# 3. THEORIES OF ORGANIC EVOLUTION

**LAMARCKISM –**

First theory of evolution was proposed by
**Jean Baptiste de Lamarck (1744-1829)**
Book : **Philosophie Zoologique (1809)**
The term **Biology** was given by **Lamarck & Treviranus.**

**Theory of Inheritance of Acquired Character –**

**Basic Concepts of Lamarckism –**

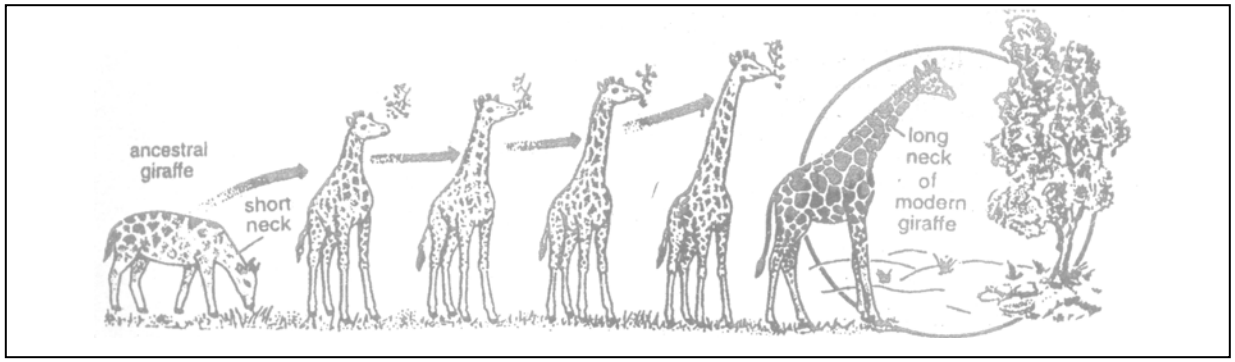
**(i) Internal Vital Forces :**
Some internal forces are present in all organisma. By the presence of these forces organism have the tendency to increase the size of their organs or entire body.

**(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 habits 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 time of an organism new characters develop due to internal vita forces, effect of environment, new needs and use and disuse of organs.

These acquired characters 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.




**Examples in support of Lamarckism :**

1. Long neck and high fore limb of Giraffe.
2. Aquatic birds stretched their toes and developed wed.
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 –**

1. 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 an grasses have evolved from trees but the size was reduced during evolution.
2. Secound 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 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 complectely false because acquired characters are not inherited.

☞ **Weismann –**

Weismann cut off the tails of rats for about 22 generations 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 type of matters are present in organism, **somatoplasm and germplasm.**

(ii) Someatoplasm in **somatic cells** and germplasm in **Germinal cell.**

(iii) Somatoplasm dies with the death of organism while germplasm 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 Pakard**

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

According to neolamarckism environment effected the inheritance of acquired character. 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 warm temperature resulting in elongation of body, large pinna and long tail. These fearures 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.

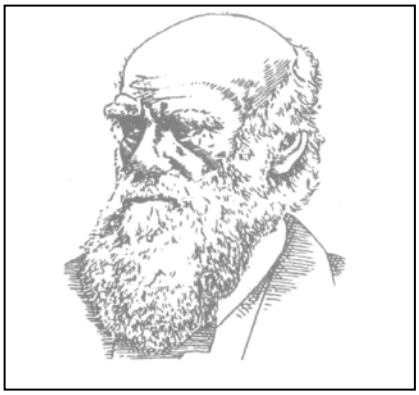
**3.Mac Dugal's Experiment –**

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

**Special Points :-**

1. **Allen's law:-** It states that animals which live in very cold climate, their extremities such as ears, tails, etc. become progressively smaller.
2. **Cop's law :-** It states that there is a tendency of animals to increase in size, during the long course of evolution.

# DARWINISM



Charles Robert Darwin was born on 12th Feb. 1809 in England.
Darwin traveled by **H.M.S. Beagle.**
The ship left on Dec. 27 , 1831 and returned on Oct. 2, 1836.
He traveled **South America, South Africa.**
**Australia and Galapagos Islands.**
Darwin was influenced by two books.
**"Principles of population" of Malthus.**
**"Principles of Geology " of Charls Lyell.**

**Alfred Russel Wallace :**

He traveled South eastern Asia and South America. The idea of natural selection striked in his mind. Wallace wrote an essay and sent it to Darwin. **"On the tendency of varieties to depart indefinitely from original type".**

There was striking similarity between the views of Darwin and **Wallace.**

Wallance's Chart : Wallace presented a chart to explain main points of theory of Darwin :

| S.No. | Facts | Consequences (Conclusions) |
|---|---|---|
| 1. | (i) Enormous rate of reproduction among Aniumals<br>(ii) Constant number of animals of a species | → Struggle for existence |
| 2. | (i) Struggle for existence<br>(ii) Heritable variations | → Survival of the fittest or natural selection |
| 3. | (i) Survival of the fittest<br>(ii) Continuous environmental changes | → Continuous natural selection leading To evolution of new species. |

