Anthro. 101:
Human Biological Evolution

Lecture 2 : Origins of Evolutionary Theory

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Darwin and the history of evolutionary thinking

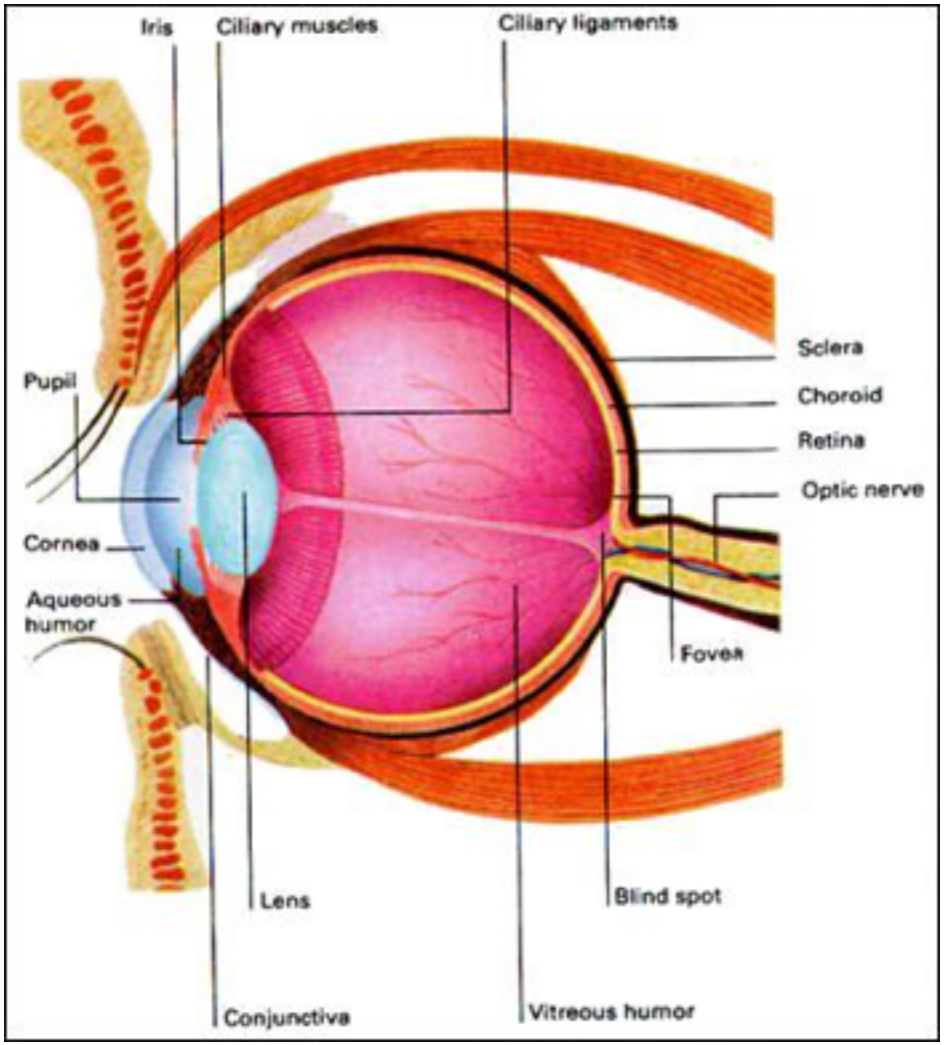
- Historical Context
- Darwin's theory of natural selection

Organisms are well-suited to their environment

- Viceroy butterfly

- Monarch butterfly

Complex adaptations require special explanation



The Scientific Revolution in Europe

- Global exploration
- Round Earth - 1492 etc.
- Biological Diversity
- Earth orbits the sun - 1541 Copernicus
- Solar system in motion - 1600's Galeleio
- physics, medicine, chemistry advanced
- Scientific methods
- Measuring instruments

Scientific revolution

- http://www.youtube.com/watch?v=9hodYUDDfsY

A problem emerges from the growing body of knowledge

- Early Geology = Study of stratigraphy
- Stratum (strata) = Layers of earth

Within these layers find fossils of non-existing animals

And many resemble living ones

A solution is proposed: James Hutton (1794)

