

Chapter 22- Descent with Modification: A Darwinian View of Life

(Key Concepts are Underlined)

Historical Context for Evolutionary Theory

Evolution- process transforming life on Earth from its earliest forms to its vast diversity today

Natural selection- (a mechanism for evolution proposed by Charles Darwin) process by which populations change over time as a result of individuals with certain heritable traits leaving behind more offspring than others

Western culture resisted evolutionary views of life

- *Carolus Linnaeus* was the creator of **taxonomy**, a study of biology concerned with classifying the diverse forms of life (e.g. KPCOFGS = Kings Play Chess on Fat Green Stools); he developed the binomial system of naming (i.e. *Genus species*)

Fossils- mineralized impressions of past organisms (usually found in strata of sedimentary rock) and studied for evolutionary kinship (i.e. **paleontology**)

Theories of geological gradualism helped clear the path for evolutionary biologists

Gradualism- profound geologic change is the cumulative product of slow but continuous processes

Uniformitarianism- geologic processes have not changed throughout Earth's history

Lamarck placed fossils in an evolutionary context

... by proposing acquired characteristics were inherited

The Darwinian Revolution

- *Charles Darwin* was born 1809 in Western England
- Darwin went to the University of Edinburgh to study medicine, to then transfer to Christ College at Cambridge where he received his B.A. in 1831

Field research helped Darwin frame his view of life:
science as a process

- at 22 years of age, Darwin began sail aboard the HMS Beagle in December of 1831 to survey the coast of South America
- he collected many flora and fauna from the continent and noticed they were distinctly different than specimens in Europe (less closely related)
- he returned to Great Britain in 1836 and began to compile evidence for the origin of species and natural selection
- in 1858, Alfred Wallace submitted a paper to Darwin essentially identical to his, which was the impetus for Darwin to move forward with his work on the origin of species
- Charles Darwin published *On Origin of Species by Means of Natural Selection* on November 24, 1859

The Origin of Species developed two main points: the occurrence of evolution and natural selection as its mechanism

- the history of life is like a tree, where each fork of the evolutionary tree is an ancestor common to all lines of evolution branching from the fork; “the natural hierarchy of the Linnaean scheme reflected the branching genealogy of the tree of life...”

Natural Selection and Adaptation:

- there is a “struggle of existence” supported by the capacity of organism’s to “overreproduce”

Artificial selection- the breeding of domesticated plants and animals provided evidence of change in a short period of time

Summarizing Darwin’s main ideas:

- 1) **Natural selection is differential success in reproduction.**
- 2) Natural selection occurs through an interaction between the environment and the variability inherent among the individual organisms making up a population.
- 3) The product of natural selection is the adaptation of populations of organisms to their environment.

Gradualism and evolutionary theory- the diversity of life is the result of minute, advantageous variations which have accumulated in a populations over many generations of natural selection (a vast amount of time)

Subtleties of Natural Selection:

- 1) a population is the smallest unit to evolve (a group of interbreeding individuals belonging to a particular species sharing a common geographic area)
- 2) natural selection involves interaction of individuals and their environment, but individuals themselves **DO NOT** evolve
- 3) evolution can only be measured as changes in relative proportions of variations in a population over successive generations
- 4) natural selection can only amplify or diminish heritable variation, not acquired characteristics

5) specifics of natural selection are situational (i.e. an adaptation in one situation may be useless in another)

- “... scientists have shown natural selection to be a pervasive mechanism of change in populations; the process has been confirmed repeatedly by careful scientific studies...”

Evidence of Evolution

* Evidence of evolution pervades biology

- 1) *Biogeography*- geographical distribution of species; species of one geographic location are more evolutionarily similar than in other species in other geographically isolated areas
- 2) *The Fossil Record*- succession of fossil forms chronicle life
- 3) *Comparative Anatomy*- e.g. homologous structures (anatomical structures of similar origin) & vestigial organs (ancestral remnants)
- 4) *Comparative Embryology*- similar structures in embryonic development (e.g. gill pouches in vertebrates)
- 5) *Molecular Biology*- similarities in DNA & proteins in closely related species

* **These evidences all coincide and support one another.**