"Darwinism" or "The theory of Natural Selection " was proposed jointly by Charles Darwin and A.R. Wallace. This theory was later on explained by Darwin in his book **'On the origin of species by the means of Natural Selection' (1859).**

**The main features of theory of Natural Selection are as follows –**

**(1) Over Production :**

All organism have capability to produce enormous number of offspring, organisms multiply in geometric ratio.

e.g. - Plants produce thousands of seeds.
- Insects lay hundreds of egg.
- One pair elephant gives rise to about six offspring and if all survived in 750 years a single pair would produce about 19 million elephants. Thus some organisms produce more offspring and other produce fewer offspring This is called **differential reproduction.**

**(2) Struggle for existence –**

Every individual competes with others of the same and other species for basic necessities like . space , shelther and food . It is called struggle for existence and it continues for the whole life from zygote stage to its natural death.

The struggle for existence is of three types -

**(i) Intra-specific struggle :** It is competition between the individuals of same needs like food, shelter and breeding **(most acqute type of struggle).**

**(ii) Inter-specific struggle :** This struggle is between the individuals of different species for food and shelter.

**(iii) Environmental struggle :** This struggle is between the organism and their environment. All organism struggle with cold, heat, wind, rain, drought and flood etc.

**(3) Variations and heredity –**

Except the identical twins no two individuals are similar and their requirements are also not same. It means there are differences among the individuals. These differences are called **variations.** Due to variations some individuals would be better adjusted towards the surrounding than the others.

According to Darwin the variations are continuous and those which are helpful in the adaptations of an organism towards its surroundings would be passed on to the next generation, while the others will disappear.

**(4) Survival of the fittest or natural selection –**

**The original idea of survival of fittest was proposed by Herbert Spencer.**

According to Darwin most suitable and fit individuals are successful in struggle for existence. The individuals with most favourable adaptations are able to lead most successful life and are able to win over their mating partners. Darwin called it **Sexual Selection.**

In the struggle for existence only those members survive which posses useful variations means nature selects fit individuals. This was called **Natural Selection.** Fitness is the end result of the ability to adapt and get selected by nature.

**(5) Origin of New Species –**

Darwin explained that variations appearing due to environmental changes are transmitted to the next generation. So offspring become different from ancestors. In next generation process of Natural selection repeats so after many generation a new species is formed.

**Criticism of Darwinism –**

1. Darwin does not explain the development of vestigial organs.
2. This theory has no satisfactory explanation for the cause, origin and inheritance of variation.
3. Darwin is unable to explain why in a population only a few individuals develop useful variation and others have m variations.
4. Criticism of Darwinism was based on sexual selection. Why only female selects the male for mating why not vice versa.
5. Darwin waws unable to differentiate somatic and germinal variations.
6. This theory was unable to explain over-specialization of some organs like tusk of elephants, antelers of deer.
7. This theory only explain the survival of fittest but unable to explain **arrival of fittest.**
8. The main drawback of Darwinism was lack of the knowledge of **heredity.**

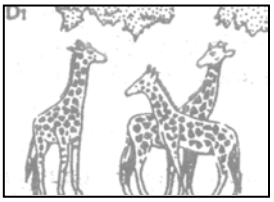
**Theory of Pangenesis**

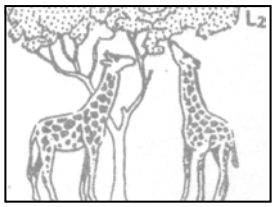
According to this theory all organs of an individual produce Pangenes, which are minute particles carrying information. about the organs. The panhenes traveling through the bllod stream will ultimately reach the gametes, so that each gamete will have pangenes for each of the different organs. After zygote formation, the pangenes tend to form the same organ from which these pangenes were produced.

## COMPARISON LAMARCKISM AND DARWINISM


L1 – Short neck in ancestral stretched and used to feed on leaves of tall trees.

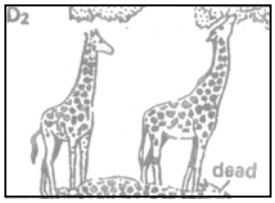
D1 -In ancestors of giraffe inheritable.

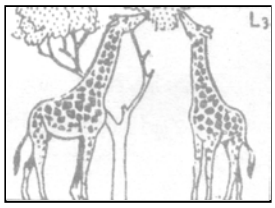



L2 – Neck in offsprings increased, this was also stretched and used to feed on leaves of all trees.

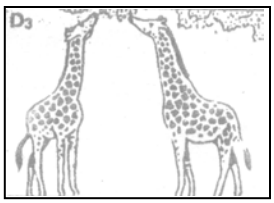
D2 – As a result of struggle for existence giraffes with longer neck were better adapted. Due to natural selection offsprings with long neck increased in number, while tose with short neck gradually disappeared.




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

D3 – Due to above resons giraffes with only longer neck survived.