- Strata = gradual process
  - erosion
  - accumulation
- Proposed “Deep Time”
  - Earth profoundly old

The solution is resisted: Georges Cuvier (1796)

- Proposed "Catastrophism"
  - Strata are formed by series of divine catastrophes
  - Acknowledges extinction
  - But, fossils represent prior creation events

The solution is refined: Lyell (1830)

- Proposes “Uniformitarianism”
- Natural processes same in past and present
- Slow accumulation of changes
- Requires deep time
- No supernatural catastrophes
- Darwin’s friend & mentor

So if the earth isn't young…maybe life isn't either

- Jean-Baptiste Lamarck
- First to propose an evolutionary mechanism for species change
- He was wrong in the details, but important nonetheless

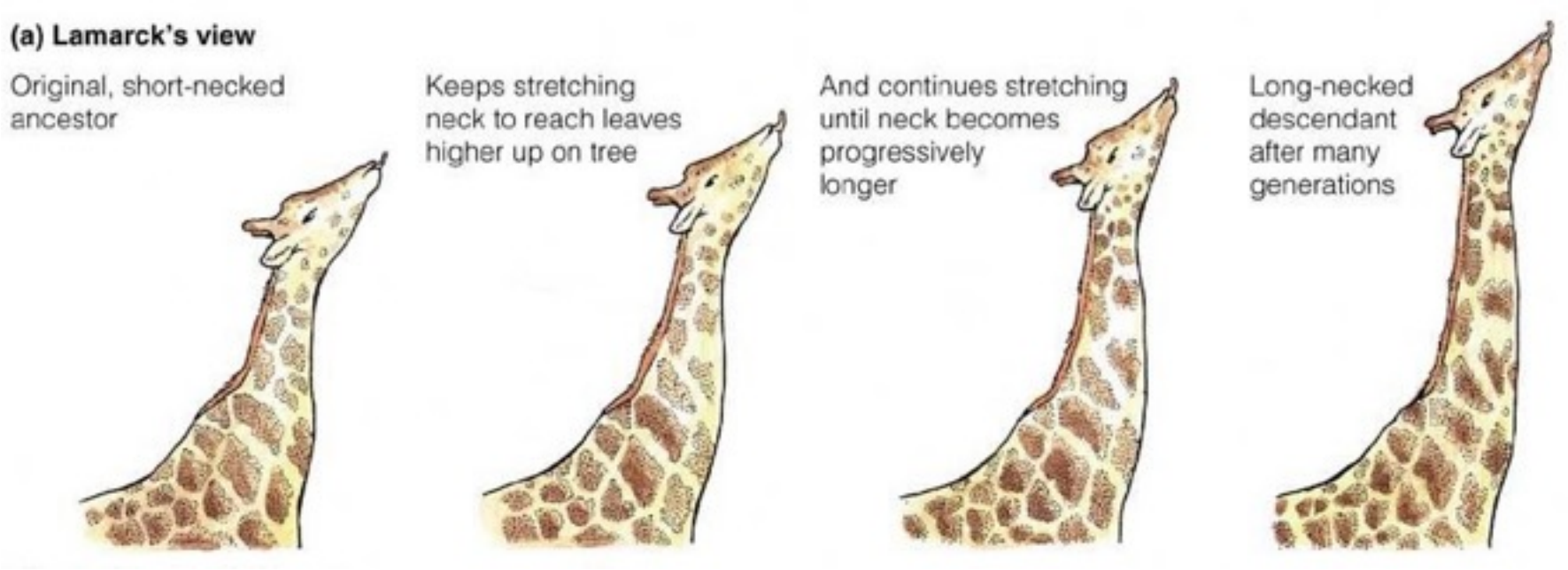
Prior to Lamarck: Fixity of Species

- **Species:** A group of organisms that can interbreed to produce viable off-spring

Biblical understanding:

- Every **species** was a unique act of creation
- Once created, never changes

…so perhaps species aren't fixed



Lamarckian Evolution – Inheritance of Acquired Characteristics

- Traits determined by their usefulness in an environment.
- If environment changes, organisms acquire new traits
- pass new traits on to their offspring

