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## 7.6. Mechanism of Evolution :-

- What is the origin of this variation ?
- How does speciation occur?
- Even though Mendel had talked of inheritable 'factor' influencing phenotype, Darwin either ignored these observation or kept silence.
- In the first decade of twentieth century, Hugo de Vries based on his work on Oenothera lamarkiana (evening Primrose) put forwed the idea of mutation.
- Mutation is large difference arising suddenly in a population.
- He believed that it is mutation which causes evolution and not the minor variations (heritable) that Darwin talked about.
- Mutations are random & non-directional while Darwinian variations are small and directional.

- Evolution for Darwin was gradual while de Vries believed mutation caused speciation and hence called it Saltation.
- Saltation is single large step mutation.
- Studies in population genetics, later, brough out some clarity on mechanism of evolution.

## 7.7 HARDY-WEINBERG PRINCIPLE :-

- According to Hardy-Weinberg Principle - In a given population, allele frequency of a gene (or a locus) are stable and constant from generation to generation.

- The gene pool (total genes and their alleles in a population) remains a constant. This is called genetic equilibrium
- Hardy-weinberg principle stated it using algebraic equations.

  frequency of dominant allele (A) = $P$

  Frequency of Recessive allele (a) = $q$

  Sum total of all allelic frequencies is 1

  i.e. $\boxed{P+q=1}$

  frequency of AA individuals (Homozygous dominant)

  $= p^2$

  frequency of aa individuals (Homozygous recessive)

  $= q^2$

  frequency of Aa individuals (Heterozygous)

  $= 2Pq$

  This is binomial expansion of $(P+q)^2$

  $$(P+q)^2 = p^2 + 2pq + q^2 = 1$$

- Disturbance in genetic equilibrium or H.W. equilibrium i.e. change of frequency of alleles in a population would then be interpreted as resulting in Evolution.

- five factors are known to affect HW equilibrium

  1. Gene migration of gene flow
  2. Genetic Drift
  3. Mutation

4. Genetic Recombination

5. Natural selection

1. Gene flow or Gene migration :- when migration of a section of population to another place & population occurs, Gene frequencies change in the original as well as in the new population. The removal of allele from one population or addition of alleles into another population is called gene flow or gene migration. There would be a gene flow if this gene migration, happens multiple times.

2. Genetic drift :- It is also k/a 'Sewell Wright effect'. It occur only $^{***}$ by chance. It is random in gene frequency. It is non-directional. It is always applicable to small isolated population like population of Islands.

* Sometimes the change in allele frequency is so different in the new sample of population that they become a different species. In this case original drifted population become founders and the effect is called founder effect.

3 Mutation :- sudden apperance of variations.

4. Genetic Recombination :- occur during sexual reproduction.

5. Natural selection :- In this process, heritable variations help the organism for better survival and enable it to reproduce & leave more progeny

* Microbial experiments show that pre-existing advantageous mutations when selected will result in observation of new phenotype. over few generations, this would result in speciation.

* A critical analysis makes us believe that

→ variation due to mutation
→ variation due to recombination during gametogenesis
→ variation due to gene flow or genetic drift
→ result in changed frequency of genes and alleles in future generation. Coupled to enhance reproductive Success, natural selection makes it look like different population.

In Population Natural selection leads to

(i) Stabilisation :- In which more individuals acquire mean character Value eg. Human baby wt at the time of delivery

(ii) Disruption :- More individuals acquire peripheral character Value at both ends of the distribution curve eg. sickle cell anemia

(iii) Directional :- More individuals acquire value other than the mean character value.
eg. moths in England
Dark winged & whit winged.

## 7.8. A Brief Account of Evolution

| Geological time | Important events |
|---|---|
| About 200 mya | • Appearance of first cellular life forms but how non-cellular aggregates of gaint macromolecules could evolve into cell with membranous envelop is not known.<br>• some of these cells had the ability to release $O_2$ (by mechanism similar to light Reaction in photosynthesis<br>• slowly single-celled organisms become multi-cellular life forms. |
| 500 mya | • origin of invertebrates |

350 mya

* origin of Jawless fishes
* It is common opinion that the first organisms that invaded land were plants.
* fishes that have Stout and strong fin could move on land and go back to water
* In 1938, a coelacanth fish (lobefinned fish) was caugh in South Africa which was thought to be extinct. In past, these lobefins have evolved into first ambhibian (capable of living on both land and in water). These were ancestors of modern days frogs & salamanders.
* Later on amphibians evolved into reptiles which lay thick-shelled eggs which were resistant to dryness.
* Again we only see their modern day descents, the turtle, tortoises and crocodiles.
* In next 200 million years, reptiles of different shapes & sizes dominated on earth.
* Gaint ferns (pteridophytes) were present but they all fell to form coal deposits slowly.

320 mya

* origin of sea weeds and few other plants

200 mya

* some land reptiles (the dinosaurs) went back into water and evolve into fish like reptiles (eg. Icthyosaurs)
* Tyrannosaurus rex was one of the biggest land reptiles (Ht = about 20 feet, with huge fearsome dagger like teeth)

65 mya

* sudden disappearance of dinosaures from the earth. Probable reasons: climatic change / Evolution of most of them into birds
* small sized reptiles of that era still existing today.

* The first evolved mammals were viviparous and shrew like. After reptiles, earth was dominated by mammals.
* In comparison to other animals, mammals were more intelligent in sensing and avoiding danger at least.
* Some mammals become aquatic: whales, dolphins, seals and sea cow.
* Evolution can be seen specifically during the evolution of Horse, elephant, dog etc.
* Evolution of man is the most successful story in which language skill and self-consciousness has also developed.

* Paleozoic Era
    - Silurea
    - Devonian
    - Carboniferous
    - Permian
* Mesozoic Era
    - Triassic
    - Jurassic
    - cretaceous
* Coenozoic Era
    - Testiary
    - Quaternary

* Therapsids is direct Reptilian ancestor of mammals.