**NEODARWINISM –**

Neodarwinism is a modified form of Darwinism along with recent researches of **Weismann, Mendel, Devries, Huxley, Gates, Stebbins** etc. They performed many experiments to remove the objections against Darwin's theory.

The salient features of neodarwinism are as follows -

1. **Rapid multiplication :** All organism multiply in geometrical ratio.
2. **Limited food and space :** Food and space are limited.
3. **Struggle for existence :** It is of three types. Intraspecific, Interspecific and environmental.
4. **Genetic Variations :** They are inheritable variation which can occur due to the following resons.

**(a) Mutation :** They are **discontinuous variations** which develop due to permanaent changes in genotype.

Mutations are of three types -

- **Genomatic mutations :** Change in number of chromosme.
- **Chromosomal Aberrations :** Change in structure of chromosome.
- **Gene Mutation :** Change in nucleotide.

**(b) Gene recombination :** They are new combination of genes which are usually caused **by crossing over.**

**(c) Hybridisation and gene migration :** It is crossing of organisms which are genetically different in one or more traits.

**(d) Genetic drift :** It is the elimination or addition of the genes of certain characters when some animals in population migrate or dies or immigrate. It changes the gene frequency of remaining population.

Genetic drift operates only in **small population.**

**(Change in frequency of genes in a gene poll is called genetic drift)**

Founder Effect : Gene pool is the sum total of all the genes found in a population. Change in the frequency of gene in a gene pool is called genetic drift. Genetic drift always operates in small population. By genetic drift often the phenotype of this small population quickly become different from the parental population and some time form a new sp. Such an effect is called Founder effect.

Bottleneck effect Death of several members of a population due to natural calamities (Earthquake. Storm. Flood) also leads to genetic drift. The original size of population is then restored by mating among the survivor. The new population may lack the genes of certain traits. This may produce a new species after some time. The loss of a section of population by death and after sometime a new species is formed that effect is known as Bottleneck effect

5. **Natural Selection –**
   If differential reproduction (some individuals produce more, some only few and still others none) continuous for many generations, genes of the individuals which produce more offspring will become predominant in the gene pool of the population. Thus natural selection occurs through differential repeoduction in successive generations.
6. **Isolation –**
   Isolation is a segregation of populations by some barriers which prevent interbreeding. The reproductive isolation between the populations due to certain barriers leads to the formation of new species.

7. **Origin of new species –**
   An isolated population of a species independently develops different types of mutations. They latter accumulate in its gene pool. After several generations the isolated population becomes genetically and reproductively different from others so as to constitute a **new species.**

**Examples of Natural Selection –**

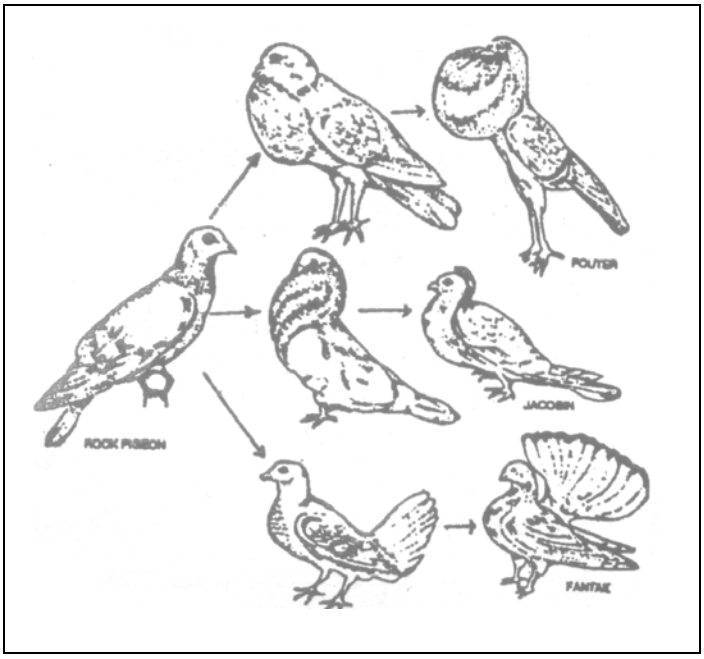
**(1) Industrial Melanism :** This phenomenon was studied by **Barnard kettlewell.**
Before industrial revolution, the dull grey forms of peppered moth**-Biston betularia –** were dominatnt; the **Carbonaria** from (Black) was rare because it was susceptible to predation by birds. The reason was that it was **conspicuously** visible while resting on tree trunks.
The industrial revolution, resulted in large scale smoke which got deposited on tree trunks turning them Black. Now grey varieties became susceptible – the Black forms flourished. Replacement of coal by oil and Electricity reduced production of black moth so the frequency of Grey moths increased again.

**(2) Drug resistance :**
The drugs which eliminate pathogens become ineffective in the course of time because those individuals of pathogenic species which can tolerate them, survive, flourished, Replacement of coal by oil and Electricity reduced production of black moth so the frequency of Grey moths increased again.

