Prof ANIL KUMAR (Zoology)
B.Sc HONS Part - III Paper - VII
Topic - Write an essay on Neo-Darwinism
Prof ANIL KUMAR
Associate Professor zoology
R.R.S College MOKAMA (P.P.U)

Q. Write an easy on Neo-Darwinism.

Ans. Introductions : Although darwin's natural selection theory is generally favoured, it has certain limitations. The recent supporters of Darwinisms modified the theory according to the latest developments in biology. This modified theory is called Neo-Darwinism or modern synthetic theory of natural selection. In Neo-Darwinism the major defects of Darwinism are rectified. Darwin's supports give their experimental evidence of natural selection. Mutations and other contributions of genetics are incorporated in Neo-Darwinism. The biologist who are extending their helping hand for the construction of Neo-Darwinism are called Neo-Darwinism. A few Neo-Darwinisms are Romances, Wallance, Fisher, Huxley, Ford, Haldane, Goldschmidt, Sewall Wright, Emer Haeckel, August, Weismann, Dobzhansky, Mendel, Kettle Well and Herbert Spencer.

The Neo-Darwinism has the following ideas :

(A) Experimental evidences.

(B) Answers to the objections.

(A) Experimental support : The natural selection theory is supported by a number of experiment conducted by biologists. A few are given below :

1. Industrial Melanism : The operation of natural selection in natural populations is explained with experimental evidences. On such evidence is provided by industrial melanism. It is a phenomenon where the moths living in the industrial areas, develop black colour (melanin pigments) to match the body to root covered background on the bark of trees. The industrial melanism is observed and worked out by a number of evolutionists like R. A. Fisher, E. B. Ford and H. B. O. Kettlewell. The original study was based on the prepared moth Biston betularia. About 45 years ago all the prepared moth that lived in Great Britain were light coloured or white coloured. The light colour is due to the absence of melanin (pigments) in the body. Hence these moth are called non-melanic forms. In 1885 one black colour is due to the presence of melanin. Hence this moth is called melanic form of carbonaria.

In 1848 the black variety formed a maximum of 1% of the population; but in 1898 it formed up to 99% of the total population. General studies showed that melanism is produced by a single dominant gene. Cross breeding experiments indicate that the melanic genes follow the typical Mendelian inheritance. The change in gene, genotype and phenotype frequencies beautifully correspond in the spreading of industry in Great Britain during the smoke and shoot, arising from the industries are deposited in the surrounding areas. Hence the light coloured area is gradually transformed into a black coloured area.

If there are white coloured moths in the root covered area, they will be easily seen by the predators and are captured and eaten by them. On the other hand if there are black coloured moths in the root covered areas they match the coloured of the surrounding and hence easily escape from the predatory birds. To escape from the enemies, the moths develop the black coloured in the industrialized areas. It is an excellent example of natural selection. Here nature (environment) favours the black moths which match the dark black ground. Industrial melanism is observed now- a-days not only in prepared moths, but also in a wide variety of moths. For example, in Great Britain about 40 species exhibit it, in United states about 120 species exhibit this phenomenon.

2. Resisdence of DDT : In agriculture, insect pests are controlled by the spraying of insecticides like DDT. However DDT cannot bring about 100% deaths in any species of insects. A certain number in individuals survive. These surviving individuals are resistant to DDT. The resistance is character controlled by genes. The resistant flies arise as a result of the application of DDT. They reproduce more and more resistant flies. Thus the resistant populations are evolved as a selective advantage against insecticides.

3. Welden's experiment on shore crab : Weldon conducted his experiment on shore crab carcinus meanus. A large break water was laid in the mouth of the river plymouth sound. The break water slowed down the rate of water flow. This resuited in the deposition of silt. The deposition caused the death of numerous crabs, living in that area. Weldon analysed the dead crabs, and the living ones. He found that the living crabs were provided with narrow carapace and the dead ones with broad carapace. He assumed that the death of the crabs was due to the accumulations of slit in the gills. Weldon observed that within five years after the construction of break water the mean diameter of carapace began to decrease. This experiment shows that changed environment produces minute changes, nutural selection operates in the changed environment and it selects the narrow carapaced crabs.

4. Resistance of bacterium to drugs : L. L. Cavalli and G. A. Maccacro (1952) experimentally proved that the colan bacteria Escherchia coli develop resistance to the antibiotic chloramphenicol 250 times as great as that tolerated by normal bacteria by exposing the bacteria to increased concentration of the drug. Crossing experiments prove that resistance has been acquired by mutations and it is inherited on the Mendelian principals. When the resistant strain are cultured in chloramphenicol free medium. They grow much more slowly than the susceptible ones. This experiment shows that populations can be made to respond adaptively to controlled changes in their environment, and these adaptive changes are due to mutations.

