

Spring 2014: Mondays 10:15am – 12:05pm (Fox Hall, Room 204)

Instructor: D. Magdalena Sorger

Website: theantlife.com/teaching/bio295-islands-evolution

LECTURE 02

Today:

Introductions part 2

Follow-up on minute papers

Take-home assignment

History of evolutionary theory

Natural selection (definitions & basic principles)

How to read a scientific paper

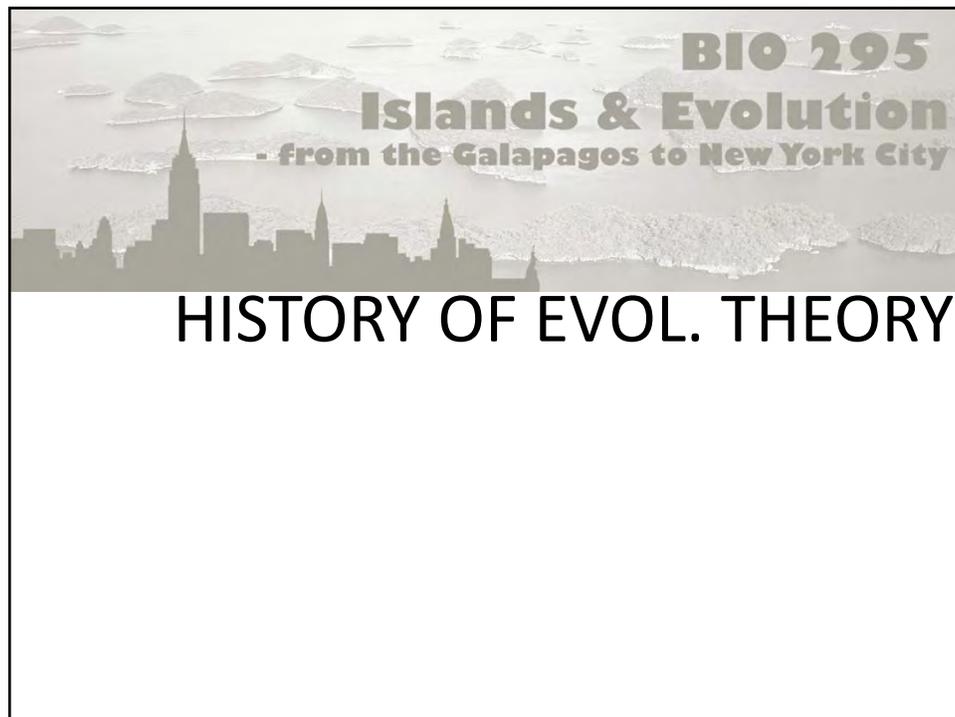
Summary



Follow-up on minute papers

- Time component of evolution
- Species
- Wallace

- Evolution is not a choice!

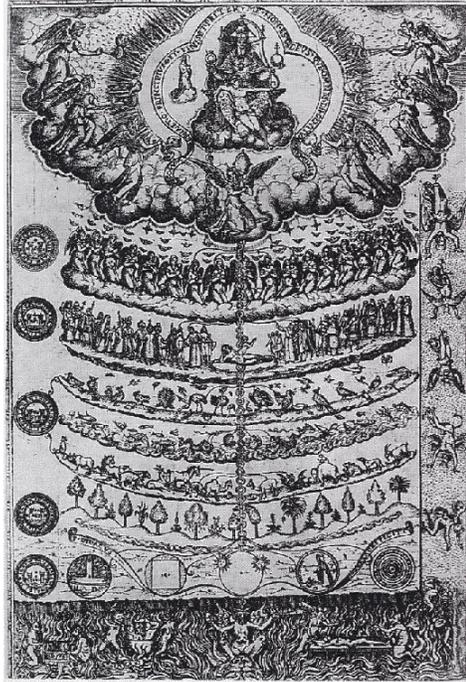


Before Darwin

- Plato's philosophy of eidos ("form" or "idea")
~400 BC
- Variation = accidental imperfection
- Christians: literal interpretation of Genesis (creationism)
- "great chain of being": Scala naturae – permanent and unchanging (change would imply imperfection in original creation)

Scala Naturae

In Rhetorica Christiana by Didacus Valdes (1579)



