Lecture 3
The Darwinian Revolution
Theories of evolution

• first developed by the Greek philosophers.
Theories of evolution

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• Anaximander (610-546 BC) wrote about the sudden appearance of humans from fish-like creatures.
Is this evolution?
Is this evolution?

NO! It is “spontaneous generation”!
Two characteristics of spontaneous generation were common to early Greek philosophers:
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1. Resulted from the generative powers of nature (i.e., not actions of a God).
Two characteristics of spontaneous generation were common to early Greek philosophers:

1. Resulted from the generative powers of nature (i.e., not actions of a God).

2. Were nonteleological (i.e., without an underlying design or goal).
The influence of Aristotle (384-322 BC)
The influence of Aristotle (384-322 BC)

1. All species are fixed and eternal
The influence of Aristotle (384-322 BC)

1. All species are fixed and eternal
   • evolution not possible!
The influence of Aristotle (384-322 BC)

2. The philosophy of essentialism
The influence of Aristotle (384-322 BC)

2. The philosophy of essentialism
   • each species represented by its “eidos”
The influence of Aristotle (384-322 BC)

2. The philosophy of essentialism

• each species represented by its “eidos”

• variation among individuals of a species is not “real”, nor important.
The influence of Aristotle (384-322 BC)

3. The scala naturae or “great chain of being”
The influence of Aristotle (384-322 BC)

3. The scala naturae or “great chain of being”
   • refers to a linear progression of organisms from most simple to most complex.
The influence of Aristotle (384-322 BC)

3. The scala naturae or “great chain of being”

• refers to a linear progression of organisms from most simple to most complex.

• over time, believed to reflect the actions of a creator.
A 1579 drawing of the scala naturae
The chain of being, from Charles Bonnet (Œuvres d'histoire naturelle et de philosophie, 1779-83)
How did evolutionary thinking develop?
How did evolutionary thinking develop?

1. The scientific revolution
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• Astronomy → earth not the center of the universe!
How did evolutionary thinking develop?

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• Geology → evidence for great age of earth, study of fossils
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How did evolutionary thinking develop?

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3. Extinction
How did evolutionary thinking develop?

4. The microscope
How did evolutionary thinking develop?

4. The microscope

• provided support for “spontaneous generation”.
How did evolutionary thinking develop?

4. The microscope
   • provided support for “spontaneous generation”.

5. Development of the science of systematics
How did evolutionary thinking develop?

4. The microscope
  • provided support for “spontaneous generation”.

5. Development of the science of systematics
  • undermined the scala naturae.
Evolution according to Lamarck (1744-1829)
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Recognized two causes of evolutionary change:
Evolution according to Lamarck (1744-1829)

Recognized two causes of evolutionary change:
1. Life has an innate potential to acquire greater and greater complexity.
Evolution according to Lamarck (1744-1829)

Recognized two causes of evolutionary change:

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- now called “orthogenesis”.
Recognized two causes of evolutionary change:

2. Organisms “reacted” to their environments and changed form.
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• changes were then transmitted to subsequent generations.
Recognized two causes of evolutionary change:

2. Organisms “reacted” to their environments and changed form.
   - changes were then transmitted to subsequent generations.
   - now called the “inheritance of acquired characteristics” or “soft inheritance”.
The science of epigenetics
Lamarck’s theory of organic progression

Diagram showing the progression of complexity over time.
Evolution according to Charles Darwin (1809-1882)
Evolution according to Charles Darwin (1809-1882)

- publication of “On the origin of species by means of natural selection or the preservation of favored races in the struggle for life” (“The origin”) occurred in 1859.
Darwin had two main objectives in writing this book
Darwin’s objectives:

1. To make the case that evolution had occurred.
Darwin’s objectives:

1. To make the case that evolution had occurred.

2. To provide a mechanism for how evolutionary change occurs.
Alfred Russell Wallace and the Ternate paper
Darwin’s “Five Theories”
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1. Evolution *per se*
Darwin’s “Five Theories”

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• the world is steadily changing and populations of organisms are transformed over time.
Darwin’s “Five Theories”

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   - the world is steadily changing and populations of organisms are transformed over time.

2. Common descent
Darwin’s “Five Theories”

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   - every group of organisms has descended from a common ancestor.
Darwin’s “Five Theories”

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   - the world is steadily changing and populations of organisms are transformed over time.

2. Common descent
   - every group of organisms has descended from a common ancestor.
   - all species can ultimately be traced to a single origin of life on earth.
Darwin’s “Five Theories”

3. Multiplication of species
Darwin’s “Five Theories”

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• this process is now called “speciation”.

Darwin’s “Five Theories”

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• Darwin’s view similar to what is now called allopatric speciation.
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4. Gradualism
Darwin’s “Five Theories”

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Darwin’s “Five Theories”

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4. Gradualism
   • most evolutionary change occurs slowly.

5. Natural selection
   • this was Darwin’s mechanism for how evolutionary change occurred.
Similarities between Lamarck’s and Darwin’s theories
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1. Lineages change over time - “evolution” occurs.
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2. A continually changing world drives evolutionary change.
Similarities between Lamarck’s and Darwin’s theories

1. Lineages change over time - “evolution” occurs.

2. A continually changing world drives evolutionary change.

3. The rate of change is slow (gradualism).
Differences between Lamarck’s and Darwin’s Theories
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<th>Inheritance</th>
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5. The belief in the philosophy of essentialism.