**(3) Sickle cell Anaemia and Malaria :**
Individuals homozygous for sickle cell Anaemia die at an early age. In heterozygous individuals, the cells containing abnormal haemoglobin become **Sickle** shaped. In fact, when an RBC becomes sickle-shaped, it kills Malarial parasite effectively so that these individuals are able to cope with malaria infection much better than normal persons. The process of Natural selection thus maintains the abnormal form of haemoglobin along with the normal form in a region where Malaria is common.

**(4) Malaria** G – 6 – PD **deficiency :**
**Glucose-6-Phosphate dehydrogenase** deficiency is a common abnormality in Negroids. Haemoglobin gest denatured and is deposited on cell membrane. **The disease is called favism .**
In these RBC, the malarial parasite cannot complete it's life cycle. Such persons get protection from Malaria.

**Artificial Selection –**




Man has been taking the advantage of genetic variations for improving the qualities of **domesticated plants and animals.** He selects **the individuals with desired characters and separates** them from those which donot have such charac- ters. The selected individuals are interbred. This process is termed as **Artificial Selection.** Thus this process is man made. If it is repeated for many generations it produces a new breed with desired characters.

By artificial selection animal breeders areable to produce improved varieties of domestic animals lik**dogs, horse, pigeons, poultry, cows, goats, sheep and pigs** from their wild ancestors. Similarlythe plant breeders have obtained improved varieties of useful plants like **wheat, rice, sugarcane, cotton, pulses, vegetables fruits etc.**

Artificial Selection is similar to natural selection except that the role of naturae is taken over by man and the characters selected are of human use.

**Special points :-**

- The breeders have successfully produced the toy-like Shetland pony, the Great Dane dog, the sleek Arabian race horse by selection.
- Many crop plants like broccoli, kale, cabbage, Cauliflower, Brussels sprouts and kohirabi have been produced through selective breeding.
- The various breeds of fowl ranging from the ceremoinial cocks **(the Japanese onago-dori)**to the **broiler, leghorns** are all derived from a single jungle fowl **Gallus gallus.**

**Reproductive Isolation –**

Reproductive isolation is the prevention of inter breeding between the populations of two different or closely related species. It maintains the characters of the species but can lead to the origin of new species.

The mechanism of reproductive isolation is explained by **Stebbins** in his book **'Process of Organic Evolution'.**

Two main subtypes of reproductive isolation are -

1. **Premating or prezygotic isolation :**
   Prevent matting or formation of zygote.
   - **(1) Ecological isolation :** Two species live in different habitats and do not meet. (One may be living in fresh water and the other in the sea).
   - **(2) Temporal isolation :** Breeding seasons or flowering time may be different in the two species.
   - **(3) Behavioural isolation :** The males of one animal species are unable to recognise the females of another species as potential mates.
   - **(4) Mechanical isolation :** The structural differences in genitalia of individuals belonging to different animal species interfere with mating.
   - **(5) Gametic isolation :** The sperms and ova of different species of animals are unable to fuse. In plants, the pollen coming from a different species may be rejected by the stigma.

**2.** **Postzygotic mechanisms :** A hybrid zygote is formed but it may not develop into a viable fertile adult.

**(1)** **Hybrid inviability :** Hybrid zygotes fail to develop. In plants, embryos arising from interspecific crosses abort.

**(2)** **Hybrid sterility :** Hybrid adults do not produce functional gametes. (Mules and henny are common examples in mammals. Several hybrid ornamental plants are sterile.)

Exception :
- -Africa lioness + Asian tiger = Tigon (Panthera leo) (Panthera tigris)
- Male lion + Female tiger = Liger
- Mallard duck + Pintail duck
- Polar bear + Alaskan brown bear
- Platy fish + Swordtail fish

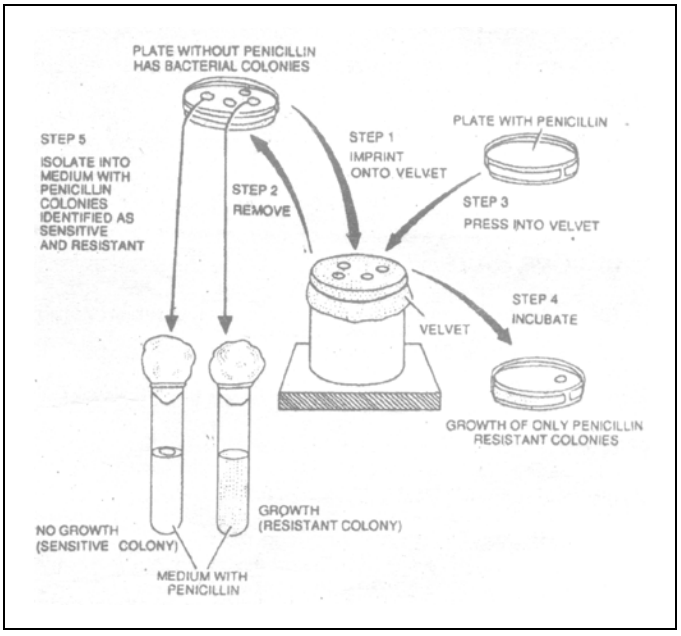
Offspring which obtained from all these hybridizations are fertile but these species do not interbreed naturally.

