Introduction to Paleontology

What is Paleontology?

Paleontology is a diverse field that focuses on examining ancient life make inferences of past environments. Paleontology incorporates many other scientific disciplines including: biology, geology, ecology, anthropology, archaeology, and even computer science to better understand the processes operating in the world around us.

Paleontology can be subdivided into many fields including:

- *Micropaleontology*: the study of microscopic fossils
- *Paleobotany*: the study of fossil plants
- *Palynology:* the study of pollen and spores
- *Invertebrate Paleontology:* study of invertebrate fossils
- *Vertebrate Paleontology:* study of vertebrate fossils
- *Human Paleontology (Paleoanthropology):* study of prehistoric human and proto-human fossils
- *Taphonomy:* study of the processes of decay, preservation, and the formation of fossils
- *Ichnology:* study of fossil tracks, trails, and footprints
- *Paleoecology:* study of ecology and climate of the past

What is a Fossil?

A fossil is the remains of any ancient organism. Fossils may look like random pieces of rock in the shape of bones or leaves or shell material. Fossils fall into two categories: body or trace fossils.

Body fossils are where a portion of the actual body of the organism undergoes the process of fossilization.


Trilobite


Trionyx

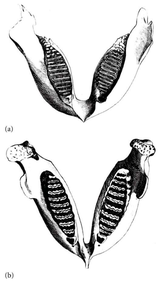
Trace fossils are the remnants of past behavior. This includes things such as resting traces, trails, burrows, nests, footprints, and even coprolites (fossilized feces)!


Thalassinoides


Dinosaur Footprint

Images from:
Fossilsandmore.org
Paleo.cc/palaxy/ovrdino.htm
www.dkfindout.com/au/dinosaurs-and-prehistoric-life/fossils

Age of Enlightenment


(a)

(b)

Evidence of extinction as seen in Cuvier's comparison of (a) the lower jaw of a mammoth and (b) the lower jaw of a modern elephant.

During the 1700s, a period of time to become recognized as the Age of Enlightenment, scientists began to describe and map rock formations and classify the fossils within them. It became clear that rock layers were the project of long periods of sediment buildup, rather than the results of single catastrophic events. In the early 1800s, Georges Cuvier and William Smith discovered rock layers in different areas that could be compared and correlated to the similar fossil assemblages.

Charles Lyell and Charles Darwin, later that century, provided evidence that influenced how society understood the history of Earth and its organisms. By comparing faunal assemblages, we can begin to understand relationships between rocks over great distances.

Nicolaus Steno's (1667) classic representation that fossils represent the remains of ancient animals. The fossil teeth look remarkably similar to modern shark teeth, shown here as a dissected shark head.

Invertebrate versus Vertebrate Paleontology

Invertebrate means without vertebrae (the components of a backbone).

Invertebrate paleontology studies ancient organisms without a backbone. This includes: insects, mollusks (snails, squids, calms, slugs, etc.), corals, jellyfish, sponges, worms, sea stars, and many more.

Vertebrate means with vertebrae, this encompasses all organisms with a backbone.

Vertebrate paleontology studies ancient organisms which possess a backbone. This includes: fish, amphibians, reptiles, birds, mammals, dinosaurs, and many more.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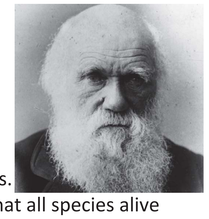
The terms 'vertebrate' and 'invertebrate' have little meaning aside from distinguishing which has a backbone. Separately, these groupings do not have evolutionary meaning.

Charles Darwin and Paleontology



Charles Darwin (1809—1882) developed the idea of natural selection in the 1830s as a way to describe how species changed through time.

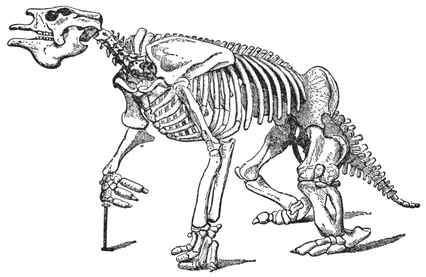
Darwin understood that individuals within a species showed variations and that there was not a fixed central 'type' that represented each of the species. He also highlighted the idea of evolution by common descent. This means that all species alive today had evolved from other species in the past. The problem that Darwin was seeking to address was how the variation within species could be understood to produce evolutionary change.

Thomas Malthus (1766-1834) demonstrated that human populations often increase more rapidly than the supplies of food, allowing for the stronger to survive. Darwin understood that this principle could be applied to most groups of animals and that the surviving individuals would be those that were best fit to obtain food and reproduce, and their particular adaptations would be inherited.

Darwin predicted that paleontology would provide key evidence for evolution. He expected that as more fossils were uncovered, they would line up in long sequences showing the pattern of common descent.

Darwin in Argentina

While Darwin's voyages to the Galapagos Islands are well-documented, Darwin's paleontological research in Argentina was just as important in formulating his theories on evolution by natural selection. His expeditions in Punta Alta (about 400 miles southwest of Buenos Aires were important in uncovering fossil remains of many large mammals, unknown to modern times. A famous example of this is one of the giant sloths, *Megatherium*, which was about 20ft in length!


Megatherium, a giant ground sloth from the Pleistocene

What do Paleontologists do?

Paleontologists use evidence from past life to reconstruct ancient environments, body forms, and so much more!
Some paleontologists work in museums, taking care of the large amounts of specimens stored around the world. Others work at universities teaching the new generation of scientists. Regardless of where they work, they are often conducting their own research, which typically requires field work. Depending on the type of paleontology, field work is a very broad term.

Field expeditions: Excursions into the field can be very different. You could be going to the Arctic to explore the animal transition to land, visiting a coast in Spain to see gigantic echinoderms, or digging in the dirt in Wyoming to uncover dinosaur remains.


Museum work: Museums hold a wealth of information for paleontologists to explore. Behind the beautiful exhibits are walls of shelves containing specimens from publications and over a century of collecting. Many paleontologists will spend weeks of their field season in museums re-examining these specimens. It is not as fun or glamorous as fieldwork but the knowledge you gain is invaluable.


Road cuts: The Department of Transportation is often a valuable resource for paleontologists. As roads are expanding, they often must cut through rock. Doing this exposes untouched rock. There are rules about roadside collecting in every state that you must read prior to beginning. Road cuts can also be extremely dangerous- make sure safety is your number one priority!


Despite the extensive amount of study, there is much more for paleontologists to learn. This includes, but is not limited to:

- Understanding the entire Tree of Life
- Rates of diversification
- Rules of extinction
- Origins of life
- Origins of skeletal material

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For Darwin Day 2016

Text and Figure References

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