Lamarck's Evolution

- http://www.youtube.com/watch?v=bd9Fwv5sZMQ

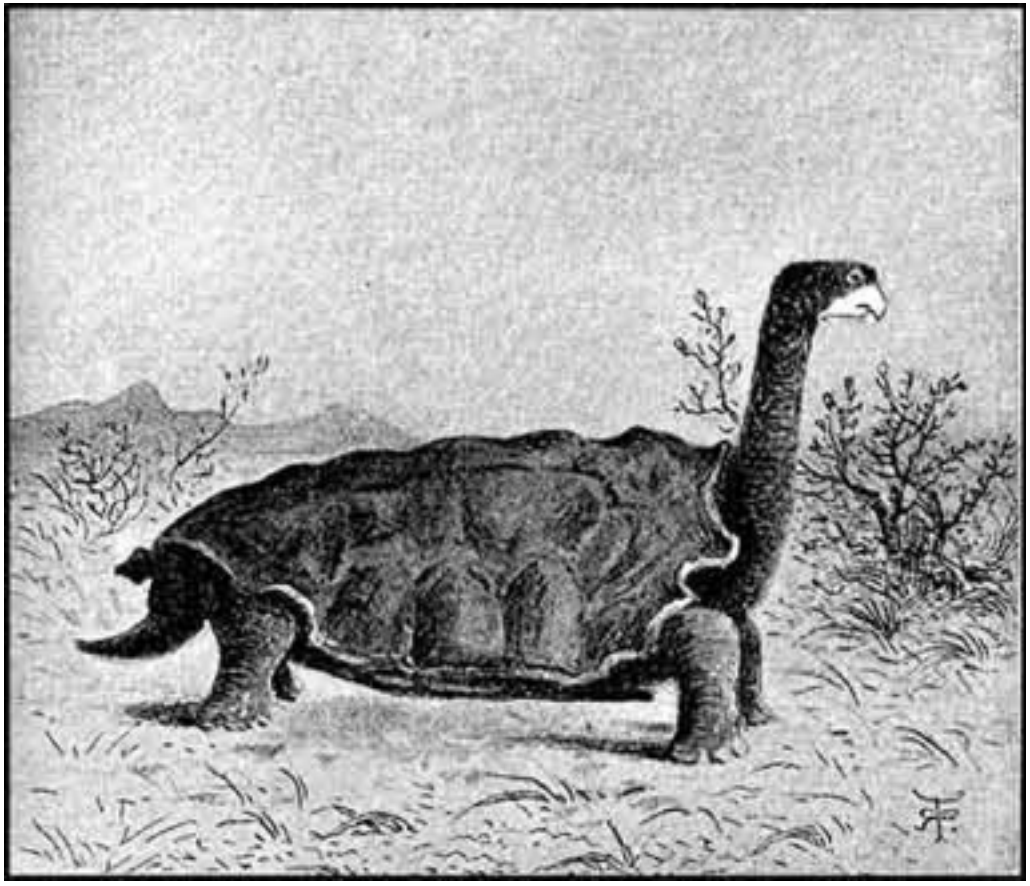
Meanwhile…

- Thomas Malthus (1798)
- *An Essay on the Principle of Population*
- Population growth outstrips food supply
- Population limited by limited resources
- Writing about human population

The Voyage of the Beagle (1831-1836)

Darwin's journey was a transforming experience

- Collected specimens
- Kept a detailed journal
- Deeply affected by the diversity of life