**(3)** **Hybrid breakdown :** Sometime inter specific mating produce a hybrid, which give rise to next hybrid by back cross but they have reduced vigour or fertility or both.

## GENETIC BASIS OF ADAPTATIONS

**Joshua Lederberg & Esther Lederberg** show genetic basis of adaptations by experimenting on bacteria. This experiment is know as Lederg's Replica plate experiment.

1. Lederberg cultured the bacterial cells on agar plate. Many bacterial colonies or groups grew on this agar plate. In this every colony is formed by the division of bacterial cells. Therefore its all cells were of same genetic structure. This type of group of cells is known as **clon.** This multi colony agar plate is known as **master plate.**
2. On this master plate one sterile velvet plate was pressed slightly so that some bacteria got stuck on velvet plate. In this way this become **replica of master plate.**
3. Now efforts of preparing replica had been made on those agar plates whose agar contains an antibiotic penicillin. It was seen that some bacteria failed to grow on penicillin agar plate while some bacteria were able to grow and developed new colony.




It was concluded that those bacterial colonies were penicillin resistant. These bacteria have penicillin resistant mutant gene.

* **Lamarckian view :** Penicillin induced a change in some bacterial cells enabling them to grow in medium containing penicillin (wrong concept).

** **According to Darwin** some bacterias were penicillin resistant in bacterial suspension. In penicillin medium, normal bacteria did not survive while mutant bacterias survived, as they are adapted, and form colony.

## MODERN SYNTHETIC THEORY OF ORGANIC EVOLUTION –

This theory is the result of the work of a number of scientists namely **Dobzhansky, Fisher, Haldane, Swall wright, Mayr, Stebbins.**

Stebbins discussed this theory in his book **"Process of Organic Evolution"** and Dobzhansky explained it in his book **"Genetics and the origin of species".**

According to this theory new species can not evolved by the presence of variable genotype in a population. Two factors are also required-natural selection and reproductive isolation. Natural selection guides different population in to different adaptive direction and reproductive isolation between them due to geographical barriers leads these direction to the evolution of new species.

In this theory following factors are included –

(i) Gene mutation
(ii) Change in chromosome number and structure
(iii) Genetic recombination
(iv) Natural selection
(v) Reproductive isolation.

Besides these factors there are two more processes which cause evolutionary changes. These are –

(i) Migration of individuals from one population. to another.
(ii) Hybridisation among species and also related genera which causes genetic variation in the population undergoing process of evolution.

## Mimicry :

- **It is a kind of adaptation.**
- The term mimicry was given by Bates (1862)
- "The resemblance of one organism to another or to any natural object for the purpose of concealments, protection or for some other advantages like attach.
- The organism which exhibits mimicry is called a **mimic** and the organism or object which is mimicked is called as **model.**

## Types of mimicry :

(1) Protective (2) Aggressive (3) Conscious.

**1. Protective mimicry :**

It is useful for an organism to protect itself from the predator.

It is of 2 Types –

**(a) Concealing –** The organism resembles the surrounding, so it cannot be easily detected by predators. Eg. Stick insect, Leaf insect.

**(b) Warning type –** The organism resembles a distasteful or poisonous organism. It is also known as **batesian mimicry.**
Eg. Viceroy butterfly

**2. Aggressive mimicry :**

It is generally used by the predator.

It is of 2 Types -

**(a) Concealing :** In this type the predator connot be noticed by the prey because it matches with the surroundings involving colur or body shape or both.
Eg. Yellow spider.

**(b) Alluring Type :** The predator attracts the prey by resembling it self to any other object.
Eg. mouth corner of African lizard resembles a flower.

**3. Conscious mimicry :**

Some organism behave as a dead object to protect them from predator.
Eg. **Tenebrinid beetles** become motionless and pebble like when in danger.

**Mullerian**

When two or more inedible or unpalatable species resemble each other this type of mimicry is called Mullerian mimicry. Mullerian mimicry is done by two species for increasing warning effect to predators. For example ctenuchid moth resembles a wasp, where both of them are unpalatable.
It is also a kind of protective mimicry.

## Mutation Theory

Proposed by Hugo-vries on the basis of his experiments on a plant Oenothera lamarckiana.

**Main Point mutation theory :**

1. Mutation or discontinuous variation are the raw material of evolution.
2. Mutation appears suddenly and produced their effect immediately.
3. Mutants are different from the parents and there are no intermediate stages between the two.
4. The same type of mutation can appear in several individuals of a species.
5. Mutation can appear in all direction and all mutations are inheritable.
6. Useful mutations are selected by nature an lethal mutations are eliminated.
7. Mutation are recurring so that the same mutant can appear again & again so chance of selection by nature are increased and new species is formed.
8. Mutation is a jerky & discontinuous process. De-vries termed single step large mutation as saltation.
9. Mutations are random and directionless while Darwinism variations are small and directional.

