

Lecture 5: Paleontology (How to find a dinosaur)



Skeleton of the theropod *Allosaurus* ([source](#))

Paleontologists looking for (extinct) dinosaurs

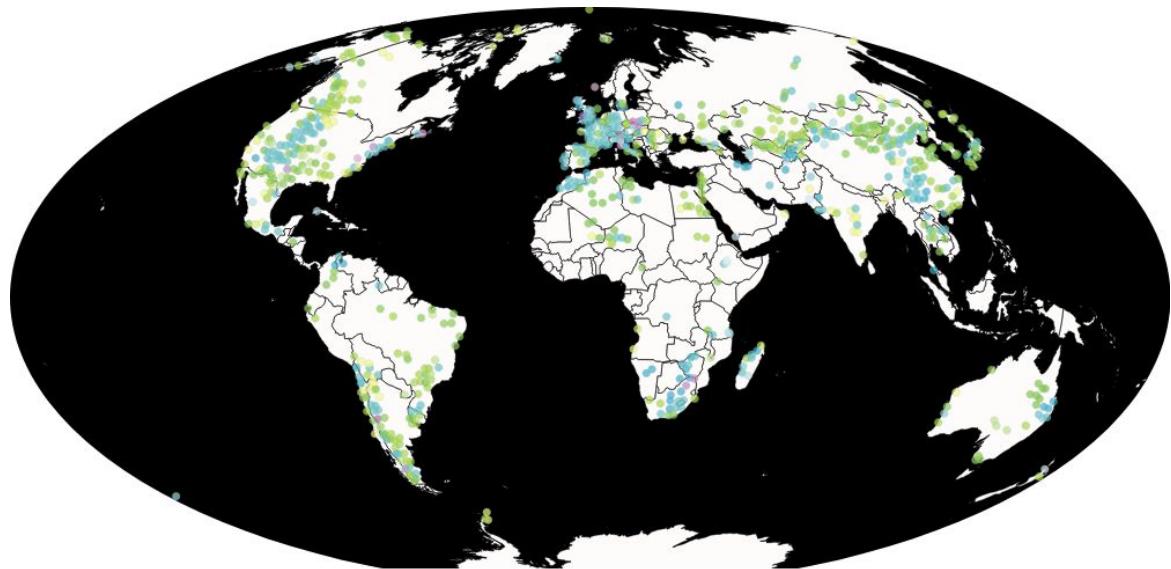


Paleontologists excavating a dinosaur tail in Coahuila State ([source](#))

- **Paleontology** is the branch science that deals with the discovery, collection, and preservation of fossils
- Some paleontologists specialize in the study of dinosaurs

Where have dinosaur fossils been found?

