Darwin and Evolution

Chapter 17

Outline

• History of Evolutionary Thought
• Darwin’s Theory of Evolution
  - Occurrence of Descent
  - Biogeography
• Natural Selection and Adaptation
• The Evidence of Evolution
  - Fossil
  - Biogeographical
  - Anatomical
  - Biochemical

History of Evolutionary Thought

• Prior to Darwin, most people had a mindset determined by deep-seated beliefs held to be intractable truths.
  - Biology during preceding century had slowly begun to accept the idea of evolution.
    ✤ Living things share common characteristics due to common ancestry.

Mid-Eighteenth Century

• Taxonomy was an important endeavor during mid-eighteenth century.
  - Linnaeus believed in the fixity of species, and that each species had an ideal structure and function, and a place in the scala naturae.
  - Count Buffon wrote 44-volume natural history describing all known plants and animals.
    ✤ Provided evidence of descent with modification.
Late Eighteenth Century

- Cuvier was first to use comparative anatomy to develop a system of classifying animals.
  - Founded Paleontology
    - Hypothesized local catastrophes had occurred whenever a new strata showed a new mix of fossils.
    - After each catastrophe, a region was repopulated by species from surrounding areas.
  - Catastrophism

- Lamarck was first biologist to believe evolution occurs and to link diversity with environmental adaptation.
  - Concluded more complex organisms are descended from less complex organisms.
    - Inheritance of acquired characteristics.
      - Giraffes stretch necks and then pass on long necks to offspring.

Darwin’s Theory of Evolution

- Occurrence of Descent
  - Charles Lyell supported a theory that the earth was subject to slow but continuous cycles of erosion and uplift.
    - Proposed uniformitarianism
      - Darwin was not convinced of uniformitarianism, but did believe the earth was very old.
        - Enough time for descent with modification.
Biogeography

- Biogeography is the study of the geographic distribution of lifeforms on earth.
  - Darwin saw how similar species replaced each other, and reasoned related species could be modified according to the environment.

Galápagos Islands

- **Tortoises**
  - Darwin wondered if tortoise speciation on islands could be correlated with a difference in vegetation among the islands.
- **Finches**
  - Darwin speculated that all the different types of finches could have descended from a single type of mainland finch.
Natural Selection and Adaptation

- Individuals have heritable variations.
- Many more individuals are produced each generation than the environment can support.
- Some individuals have adaptive characteristics enabling increased survival and reproduction.
- Increasing proportion of succeeding generations have these characteristics.
- Populations become adapted to their local environment.

Organisms Have Variations

- Darwin emphasized members of a population vary in their functional, physical, and behavioral characteristics.
  - Believed variations were essential.
    - Heritable variations allow adaptation to the environment.

Organisms Struggle to Exist

- Malthus stressed the reproductive potential of human beings.
  - Proposed death and famine were inevitable due to rapid population growth.
    - Each generation has the same reproductive potential as the previous generation.
      - Constant struggle for existence.

Organisms Differ in Fitness

- Fitness is the relative reproductive success of an individual.
  - Most-fit individuals capture a disproportionate amount of resources.
    - In nature, interactions with the environment determine which members of a population reproduce to a greater degree.
      - Artificial Selection
Organisms Become Adapted

- An adaptation is a trait that helps an organism become more suited to its environment.
  - Product of natural selection

The Evidence of Evolution

- Fossil Evidence
  - Fossil record is the history of life recorded by remains from the past.
  - Documents a succession of life forms from the simple to the more complex.
  - Sometimes the fossil record is complete enough to allow a trace of the evolutionary history of an organism.
"Can we doubt . . . that individuals having any advantage, however slight, over others, would have the best chance of surviving and procreating their kind? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favorable variations, I call Natural Selection."

Fig. 17.12
Biogeographical Evidence

- Distributions of many plants and animals throughout the world are consistent with the hypothesis that when forms are related, they evolved in one locale and then spread to accessible regions.

Anatomical Evidence

- Darwin was able to show a common descent hypothesis offers a plausible explanation for anatomical similarities among organisms.
  - Despite dissimilar functions, all vertebrate forelimbs contain the same sets of bones in similar ways.
Anatomical Evidence

- Homologous Structures are anatomically similar because they are inherited from a common ancestor.
- Analogous Structures serve the same function, but are not constructed similarly, and do not share a common ancestor.
- Vestigal Structures are fully-developed anatomical structures developed in one group of organisms, but reduced, and may have no function, in similar groups.

Biochemical Evidence

- Almost all living organisms use the same basic biochemical molecules.
  - Also utilize same DNA triplet code and same 20 amino acids in their proteins.
  - When the degree of similarity in DNA base sequences are compared, the data suggest common descent.

Biochemical Differences

Review

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