# EVOLUTION

# **BIOLOGICAL EVOLUTION**

## THEORIES OF BIOLOGICAL EVOLUTION (LAMARCK, DARWINIAN AND MUTATION)

- Father of Iridian paleontology Birbal Sahni
- **Palaeontological** and **biogeographical** evidences are considered as best evidences in support of organic evolution.
- India is situated in Oriental realm.
- Palaearctic and Oriental realms are separated by high Himalayan Mountains.
- The aquatic mammals like Dolphins, Whales, Seals and Porpoises don't have gills slits, because their adaptation to aquatic life is secondary.

## LAMARCKISM :

First teory of evolution was proposed by

#### Jean Bapttiste de Lamarck (17-44 - 1829)

Book : Philosophie Zoologique (1809)

Lamarck coined the terms – **Invertebrates, Annelida**.

The term **Biology** was given by **Lamarck & Treviranus**.

#### THEORY OF INHERITANCE OF ACQUIRED CHARACTER-

#### **BASIC CONCEPT OF LAMARCKISM-**

#### (i) Internal Vital Forces :

Some internal forces are present in all organisms. By the presence of these forces organism have the tendency to increase the size of their organs or entire body.

(ii) Effect of environment and new needs:

Environment influences all type of organisms. Changing environment gives rise to new needs. New needs or desires produce new structures and change habit of the organism.

#### (iii) Use and disuse of organs:

If an organ is constantly used, it would be better developed whereas disuse of organ result in its degeneration.

## (iv) Inheritance of acquired character:

During the life of an organism new character develop due to internal vital forces, effect of environment, new needs and use and disuse of organs.

These acquired character are inherited from one generation to another. By continuous inheritance through many generation these acquired characters tend to make new generation quite different from its Ancestors resulting in the formation of new species.



## **EXAMPLE IN SUPPORT OF LAMARCKISM :**

- **1.** Long neck and high fore limb of Giraffe.
- **2.** Aquatic birds stretched their toes and developed web.
- 3. Snakes lost their legs.
- **4.** Deers became good runners by the development of strong limbs and streamlined body.
- 5. Retractile claws of carnivorous animals

#### **CRITICISM OF LAMARCKISM -**

- According to first concept organism tends to increase their size but it is not universally true. For Example among angiosperm the trees seem to be primitive and the shrubs, herbs and grasses have evolved from trees but the size was reduced during evolution.
- 2. Second concept is false. Can we sprout wings wishing to fly like birds.
- 3. The third concept is some what true like the well developed biceps muscles of blacksmith and less developed wings in flight less birds.

But this concept also have many objections like the eyes of a student/reader do not increase in size and power with increasing age, the constantly beating heart maintains a constant size through generation.

4. Fourth concept is completely false because acquired characters are not inherited.

#### WEISMANN -

Weismann cut off the tails of rats for about 22 genrations but there was no reduction in the size of tail on the basis of this experiment Weismann proposed **the theory of continuity of germplasm**.

#### ACCORDING TO WEISMANN.

- (i) Two types of matters are present in organism, **somatoplasm and germplasm**.
- (ii) Sometoplasm in somatic cells and germplasm in Germinal cell.
- (iii) Somatoplasm dies with the death of organism while germaplasm transfers into the next generation.
- (iv) If any **variation** develops in germplasm, it is inherited , while if variation develop in somatoplasm it is not transmitted.

#### **PYANE:**

Pyane kept drosophila in dark up to **69 generation,** but there was no reduction in the size or sight of eyes

Boring of ear and nose in Indians.

Iron shoes of Chinese.

## NEOLAMARCKISM-TERM BY PACKARD

Although Lamarckism remained controversial but some scientists gave the following evidences in favour of Lamarckism. The are known as **neo-lamarckians**.

According to neolamarckism environment effected the inheritance of acquired charater. According to it changing environment give rise some physical and chemical changes in organism, which effect their germplasm, and these acquired characters are definitely inherited.

#### 1. Sumner's Experiment-

Sumner kept white rat in warn temperature resulting in elongation of body, large pinna and long tail. These features were inherited by the offspring.

#### 2. Kammerer's Experiment-

Kammerer kept salamander in dark background. The black spots found on skin were widely spread. In lighter, background the skin became yellow with limited black spots. These character were inherited by the offspring.

#### 3. Mc Dugal's Experiment-

Mc Dugal trained white rats to cross a tank of water following a definite route. These trained rats were mated and their offspring were again trained. It was observed that there was decrease in the number of errors by offsprings of white rats.

