# Darwinism

Lecture 8

Theory of Natural Selection

# Darwin's Quote of Natural Selection

- "Variation is a feature of natural populations and every population produces more progeny than its environment can manage. The consequences of this overproduction is that those individuals with the best genetic fitness for the environment will produce offspring that can more successfully compete in that environment. Thus, the subsequent generation will have a higher representation of these offspring and the population will have evolved."

# Basic Tenets of Natural Selection

1) More individuals are produced each generation that can survive.
2) Phenotypic variation exists among individuals and the variation is heritable.
3) Those individuals with heritable traits better suited to the environment will survive.
4) When reproductive isolation occurs new species will form.

# Factors Involved in Natural Selection

1) The universal occurrence of variation
2) The excessive natural rate of multiplication
3) The struggle for existence
4) The consequent elimination of the unfit and the survival of only those that are satisfactorily adopted, and
5) The inheritance of the recombination that make for success in the struggle for existence and spread over a few generation and result in the formation of a new species.

# Prodigality of Production

- All individuals have the power of multiplication and the productivity of all living organisms is far beyond the ultimate numbers.
- Examples
  - In herring (fish), the number of eggs produced by one individual varies from 20,000 to 47,000;
  - In a cod about 5,000,000, in salmon about 28,000,000 eggs were produced in a single spawning.
- Such enormous population to survive and reproduce in each generation
  - Population will increase in geometric proportion
  - The food and space will soon fall short for the survival

# Struggle for Existence

- The concept of **struggle for existence** is of competition or battle for resources needed to live.
- Efficient check system used in evolution and a key point in natural selection
- Struggle for existence includes
  - The competition between all organisms
  - Also between each individual and the physical environment
- Intraspecific struggle
  - The struggle against the organism's own kind. Mostly, this is the most severe check of all.

# Struggle for Existence

- Examples of the intraspecific struggle
  - The young trees in a forest. As seedlings they may spring up over a clustered area in general abundance
  - In artificial lobster culture, if the new hatched youngs are not immediately transferred, they turn their own worst enemies and the result is cannibalistic selection.
- Struggle is between members of different species
  - Often in the nature of competition,
  - More frequently one may afford or used as food for the others.

# Struggle for Existence

- Environmental struggle is against the physical environment
  - Against excess of moisture or of drought
  - Against extreme heat or cold
  - Against lightening and tempest, earthquake and volcanic eruption

# Variation

- Any difference between cells, individual organisms, or groups of organisms of any species caused either by genetic differences (genotypic variation) or by the effect of environmental factors on the expression of the genetic potentials (phenotypic variation)
- The basic prerequisite to evolution is variation which together with heredity may be regarded as an undeniable fact.
- Without variation no change could occur and evolution would be impossible

# Variation

- All variations are not similar and only a few are heritable. Those that cannot be inherited can have no part in the evolution of a species as they concern only the individual and not the race
- Different types of variations
  - Germinal variations
  - Acquired or somatic variations
  - Indeterminate and Determinate variations
  - Continuous and Discontinuous variations

# Germinal variation

- Arise in the germplasm either due to recombination of genes or to mutation
  - A result from radical alternation in the gene complex
- Changes are manifest only in the soma or body
- Do not depend on external conditions for their origin
- May appear at any period from the beginning of embryonic life to the death of organism

# Acquired or somatic variations

- Imposed on the organism during its life time and are caused due to external influences.
- The best example of germinal and somatic variation
  - Found in bee hive
  - The sex distinction between the worker and queens is an acquired variation
  - The sex distinction between drone and queen or worker is germinal.

# Indeterminate and Determinate variations

- **Indeterminate variations** are such fortuitous variation which are not subject to any law but occur in any conceivable direction of change.
  - The Darwinian factor of natural selection is supposed to operate on these
- **Determinate variations**, being controlled by some unknown influence, are confined to certain definite lines or directions of change usually in an adaptive direction.
  - Some claim that they have no real existence. No such tendency to vary always in a given direction in successive generation.
  - Others considered these variations which they call orthogenetic as important ones in evolution.

# Continuous and Discontinuous variations

- The continuous or small variations are abundant and occur in graded series.
  - So called Darwinian variations or fluctuations.
  - Generally quantitative rather than numerical.
  - The great many of variations are of continuous type
- The discontinuous variations are mostly large and rare, also known as mutations or saltations.
  - May be meristic or number variation and are likely to occur where any structure is repeated in numerical series
  - E,g. the number of segment of worms and arthropods or in the vertebral column, ribs, muscles or in the number of appendages.

# Causes of Variation

- The causes of acquired variations or modifications
  - Occurs in response to any external condition which include abundance or scarcity of food, the influence of heat, cold, moisture etc.
- The causes of germinal variation
  - The inherent tendency of organism to vary influenced by complex and countless molecule in a organism, which are in a continual state of chemical change due to energy traffic.
  - Dual or biparental parentage (amphimixis) is perhaps an important cause of variation. It is the germplasm that is handed over to the next generation.

# Causes of Variation

- The causes of germinal variation
  - Offsprings are produced by the division of the mother cell into two daughter cells as in Protozoa or by parthenogenesis as in many insects, in the absence of amphimxis
  - The environmental variations such as X rays in the atmosphere may act directly to bring about heritable change.
  - Hormonal secretion of endocrine glands which circulate through the blood and also pass to the reproductive organs may bring about germinal variations.

# Causes of Variation

- Survival of the fittest
  - Natural selection, therefore forces adaptations of two forms in competition, the adaptable will crowd out the inadaptable.
- Heredity
  - When variation has given rise to a new character, heredity causes it to persist
- The progressive changes from generations to generations preserved by heredity lead to the origin of species

# Summary

- Under new conditions harmful characters will be eliminated by selection.
- Beneficial characters are intensified and modified.
- The majority of characters neither harmful nor beneficial will not be modified but will persist through heredity.
- According to natural selection, thousands must die where one or ten may live to maturity; which ten of the thousand shall live depends on the slight but sufficient advantage possessed by ten individuals in the struggle for existence… … … … …