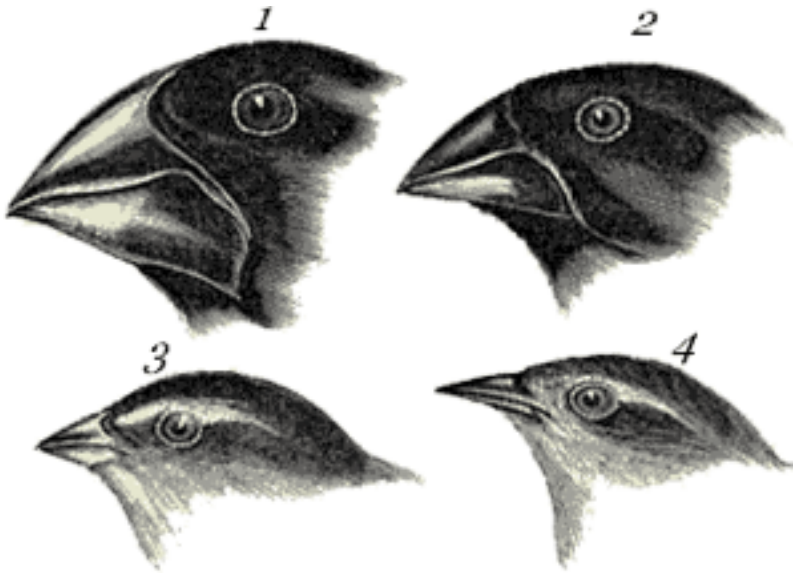


The *HMS Beagle* visited the Galapagos Island

- Animals unique to each island
- Similar to mainland species
- Islands are volcanic, recent formations
- Appearance of NEW FORMS

Darwin collected many birds on the Galapagos

- A variety of finch species
- Similarity in beak structure, body shape, and coloring
- Perfect gradation between species
- One species modified for different purposes



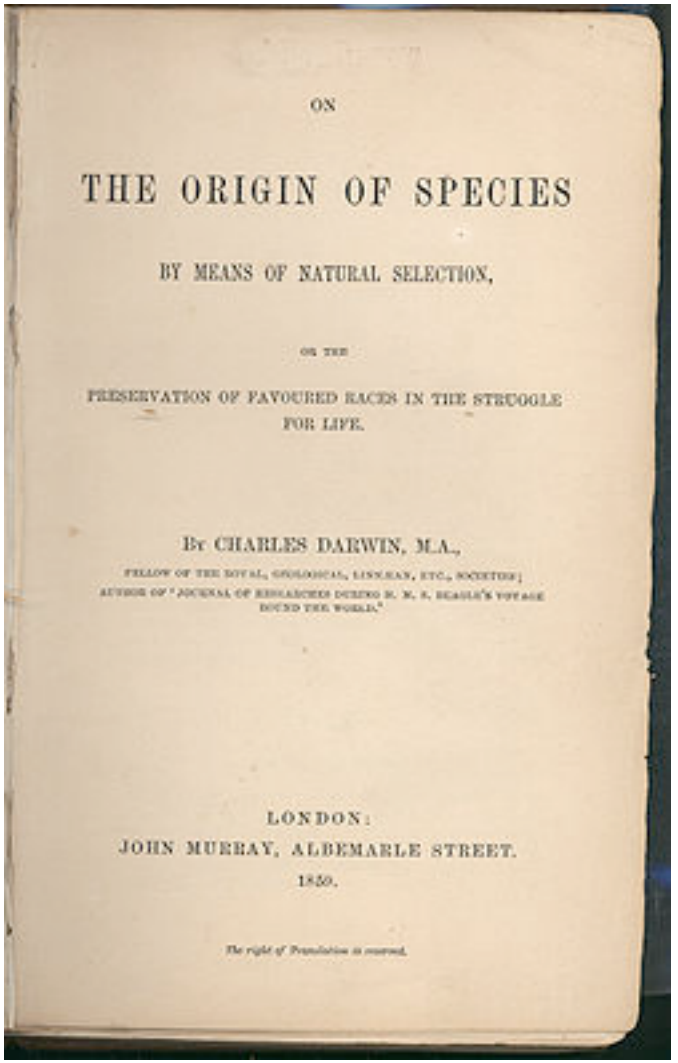
Adaptive Radiation

Enter Wallace

- Alfred Russel Wallace
- Working-class family, b.1823
- little formal education
- Expedition to Amazon in 1848
- Developed similar ideas in response to variety of natural phenomena

Publication

- 1858: Wallace sends Darwin his paper on natural selection
- Forced Darwin to write up his ideas - FINALLY
- Both papers presented at the Linnean Society of London.
- No-one noticed
- 1859: Darwin published *On the Origin of Species*. People noticed



ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNEAN, ETC., SOCIETIES;

AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1859.