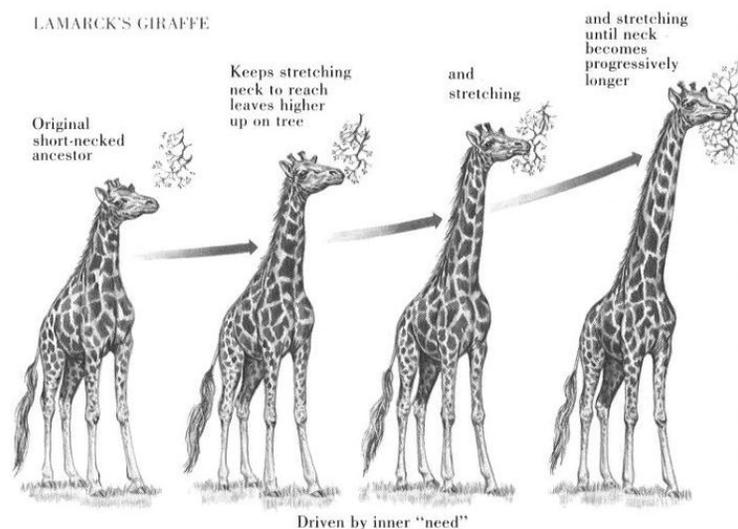
Before Darwin: Carl Linnaeus

- Swedish botanist, physician, zoologist
- *Systema naturae* (1735)
- Exhaustive classification into genera and species (binomial nomenclature)
- “Father of taxonomy”
- He tried to discover patterns in the creation.

Before Darwin: Chevalier de Lamarck

- Most significant pre-Darwinian evolutionary hypothesis
- *Philosophie Zoologique* (1809)
- Species originated by spontaneous generation from non-living matter, starting at bottom of chain of being
- “nervous fluid” acts within each species, causing process up

Lamarck's giraffe



Lamarck's giraffe

- **Inheritance of acquired characteristics**
- **"the environment shapes genes"**
- Species acquired long necks over time due to individual organisms that changed over their lifetimes
- Lamarck's theory had little impact during his lifetime

BUT...

Lamarck's giraffe

- Darwin (later in life) agreed with the importance of environmental inputs
- **Epigenetics**

Epigenetics (some definitions)

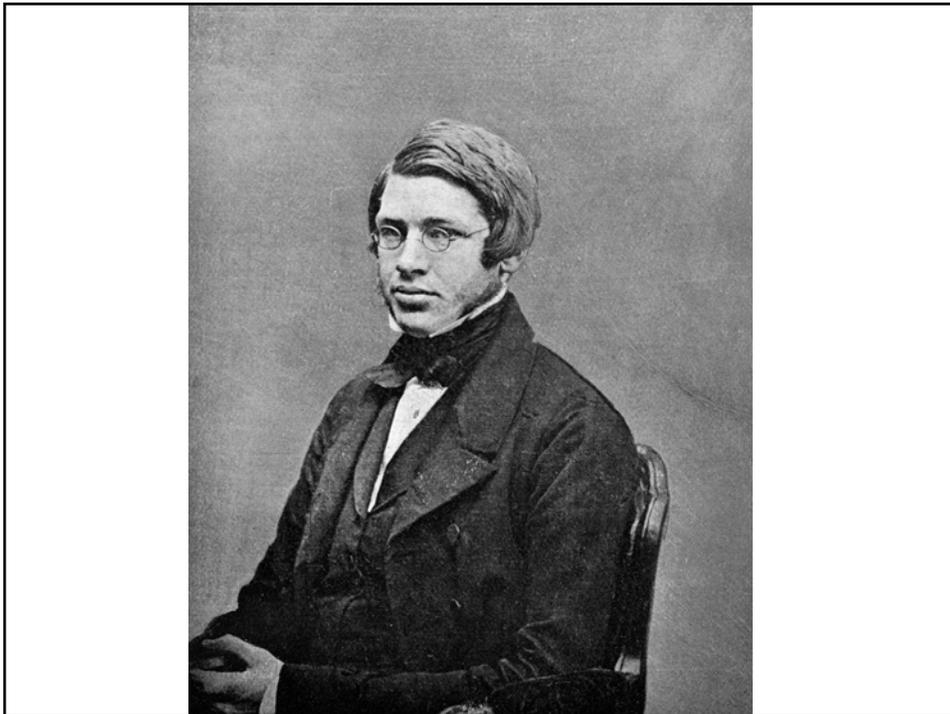
- heritable changes in gene activity that are **NOT** caused by changes in the DNA sequence
- anything other than DNA sequence that influences the development of an organism
- stably heritable phenotype resulting from changes in a chromosome without alterations in the DNA sequence