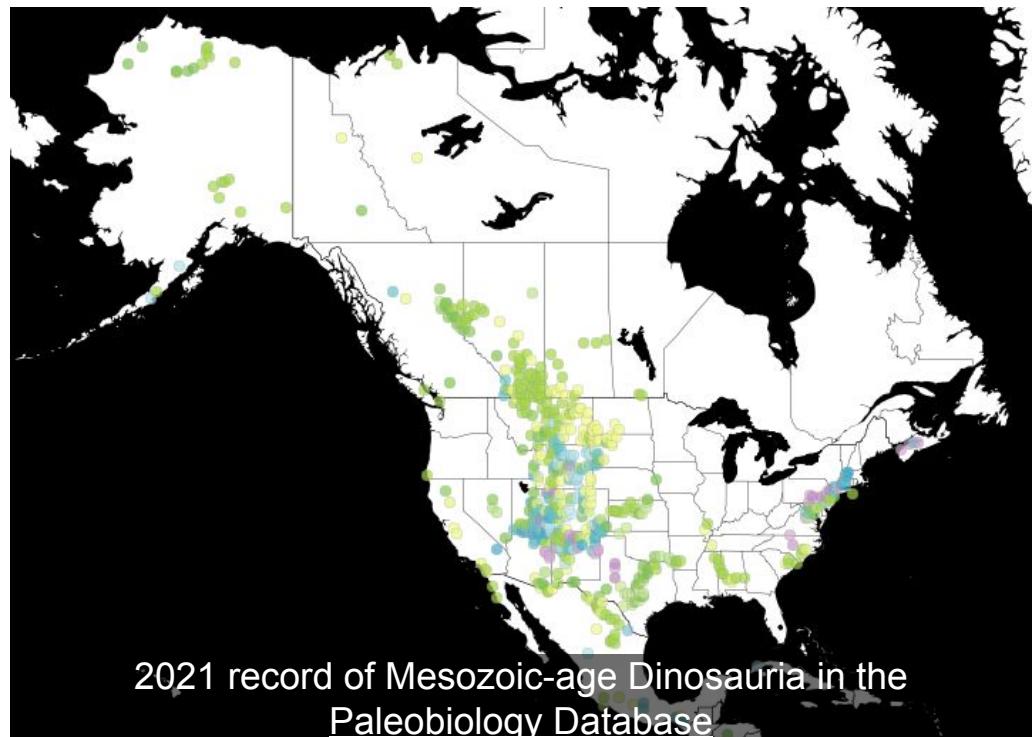
- Dinosaurs have been found on every continent, but they are not distributed across the globe evenly



2021 record of Mesozoic Dinosauria in the Paleobiology Database

Where have dinosaur fossils been found?

- In North America, most dinosaur fossils have been found in a belt across the middle of the continent
- Why are dinosaurs only found in certain locations?



Step 1: Your rocks have to be the right age

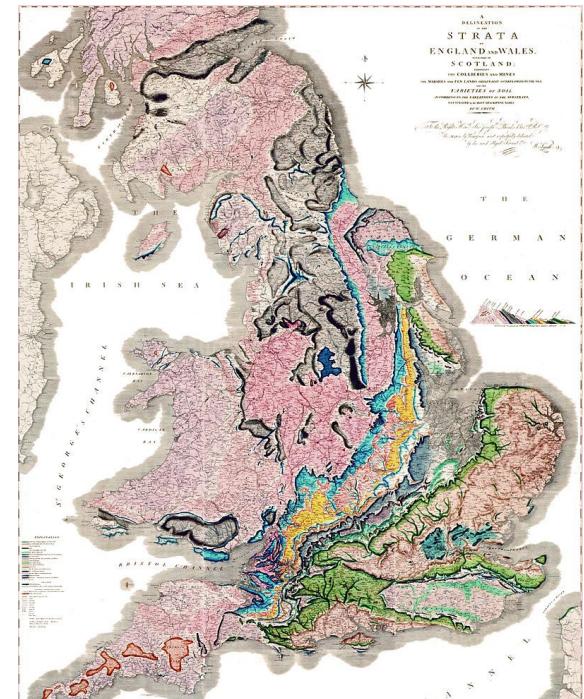


Paria Canyon/Vermilion Cliffs Wilderness ([source](#))

- Complex patterns of **sedimentation** and **erosion** mean rocks from different geologic ages are exposed in different parts of the world
 - **Sedimentation:** the laying down of dirt and mud, eventually turning into layers of rock
 - **Erosion:** the weathering of rock by wind and water