Crash Course Dude

- https://www.youtube.com/watch?v=aTftyFboC_M

The Theory of Evolution by Natural Selection

- **Evolution**: Change over time
  - Can apply to many things besides biological organisms
- **Natural Selection**: Process by which species evolve
  - Analogous with artificial selection
- Darwin interested in *change over time of biological forms via the process of natural selection*

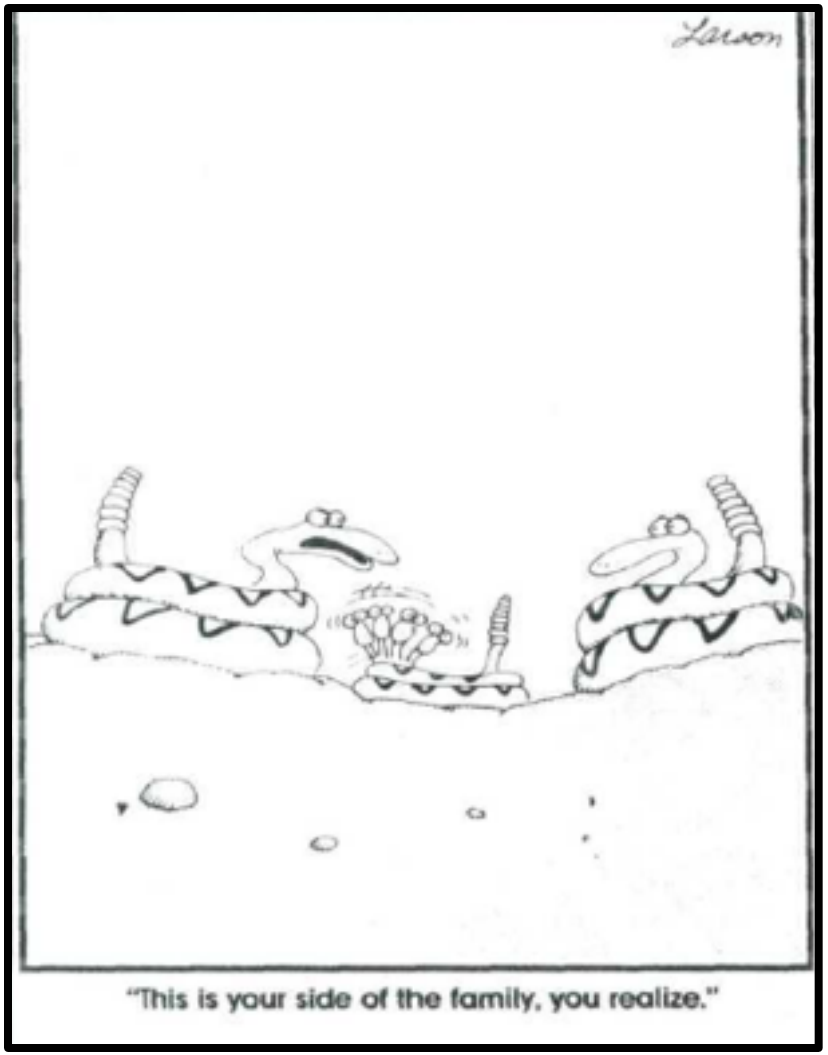
Darwin's Theory of Natural Selection (v1)

1. The ability of a population to expand is infinite, but the ability of the environment to support populations is always finite.

2. Organisms within populations vary, and this variation affects the ability of individuals to survive and reproduce.

3. Variations are transmitted from parents to offspring.

Darwin called this process
natural selection



The Theory of Evolution by Natural Selection (v2)

1. **Competition:**

Malthus: Capacity of populations to increase is unlimited. Resources are not

2. **Variation:**

In all species, individuals vary in some of their physical or behavioral characteristics

3. **Fitness:**

Some members of a population have a variant that grants an advantage over others

The Theory of Evolution by Natural Selection (v2 cont)

4. **Heritability:**

Some portion of this trait variation is inherited

5. **Differential Reproductive Success:**

Individuals with favorable traits produce more offspring than those who don't, leading to more members of the population who inherited the trait

6. **Adaptation:**

Highly favorable traits will eventually become widespread in the population, building new species-typical features

7. **Speciation:**

Over time, as new variants accumulate and old ones disappear, new species develop

Evolution

- http://ed.ted.com/lessons/myths-and-misconceptions-about-evolution-alex-gendler

Break up into Groups discuss video and answer these questions;

- What is evolution?
- Explain the concept of ‘natural selection’ and what it really means. Specify what mechanism causes the process of natural selection and why this occurs?