed the dinosaurs?

The leading theory is that the dinosaurs were killed by a severe climatic disruption caused by a massive meteor impact.



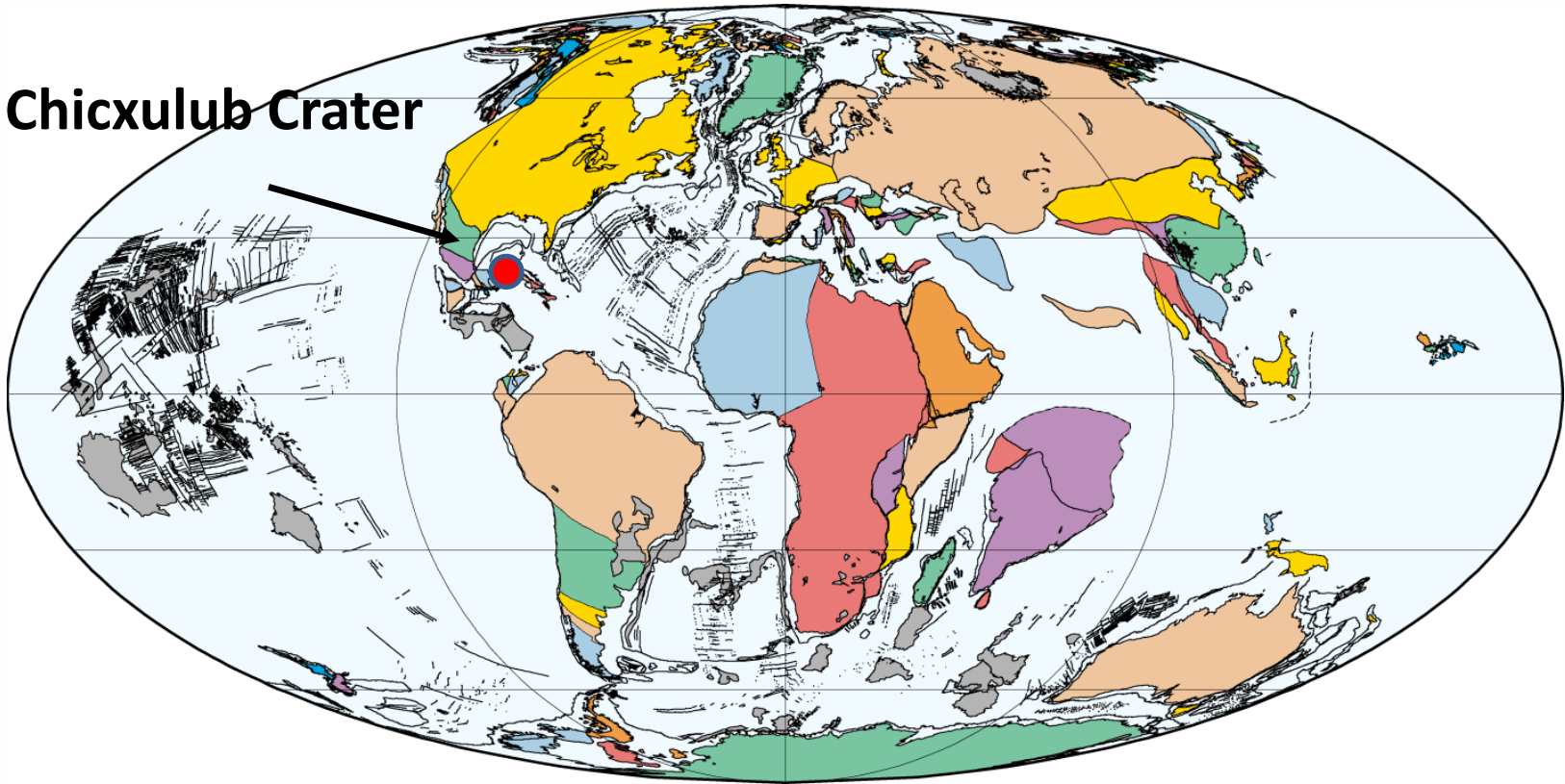


The impact caused a huge crater, now buried, beneath Mexico's Yucatan Peninsula.