Step 1: Your rocks have to be the right age

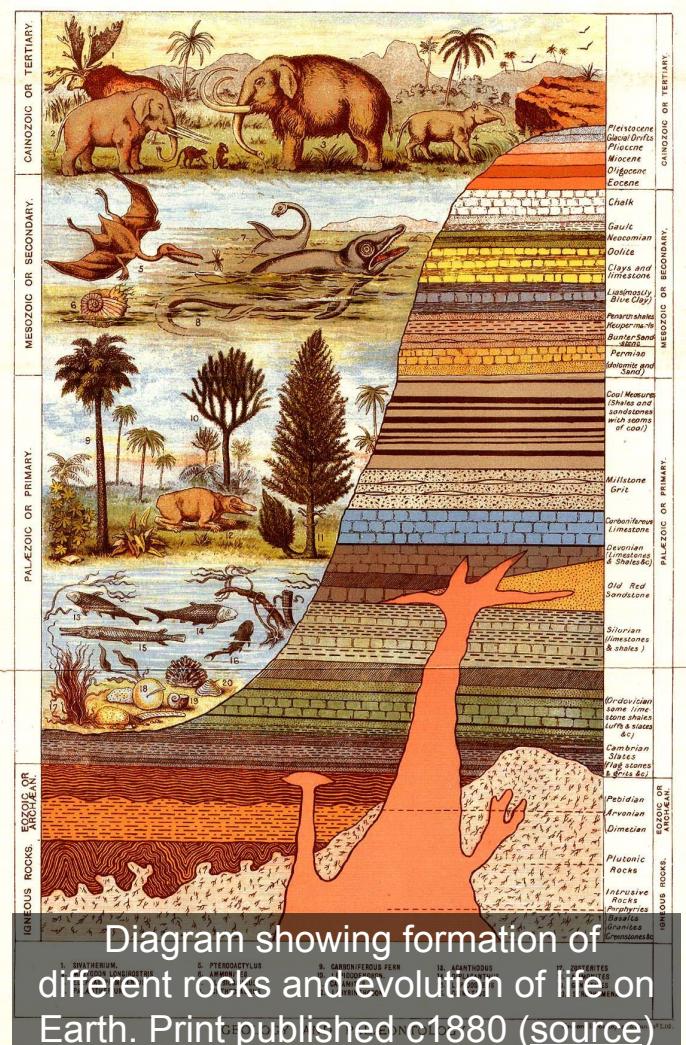
- Complex patterns of **sedimentation** and **erosion** mean rocks from different geologic ages are exposed in different parts of the world
 - These ranges are plotted on **geologic maps**



The first geologic map, published in 1815 by William Smith ([link](#))

Scientists quickly discovered that dinosaurs are only found in specific layers of rock

- Erosion helps reveal the order rock layers (or **strata**) were deposited
- Stratigraphy** is the science of mapping the order of rocks
- Dinosaurs are found in **Mesozoic** rocks (Greek: “meso” = middle; “zoa” = life) because they are in the middle of the stratigraphic column