Charles Darwin

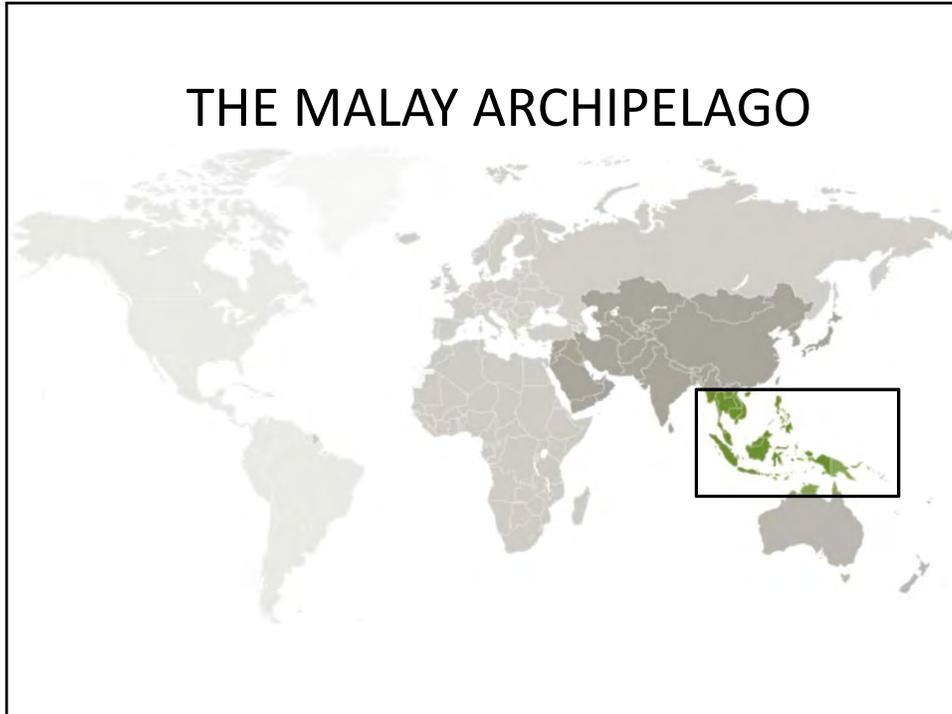
- Son of English physician
- Briefly studied medicine then wanted career in clergy
- Trip on Beagle (1831): observations & collections
- Rest of life devoted to biological work
- Developed theory of natural selection over next 20 years
- ***On the Origin of Species*** published in 1859

Alfred Russel Wallace

- independently came up with same theory from collecting specimens in the Malay archipelago
- was considered by many (especially Darwin) as a leading thinker on evolution



THE MALAY ARCHIPELAGO



Evolutionary synthesis

- 1930s-40s
- Contributions from genetics, systematics, cell biology, botany, morphology, ecology, paleontology
- Reconciled Darwin's theory with facts of genetics
- Stimulus populations genetics: showed that Mendelian genetics consistent with natural selection and gradual evolution

Evolutionary synthesis

- Julian Huxley coined term in his book *The modern synthesis* (1942)
- Important figures in modern synthesis: Fisher, Dobzhansky, Haldane, Wright, Ford, Mayr, Rensch, Chetverikov, Simpson, Stebbins

Evolutionary synthesis

- Fisher, Haldane and Wright developed mathematical theory of population genetics
- Showed that mutation and natural selection together cause adaptive evolution (mutation is the “raw” material)
- Chetverikov and Dobzhansky pioneered study of genetic variation and change in natural populations

Evolutionary synthesis

- argued that mutation, recombination, natural selection, and other processes operating within species (**microevolution**) account for the origin of new species and for the major, long-term features of evolution (**macroevolution**)

Since the synthesis

- Mid-1960s evolutionary theory expanded into areas like ecology, animal behavior, reproductive biology
- **Neutral theory of evolution** (Kimura, 1968): most of evolution of DNA sequences occurs by genetic drift rather than by natural selection
- More sophisticated methods: **molecular evolution** (on level of genes) and **evolutionary genomics** (multiple genes, entire genome)