Chicxulub Crater



Chicxulub Crater



70 Ma
Maastrichtian (Late Cretaceous)

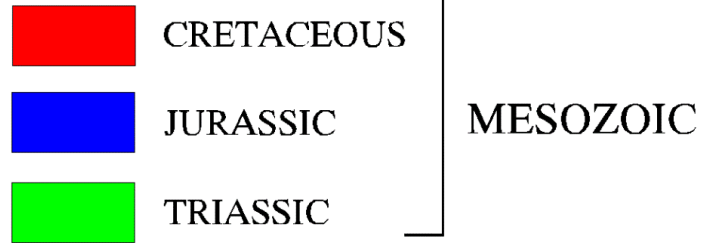
PLATES/UTIG
August 2002

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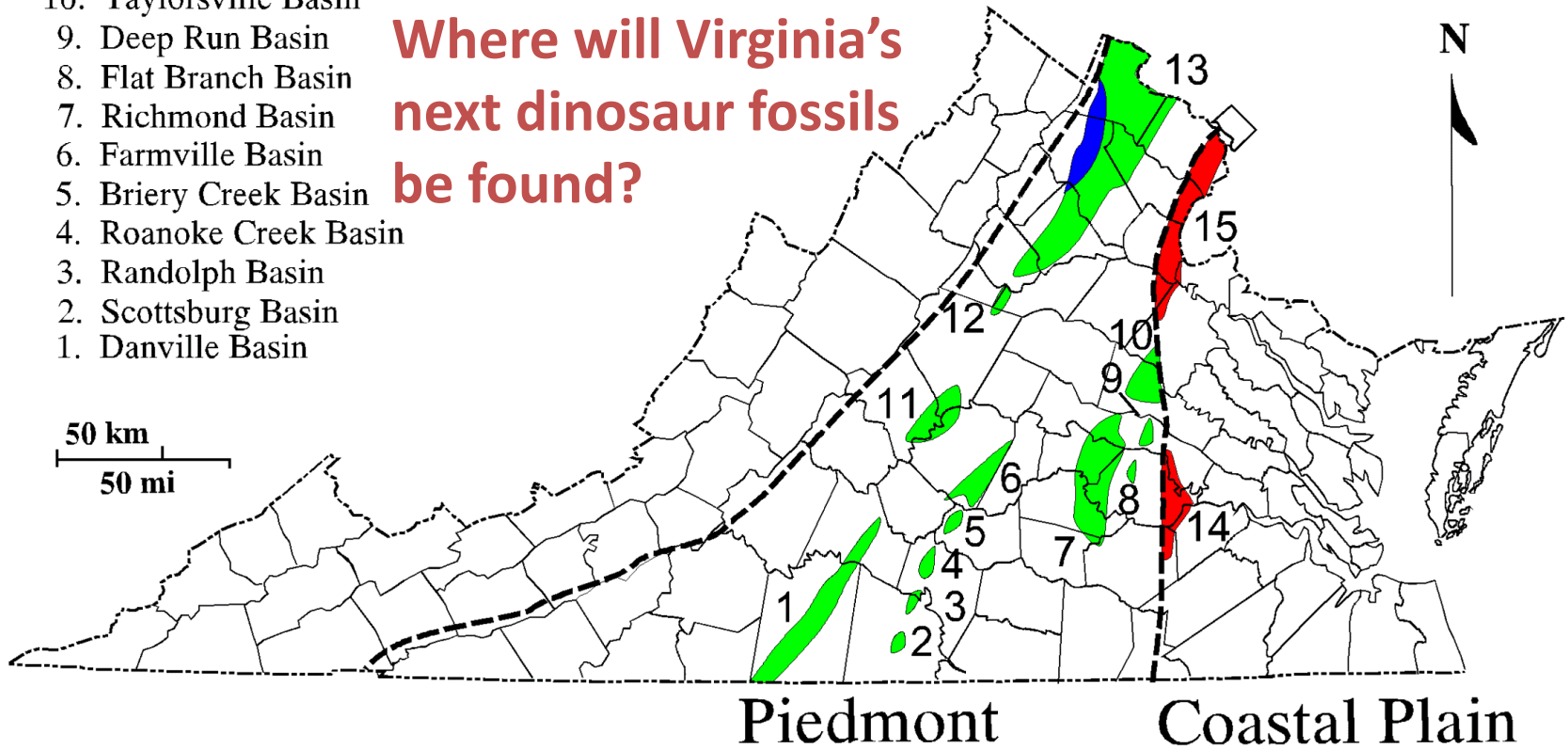
The reconstructed arrangement of the continents at the time of the Chicxulub impact.



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Where will Virginia's next dinosaur fossils be found?



50 km
50 mi



Weems, 2016

Keep Looking!