#### **BASIC CONCEPTS OF DARWINISM -**

- Branching Descent and Natural Selection are the two key concepts of Darwinian Theory of evolution.
- Natural selection is based on certain observations which are factual.

## (i) Over production:

- All organisms have the capability to produce enormous number of offspring or organisms (multiply in geometric ratio).
- Hence, theoretically population size will grow exponentially if everybody reproduced maximally (this fact can be seen in a growing bacterial population) but the fact is that population sizes in reality are limited.

#### (ii) Struggle for existence:

• Natural resources are limited and populations are stable in size (except for seasonal fluctuation) means that there had been competition for resources. Only some survived and grew at the cost of others that could not flourish. This is called struggle for existence.

## **IT IS OF THREE TYPES -**

- (a) Intra specific struggle: It is competition among the individuals of same species for same needs like food, shelter and breeding. (Most acute type of struggle)
- **(b) Inter specific struggle:** It is the struggle among the individuals of different species for food and shelter. It is the most potent force for organic evolution.
- (c) Environmental struggle: This struggle is between the organisms and their environment. All organisms struggle with cold, heat, wind, rain, drought, flood etc.

#### (iii) Variations and heredity:

- Members of a population vary in characteristics (in fact no two individuals are alike) even though they look superficially similar i.e. population has built in variation in characteristics.
- Those characteristics which enable some to survive better in natural conditions (climate. food. physical factors, etc.) are called adaptive or useful variations while others are called as non adaptive or harmful variations.
- The novelty and brilliant insight of Darwin was, he asserted that variations, which are heritable and which make resource utilisation better for few (adapted to habitat better) will enable only those to reproduce and leave more progeny.

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#### (iv) Natural selection/ Survival of the fittest:

- Individuals with more adaptive variations are "better fit" than the individuals with less adaptive variations. Hence, those who are better fit in. an environment would be selected by nature and leave more progeny than others. Darwin called it natural selection and implied it as a mechanism of evolution.
- Fitness is the end result of the ability to adapt and get selected by nature.
- The fitness, according to Darwin, refers ultimately and only to reproductive fitness.
- It is observed that all adult individuals of a population don't have equal chances of mating; some males with better phenotype are preferred by females. This is called Sexual selection.

#### (v) Origin of New species:

- As a result of heritable variations and natural selection there would be a change in population characteristic and hence new forms appears to arise.
- Theory of Pangenesis-According to this theory all organs of an individual produce Pangenes, which are minute particles carrying information about the organs. The pangenes travelling through the blood stream will ultimately reach the gametes, so that each gamete will have pangenes for each: of the different organs. After zygote formation, the pangenes tend to form the same organs from which these pangenes were produced.

#### **CRITICISM OF DARWINISM-**

- **1.** The main drawback of this theory is that Darwin didn't have the knowledge of genetics and he had no satisfactory explanation for the cause, origin and inheritance of variations.
- **2.** This theory only explained the survival of fittest but was unable to explain the arrival of fittest.
- **3.** Darwin was unable to explain why in a population only a few individuals develop useful variations and others have harmful variations.
- **4.** Criticism of Darwinism was based on sexual selection. Why only females have the right of selection for mating?
- 5. Darwin couldn't explain the existence of vestigial organs.
- **6.** Darwin was unable to differentiate the somatic and germinal variations.

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## **Comparison of Lamarckism and Darwinism**



L1 - Short neck in ancestral stage of giraffe. Neck was stretched and used to feed on leaves of tall trees.

increased, this was also

on leaves of tall trees.

 $D_1$  – In ancestors of giraffe different length of neck was inheritable.





D<sub>3</sub> - Due to above reasons D<sub>3</sub> giraffes with only longer neck survived.





L3 - Neck in the offsprings of giraffe continued to increase in next generations resulting in the evolution of long neck in modern giraffe.



## **MUTATION THEORY –**

- This theory was proposed by Hugo de Vries based on his work on evening primrose • (Oenothera lamarckiana).
- Large differences arising suddenly in a population are called mutations. Actually mutations are sudden changes of genetic material (DNA) and hence all are inheritable.
- In addition to recombination, mutation is another phenomenon that leads to variation in DNA
- Mutation is a discontinuous source of variations and provides raw material for evolution.
- According to Hugo de Vries it is mutation which causes evolution and not the minor variations (heritable) that Darwin talked about.
- Mutations are random and directionless while Darwinian variations are small and directional.
- Evolution for Darwin was gradual while de Vries believed mutation caused speciation and hence called it saltation (single step large mutation).

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## Criticism-

- (i) Natural mutations are not very common as Hugo de Vries thought
- (ii) Mutations are normally recessive & harmful, while the characters taking part ·in evolution are usually dominant.