**Points in favoue of mutation theory :**

1. Mutations are actually thesource of all variations and fountain head of evolution.
2. Mutation theory can explain both progressive & retrogressive evolution.
3. A number of mutations have appeared in nature and mutations are also induced which have given rise to a new varities.

**Points against the theory :**

1. Natural mutation are not very common as Hugo-de-vries thought.
2. Mutations are normally recessive while characters taking part in evolution are usually dominant.
3. This theory cannot explained the development of mimicry, relationship between position of nactaries in flower and length of proboscis in their insect pollinators. These cannot be imagined to have developed all of sudden by mutation.
4. Oenothera lamarckiana is not a normal plant but a complex heterozygous plant form with chromosomal aberration.

**Significance :**

De-vries mutation theory generally accepted because the mutation were found to be inheritable. It was later though that evolution cannot occur by mutation alone, natural selection and isolation of mutants are also necessary for evolution.

### Natural Selection & Polymorphism :

A population is called polymorphic for a character if two or more distinct form are present in this population.

**Ex. : ABO Blood Group :**

There are 4 type of blood group are present in human being A,B,AB. and O. They are due to the presence of different genotype.

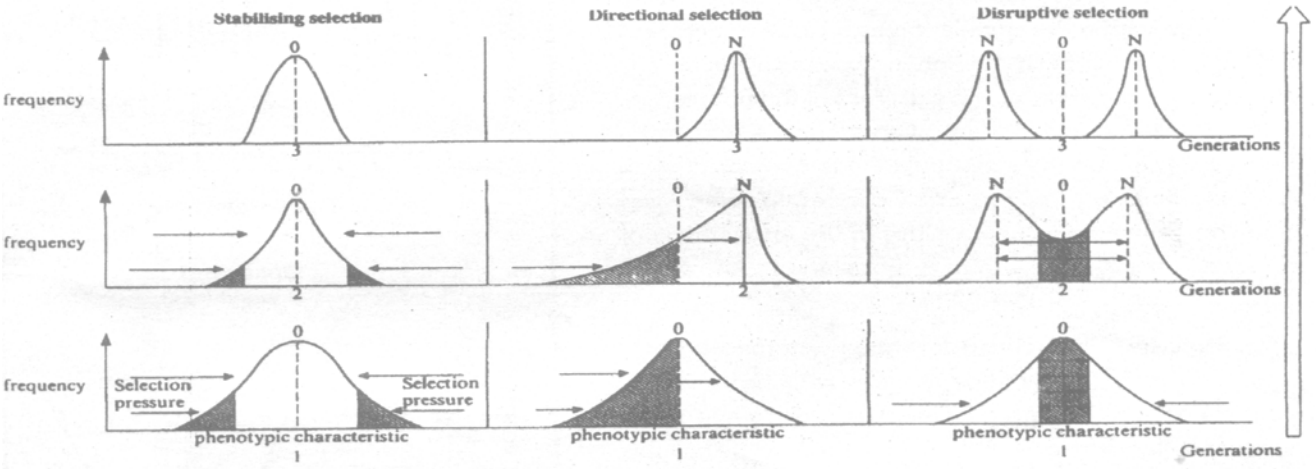
Sickle cell anemia is also an example of polymorphism. In this disease one amino acid is changed in polypeptide chain due to change in one $N_2$ base. That's why the normal shape of RBC is changed into sickle shape.

The organism in which heterozygous condition is present for this characters, the RBC become sickle shaped In this type of RBC malarial parasite can't have a normal growth that's why these individuals are resistant towards malaria. The HbS, HbS condition leads to the death of organism. The organism with HbS, HbA condition are selected by nature because these are the fittest of all. The lose of HbS gene due to the death of organism having HbS, HbS is recovered & balanced by the reproduction of heterozygous condition (HbS, HbA). This type of selection is called **balancing selection.** It means the preservation of genetic variability is maintained by the selection of heterozygotes which is called **'Balanced polymorphism'.** But this kind of balancing selection founs very rarely in nature.

**Types of Natural Selection :**

Based upon different organism – environment relationship. Following different kinds of natural selection have been recognised.

- Stablising selection.
- Directional selection.
- Disruptive selection.




*Diagrams showing the three types of selection operating within populations. 0 indicates the original coincidence between optimum phenotype and optimum environmental conditions; N indicates the new position of coincidence of optimum phenotype and optimum environmental conditions. Organisms possessing characteristics in the shaded portions of the normal distribution are at a selective disadvantage and are eliminated by selection pressure. (The numbers 1–3 indicate the order of generations.)*

**(1) Stabilising selection :**

Stabilizing selection operates when phenotypic feature coincide with optimum environmental conditions and competition is not present. It keeps a population genetically constant. It favours the average or normal phenotypes and eliminate the extreme variants, that fall towards both ends of the bell-shaped curve of variability for the distribution of measurements of phenotypic traits. Due to continuous elimination of both extremes, the bell shaped curve tends to narrow. Stabilising selection always operates in constant or unchanging environment. Ex. Mortality in babies : The birth weght of human babies provides another example influenced by stabilizing selection. The optimum birth weight favoured by stabilizing selection is 7.3 pounds. New born infants less than 5.5 pounds and more than 10 pounds have the highest mortality rate. The curve for mortality is virtually the complement of the curve of survival.