A geologic map of the United States

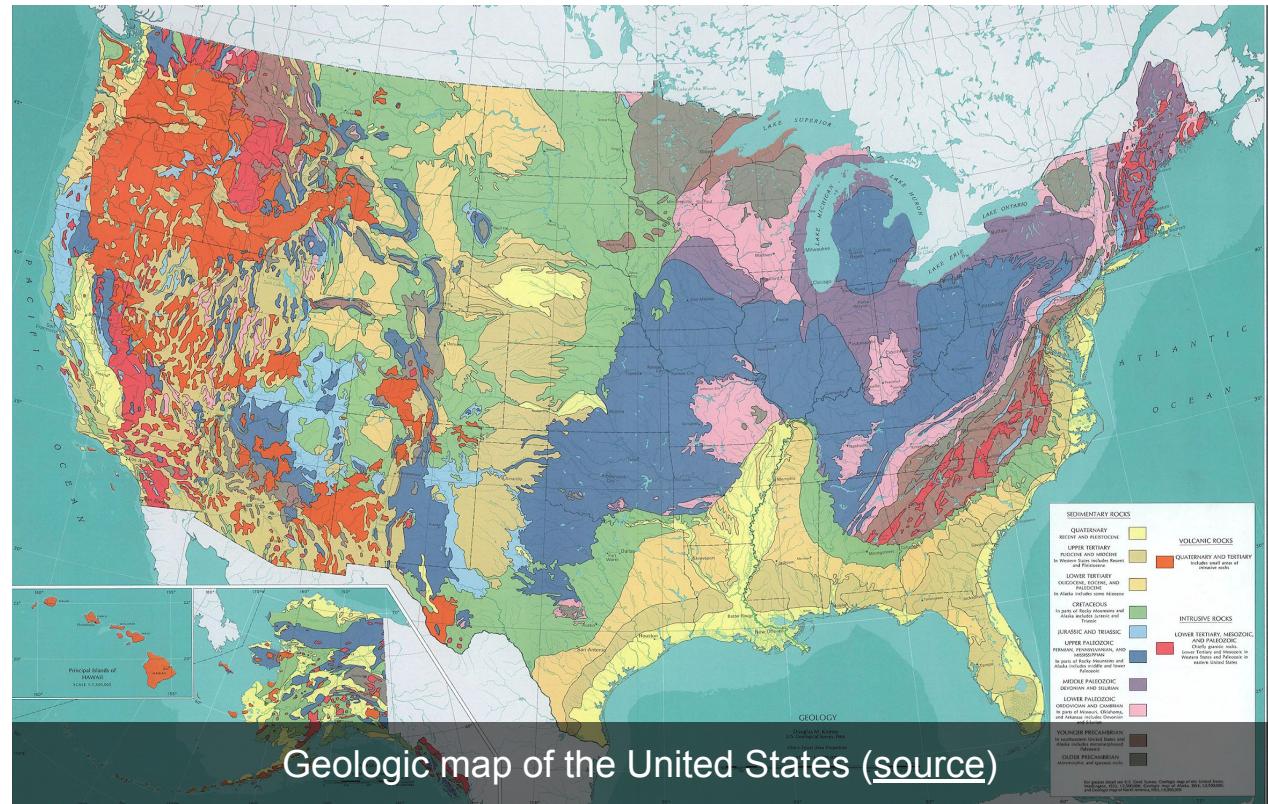
Mesozoic-age rocks:



Cretaceous



Triassic /
Jurassic



Step 2: Your rocks have to be the right type

- Geologists divide rocks into three major groups:

- **Igneous** - formed through the cooling and solidification of magma and lava.
- Sedimentary
- Metamorphic



Igneous rock being produced by lava ([source](#))

Step 2: Your rocks have to be the right type

- Geologists divide rocks into three major groups:
 - Igneous
 - **Sedimentary** - formed by the accumulation and cementation of sediment at the Earth's surface
 - Metamorphic



Triassic-age sedimentary rocks in Utah ([source](#))

Step 2: Your rocks have to be the right type

- Geologists divide rocks into three major groups:
 - Igneous
 - Sedimentary
 - **Metamorphic** - formed by the transformation of other rocks through extensive heat and pressure



Mississippian-age marble in Wasatch Mountains, Utah ([source](#))

Step 3: You have to get lucky



Illustration of the original 1915 material recovered from *Spinosaurus* ([source](#))

- Even with the best knowledge, you still don't know until you look
- Paleontologists often revisit promising field sites year after year hoping for major discoveries
- Even then, most discoveries are fragmentary and fragile

History has played an important role on where paleontologists have (and have not) looked



Mary Anning, one of the first British paleontologists
[\(source\)](#)

- Modern paleontology arose in Britain, and traveled alongside European colonialism
- European interest in the rediscovery of ancient Greek writings is why most dinosaurs have Greek / Latin names
- Most early discoveries occurred in Europe and the United States

A brief history of dinosaur research

1820s-1850s

First dinosaurs discovered in Britain

1860s-1880s

Dinosaur “bone wars” in the United States

1890s-1910s

Major finds in Canada (Dinosaur Provincial Park)