BIO 295
Islands & Evolution
- from the Galapagos to New York City

SOME DEFINITIONS

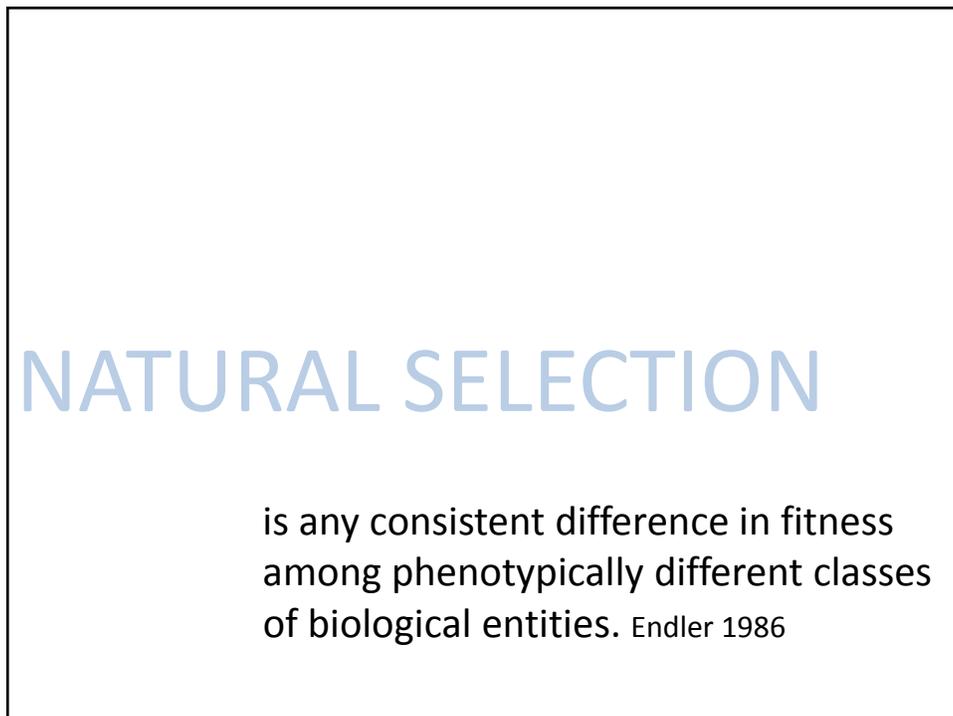
Scientific hypothesis – informed statement of what might be true

Fact – hypothesis that has acquired so much supporting evidence that it becomes a fact

Scientific theory – mature, coherent body of interconnected statements, based on reasoning and evidence that explain a variety of observations

Evolution is a fact. The fact of evolution is explained by **evolutionary theory.**

DEFINITIONS



FITNESS = reproductive success

FITNESS

1. Probability of survival to the various reproductive stages
2. Average number of offspring produced by female function
3. Average number of offspring produced by male function

NATURAL SELECTION can only exist

if different classes or entities differ in one or more features or traits that affect

the components of **FITNESS**

Prerequisites of evolution by means of natural selection

VARIATION among individuals in some attribute or trait.

DIFFERENTIAL FITNESS – A consistent relationship between that trait and mating ability, fertilizing ability, fertility, fecundity, and, or, survivorship.

INHERITANCE – A consistent relationship, for that trait, between parents and their offspring, which is at least partially independent of common environmental effects.



Charles Darwin 1867 (answer to “What exactly do you mean by natural selection?”)

“...I would now say that of all birds annually born, some will have a beak a shade longer, and some a shade shorter, and that under conditions or habitats of life favoring longer beaks, all the individuals, with beaks a little longer would be more apt to survive than those with beaks shorter than average.”

Variation



Medium ground finch (*Geospiza fortis*)

DARWIN'S FINCHES

Differential Fitness



FARMERDODD.COM

DARWIN'S FINCHES

Inheritance



DARWIN'S FINCHES



SUMMARY

1. What was the most important thing you learned during this class?
2. What important question regarding what you learned remains unanswered for you? (What would you like to know about next?)

SUMMARY

For next class (27-Jan):

The Beak of the Finch: Read Chapter 3

Be on the lookout for an email from me!