**(2) Directional selection of Progressive selection :**

Directional selection produce a regular change in a population in respect to certain traits. This form selection operates in response to gradual changes in environmental condition. It favour individuals that change in response to the environmental change and become best adapted to new environmental condition. It favour the phenotype which is non average or extreme and then pushes the phenotype of the population in that direction. Directional selection removes more individual from one end of the normal curve of variability distribution and adds towards the other end and alters the man value of the trait in the population in a particular direction, so the mean moves in one direction. Directional selection operstes when environment is changing in one direction.

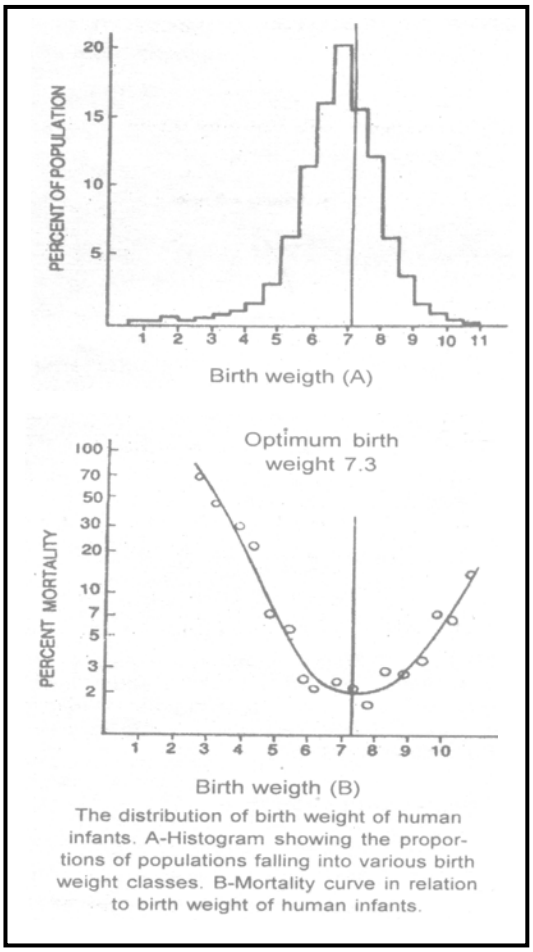
Ex. (1) Biston betularia

(2) Resistance of insects to DDT.

**(3) Disruptive selection :**

This is probably the rerest form of selection but can be very important in bringing about evolutionary change. Fluctuating conditions within an environment, say associated with season and climate may favour the presence of more than one phenotype in a population. Selection pressure acting from within the population as a resultof increased competition may push the phenotype away from the population mean towards the extremes of the population. This can split a population into two subpopulation. If the gene flow between the subpopulation is prevented, each population may give rise to a new species. In some cases this form of selection can give rise to the appearance of different phenotype within a population, known as polymorphism.

**Eg. Shell pattern in limpets :** Shell patterns of limpets (marine Mollusca) present a continuous, ranging from pure white to dark tan. These are either attached to white or light- coloured limpets camouflaged with white barnacles and tanned ones were protected on the tan-coloured rocks. Limpets of intermediate shell patterns, being conspicuous are preyed by predatory shore birds, resulting in distruptive selection.



The distribution of birth weight of human infants. A-Histogram showing the proportions of populations falling into various birth weight classes. B-Mortality curve in relation to birth weight of human infants.

## SPECIES

**1. BIOLOGICAL SPECIES CONCEPT :** A species is a sexually interbreeding group of individuals separated from other species by the absence of genetic exchange. Member of a species are capable of breeding with one another and produce living, fertile offspring but are unable to breed with members of other species normal.

**SIBLING SPECIES :** Species which are morphologically similar but do not interbreed normally, are known as sibling species.

eg. : Drosophila pseudoobscura & Drosophila ersimillis.

**2. EVOLUTIONARY SPECIES CONCEPT :** Proposed by **George Gaylord simpson.**

Biologicalsp. concept explained only sexually reproducing animals. Animals with asexual reproduction can not be explained like-prokaryotes, some protest, some fungi which kept in same sp. on the basis of same morphology & same biochemistry. According to evolutionary sp. concept species is defined on the basis of differences which are not based on sexual reproduction. Supporter of this theory gave more importance to evolutionary isolation as compare to sexual isolation. According to this concept a species is a lineage (an ancestor descendant sequence of population) which evolved separately from other species and have its own evolutionary role and tendencies. This concept also include evolution. In this concept morphological, genetic, behavioural and ecological differences are include. But this concept is also not completely true.

**3. TYPOLOGICAL CONCEPT :** According to this concept a fix pattern of characters is present in the species of every living organism and all the members of that species shows maximum resemblance with this pattern. **[The most acceptable concept].**

According to this concept species are of 2 types.