1920s-1930s

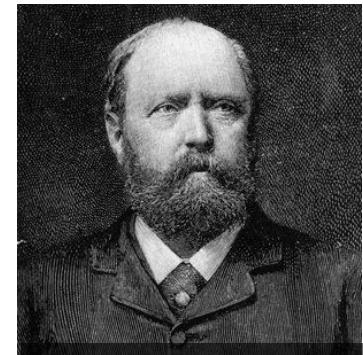
American paleontologists study the Gobi desert
(China eventually closes off)

1910s-1950s

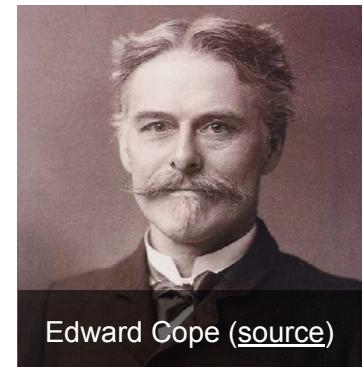
German paleontologists study Tanzania;
French paleontologists study Morocco, Algeria,
and Madagascar

A case study in how History Shapes Dinosaurs: The dinosaur “bone wars”

- Othniel Charles Marsh
 - Nephew of multimillionaire George Peabody
 - Yale University graduate
 - Persuaded his uncle to finance the Peabody Museum at Yale, which supported his field work.
- Edward Drinker Cope
 - Grew up a Quaker in Philadelphia
 - Inherited a small fortune that allowed him to pursue paleontology

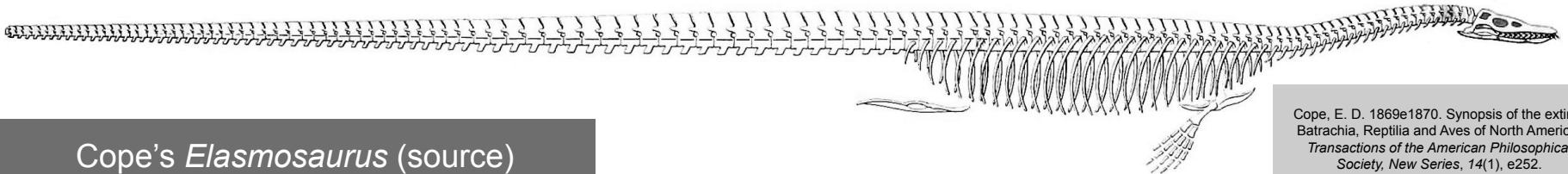


Othniel Marsh ([source](#))



Edward Cope ([source](#))

The dinosaur “bone wars”



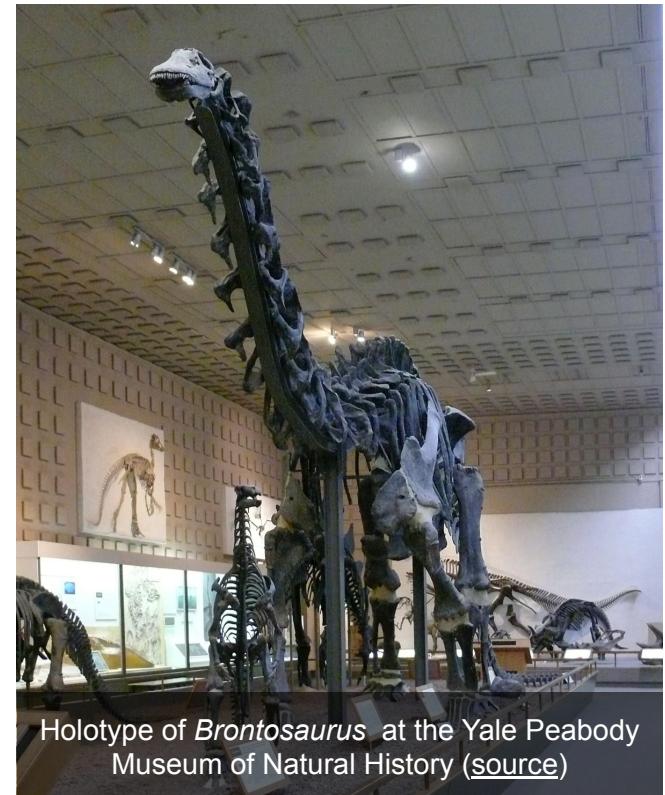
Cope's *Elasmosaurus* (source)