(B) Explanations against the objections : Neo-Darwinians tried to vive convincing evidences and explanations against the objections & criticisms raised against Darwinism. They are as follows :

1. Germ plasm theory : The important objection levelled against Darwinisms is that Darwin did not distinguish between heritable and non-heritable variations. This objection is answered by 'Germplasm theory' proposed by August Weismano in 1904. According to this theory the character appearing in the somatoplasm disappar with the possessor, so they are not inherited. The characters or changes appearing in the germplasm alena are inherited generation after generation.

2. Variation : A third objection against Darwinism is that it does not explain the origin of variation. After the discovery of Mendal's laws, the origin of variation is clearly understood. Mendal's experiments prove that characters are controlled by genes. When there is change in the genes (mutation) the characters are also changed and thus variations appears. Now the origin of variation is clearly understood. It is produced by the following factors :

(1) Mutation (2) Recombination (3) Hybridization (4) Isolation (5) Natural selection (6) Genetic drift (7) Founders effect (8) Migration & gene flow.

Mutation : A mutation is a spontaneous change in a gene or a chromosome ; this change may produce an alteration in the character. Dobzbamsky stated that mutation is a mistake or misprint in cell division. The change that occurs in a gene is called gene mutation of point mutation; the change that occurs in a chromosome is called chromosomal mutation; or chromosomal aberration. A mutation is a somatic cell may not be very important in evolution, but if the cell is a gamete mother cell, a gamete or a zygot, the entire organism arising from this cell may be affected. Since the mutant form of the gene is inherited in the usual way, the mutation will persist in subsequent generations. Thus mutation produces variations.

3. Recombination : The formation of gene combinations not present in the parental type is called recombination. It is process of mixing up of the available genes. Moody (1970) states that recombination involves the reaserting and recombining of genes already present ; he compares this process to the mixing and sorting out of playing cards. It is produced by the following processes :

1. Crosing over at the time of meiosis.
2. Free assortment of genes at the time of gamete formation.
3. Random union of gametes at the time of fertilization.
4. Interbreeding.

It does not produce new genes; but it does produce new gene combinations or geno-types. Recombination assists the spreading of mutant genes in the population. It is a primary source of variation . It is more potent than mutaion in producting variations. In recombination the genes are rearranged and hence they are brought in close association with new genes. This cause position effect and epistasis. Hence the original character of the animal is changed and new characters appear by recombinations.

3. Hybridization : Hybridization refers to a cross involving two species resulting in the formation of hybrids. The hybrids share the genetic materials from two different species. Hence they develop new characters.

Examples : 1. Mule is a hybrid between horse and donkey.

2. Rapha nobrassica is a hybrid between Raphanus (Radish) and Brassica (cabbage).

3. Pomato is a hybrid between potato and tomato.

4. Natural selection–Variation is the raw material for evolution. It is produced by mutation and recombination. Once variations are produced, natural selections processes the variation and makes evolution to proceed. Johannsen stated that selection is effective in genetically mixed population but inoperative in genetically uniform ones. Genetical variation is produced by mutations & recombinations. The variation may be favourable or unfavourable. The animals provided with favourable variations are well adapted in the given environment Fisher (1936) stated that evolution is progressive adaptation & consists of nothing else. The invironment favours animals have ample opportunities for mating and they produce more off spring. Hence the genes combinations controlling favourable characters spread more rapidly than other genes. This leads to differential reproduction of genes by which some genes are favoured over others.

5. Genetic drift : In small populations gene frequencies change of fluctuate purely by chance ; the smaller the population, the greater the change, for change. The random changes in gene frequency be chance in a small population is called genetic drift. This view was proposed by Sewell Wright. Hence it is also called Sewell Wright effect. As a result of genetic drift, a new mutation arising in a small population is either fixed or lost. Ingenetic drift the adaptive value of mutation or character is not considered, hence the character lost or fixed in a small population may be adaptive or non-adaptive. The fixation or loss of a character is due to the fact that hetrozygous gene pairs tend to become homozygous by chance rather than by selection. This is the reason why in small populations sometimes unfavourable characters are fixed. The organisms with deleterious genes die and hence the deleterious genes are eliminated from the population. Thus an isolated small separated from the larger bulk of the population and eventually would evolve into new species.

6. Isolation : Isolation is the separation if individuals of a species by some barrier, which prevents interbreeding. Geographic isolation causes two populations to be separated. The geographically separated populations are called allopatric populations. Mayr (1963) states that geographic isolation is usually a necessary first step in the development of diversity between populations and the subsequent origin of species. So long as the gene pool of a population remains undivided, two different populations cannot arise from it.

Once separated, the gene pools are out of touch with each other, they are exposed to two different types of environmental conditions, the two populations are free to go their evolutionary ways. Elemental forces of evolution, namely

mutation, recombinations, natural selection and genetic drift occur independently and differently in each population. This leads to progressive genetic divergence, the nature of genetic divergence is different in two populations. This divergence leads to the failure of interbreeding between the population if they come together by migration or by the disappearance of geographic isolation. Thus reproductive isolation is established. When this point is reached the population may live in the same area. Thus allopatric populations becomes sympatric still they retain the integrity of their respective