**(A) Monotypic Sp. :** In the formation of this type of species main ancestor species do not divide in to small groups and modify into a new species. So the no. the no. of species are not increased.

**(B) Polytypic Sp. :** In the formation of this type of species the main ancestor sp. divided into two or more group and each group form a new species. So the no. of species will increased.

**Speciation**

Formation of one or more new species from an existing species is called speciation. Speciation are of 2 types.

**A. DIVERGENT SPECIATION :** Origin of one or more new species from an ancestor species is called divergent speciation. In this type of speciation ancestor sp. is also continuous to exist with new species. In this type of speciation no. of species are increased.

- **Demes :** Local population of a particular area is called demes. The members of two different demes of same sp. can interbreed normally.

**Race :** Races are small groups of a species which are geographically isolated and have some genetically difference, which are controlled by genes.

**Divergent speciation are of two types –**

**(1) Allopatric Speciation :** When a species split into two or more geographically isolated population and these population finally form a new speices. This mode of speciation in called allopatric speciation and these sp. are known as allopatric species.

Ex. : Finches of Darwin are example of Allopatric speciation.

**(2) Sympatric species :** In this type of speciation a sub population become treproducatively isolated from its parental p[opulation. Sympatric speciation is the formation of species without geographical isolation and these sp. are known as sympatric species. Mainly present in plants due to polyploidy.

**B. Transformation speciation :** In this type of speciation an ancestor species change into a new sp. with time. In this process no. of species is not inca

Transformation speciation are of two types -

**(1) Phyletic Evolution :** When an ancestor sp. changed in to a new species by gradual changes in thousand of years.

e.g. Eohippus → Mesohippus → Merchippus → Pliohippus → equus

**(2) Quantum Evolution :** In this process suddenly changes appears in ancestor species and ancestor species immediately changed into new sp. No. connective links arepresent in this type of speciation. It is caused by major mutation.

**Special point :**

- **Micro evolution :-** Microevolution is the occurrence of small-scale changes in gene frequencies in a population, over a few generations. It occurs at or below the species level. It often cause the formation of new subspecies. These changes may be due to several process-Natural selection, gene flow, mutation, recombination, genetic drift etc.

  eg. Formation of clines.

- **Macro evolution :-** Macro evolution is the evolution, which results ios the production of new adaptive types through a process of population fragmentation and genetic divergence. It is the occurrence of large-scale changes in gene frewuencies in a population, over a geological time period (consisting of lots of micro evolution). Macro evolution operates above the species level and results in the establishment of new genera, families and order. The change in the organization occurs due to accumulation of large mutation (macro mutation). Macro evolution is the actually adaptive divergence. The divergent evolution of different reptilian group from initial reptile ancestor is example of macro evolution.
- **Mega evolution :-** The origin and evolution of new types of biological organization as a result of general adaptation from its predecessor resulting in the formation of new classes, phylum. Mega evolutionary changes are rare and have occurred only a few times in the evolutionary history of living beings.
- **Anagenesis :** It is the evolution of species involving a change in gene frequency in an antire population. It is also known as phyletic change. Anagenesis may also be reffered phyletic evolution or gradual evolution.
- **Cladogenesis :** It is an evolutionary splitting event in which each branch and it's smaller branches form a 'clade', an evolutionary mechanism and a process of adaptive evolution that leads to the development of a greater Varity of sister organism.

## BRIEF REVIEW

- Main concept of Lamarckism or Theory of inheritance of aquired character.
  - (1) Internal vital force
  - (2) Effect of environment and new needs.
  - (3) Use and disuse of organs.
  - (4) Inheritance of aquired character.
- Weismann give the theory of continuity of germplasm.
- Main points of Darwinism to Theory of natural selection.
  - (1) Over production
  - (2) Struggle for existence
  - (3) Variation and heredity
  - (4) Survival of fittest/natural selection.
  - (5) Origin of new species.
- Examples of natural selection
  - (1) Industrial melanism
  - (2) Drug resistance
  - (3) Sickle cell amaemia & malaria
  - (4) Malaria & G-6-PD deficiency.
- Mutation theory proposed by hugo de vries.
- According to lederbergs, genetic basis of adaptation in preexisting gene mutation.
- Modern synthetic theory of organic evolution is a modification of neodarwinism.
- Type of natural selection – Stabilizing, Directional, Distruptive.
- Reproductive isolation are of two types
  - (i) Premating isolation (ii) Postmating isolation
- Mimicry is a kind of adaptation.
- 3 types of mimicry
  - Protective mimicry
  - Aggressive mimicry
  - Concious mimicry
- Three main concept for species
  - (1) Biological species concept
  - (2) Evolutionary species concept
  - (3) Typological concept
- Speciation are of two types
  - (1) Divergent speciation
  - (2) Transformation speciation
- Divergent speciation → Allopatric speciation
  Sympatric speciation
- Transformation speciation → Phyletic evolution.
  Quantum evolution.