Cope, E. D. 1869e1870. Synopsis of the extinct Batrachia, Reptilia and Aves of North America. *Transactions of the American Philosophical Society, New Series*, 14(1), e252.

- Marsh pointed out errors in Cope's 1868 description of the marine reptile *Elasmosaurus*.
- Embarrassed, Cope tried to buy all the copies of his article, but Marsh kept several copies.
- Marsh's and Cope's ambition to be the first to describe the largest and most spectacular fossils started a "dinosaur rush" that lasted for a decade.
- They hired teams of men to find new locations, to dig for dinosaurs and to send bones to New Haven and Philadelphia for description.

The dinosaur gold rush

- Each scrambled to be the first in print with new dinosaurs. As a result, many dinosaurs received two or more names.
- For example, Marsh described *Apatosaurus* in 1877 and *Brontosaurus* in 1879.
- Assuming they are the same animal, the older name has priority.



Holotype of *Brontosaurus* at the Yale Peabody Museum of Natural History ([source](#))

Fossil dispossession and Westward expansion



Yale students ransacking Sioux burial platforms during an 1870 expedition

- Americans, expanding West, led geological surveys to look for resources
- The presence of fossils was sometimes used as justification to move Native Americans off of land

Schuchert, C., and LeVene, C.M. OC Marsh, pioneer in paleontology. Yale university press, 1940.
Bradley, L.W. Dinosaurs and Indians: Paleontology resource dispossession from Sioux lands.
Outskirts Press, 2014.

The dull days of dinosaurs

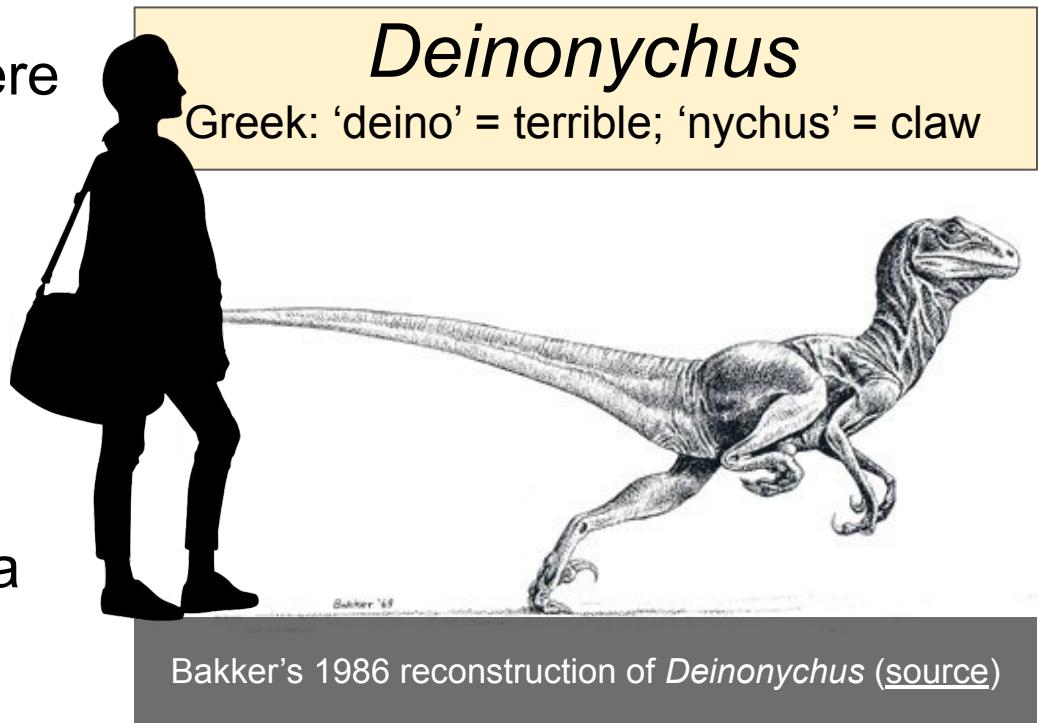


Triceratops and *Tyrannosaurus* by Charles Knight

- Early excitement of dinosaurs eventually gives way to stagnation
- The animals are not an important area of science
- Considered evolutionary failures

The Dinosaur Renaissance

- In the 1960s dinosaurs were seen as big reptiles and evolutionary losers
- The discovery of *Deinonychus* with the advocacy of John Ostrom and Robert Bakker led to a reconsideration



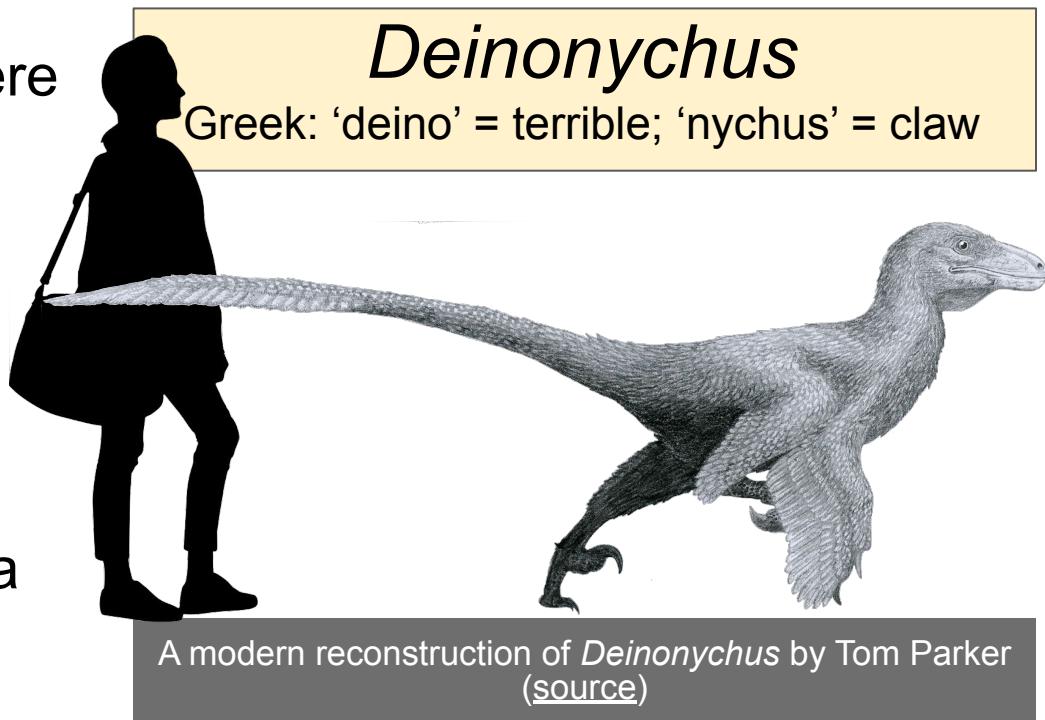
Deinonychus

Greek: 'deino' = terrible; 'nychus' = claw

Bakker's 1986 reconstruction of *Deinonychus* ([source](#))

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Jurassic Park



Phil Tippett working on *Velociraptors* in *Jurassic Park* ([source](#))

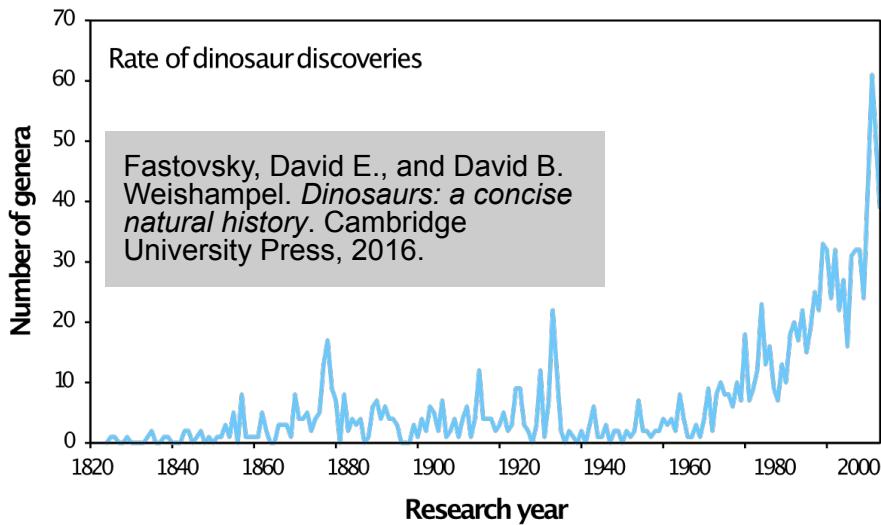
Jurassic Park



Jurassic Park



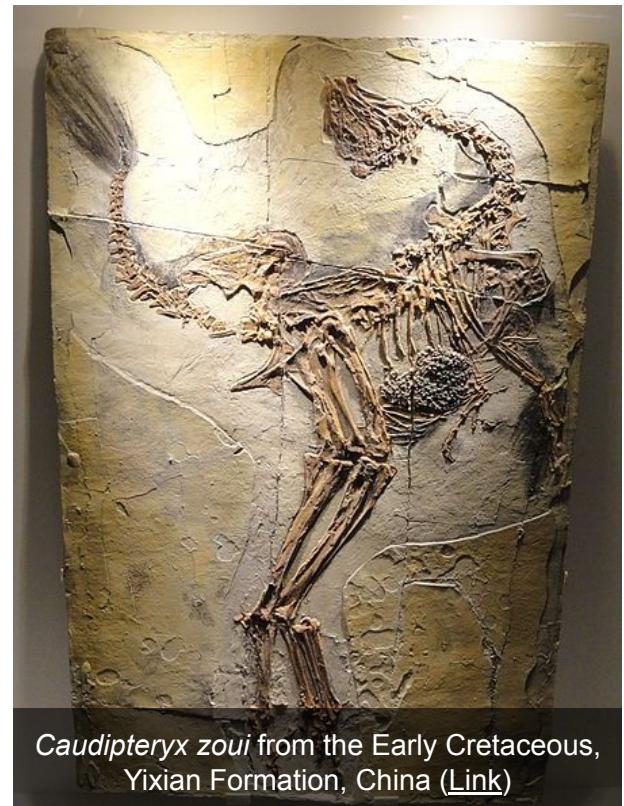
Fossil hunting goes global



- As paleontology surged in the 1970s-1990s, more people got involved in science and scientists began exploring more diverse places
- Major discoveries in South America, Africa, Antarctica

The impact of geopolitics on science: the Yixian formation

- Previously discussed as an example of **lagerstätte**
- No collaboration between Chinese and global scientists until the 1990s
- A missing menagerie of feathered dinosaurs



Conclusion



- Paleontologists use knowledge of the rock record to increase their chance of finding fossils
- Where people have looked for fossils is also impacted by history, geopolitics, and even film
- Dinosaurs are being described at a near-exponential rate, improving our knowledge of the group

Next class

Why do we think dinosaur fossils are old?

SECTION IN
GRAND WASH
CLIFFS

