B. Sc. Part I PAPER – III: ELEMENTS OF CELL BIOLOGY, EVOLUTION AND ECOLOGY,

Natural selections theory of Darwin or Darwinism

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Darwinism is a theory of biological evolution developed by the English naturalist Charles Darwin (1809–1882) and others, stating that all species of organisms arise and develop through the natural selection of small, inherited variations that increase the individual's ability to compete, survive, and reproduce.

Charles Robert Darwin was born on February 12, 1809, in Shrewsbury, England, the fifth child of Robert and Susannah Darwin. His father was a successful doctor, as was his grandfather, Erasmus Darwin, who had a great influence on Charles's later theories.

He was an English naturalist, geologist and biologist best known for his contributions to the science of evolution. In a joint publication with Alfred Russel Wallace, he introduced his scientific theory that this branching pattern of evolution resulted from a process that he called natural selection, in which the struggle for existence has a similar effect to the artificial selection involved in selective breeding

Beginning in 1837, Darwin proceeded to work on the now well-understood concept that evolution is essentially brought about by the interplay of three principles: (1) variation—a liberalizing factor, which Darwin did not attempt to explain, present in all forms of life; (2) heredity—the conservative force that transmits similar organic form from one generation to another; and (3) the struggle for existence—which determines the variations that will confer advantages in a given environment, thus altering species through a selective reproductive rate.

On the basis of newer knowledge, neo-Darwinism has superseded the earlier concept and purged it of Darwin's lingering attachment to the Lamarckian theory of inheritance of acquired characters. Present knowledge of the mechanisms of inheritance are such that modern scientists can distinguish more satisfactorily than Darwin between non-inheritable bodily variation and variation of a genuinely inheritable kind.

MAIN IDEA: Charles Darwin developed a theory of evolution based on natural selection.
Descent with Modification

Evolution explains the unity and diversity of life

The theory of evolution by natural selection, first formulated in Darwin's book "On the Origin of Species" in 1859, is the process by which organisms change over time as a result of changes in heritable physical or behavioral traits. Changes that allow an organism to better adapt to its environment will help it survive and have more offspring

- **Published book: *On the Origin of Species by Means of Natural Selection* with help from another scientist, Alfred Russel Wallace**
- **Theory based on 5 main ideas or postulates :**
  - **Overproduction**
  - **Struggle for existence or Competition**
  - **Survival of the fittest or Natural selection**
  - **Variations (inheritance of useful variations)**
  - **of traits**
  - **Speciation or origin of species**

1. Over production or geometric increase or prodigality:

According to Darwinism, the populations tend to multiply geometrically and the reproductive powers of living organisms (biotic potential) are much more than required to maintain their number e.g.,

Paramecium divides three times by binary fission in 24 hours during favourable conditions. At this rate, a Paramecium can produce a clone of about 280 million Paramecia in just one month and in five years, can produce Paramecia having mass equal to 10,000 times than the size of the earth.

Other rapidly multiplying organisms are: Cod (one million eggs per year); Oyster (114 million eggs in one spawning); Ascaris (70, 00,000 eggs in 24 hours); housefly (120 eggs in one laying and laying eggs six times in a summer season); a rabbit (produces 6 young ones in a litter and four litters in a year and young ones start breeding at the age of six months).

Similarly, the plants also reproduce very rapidly e.g., a single evening primrose plant produces about 1, 18,000 seeds and single fern plant produces a few million spores.

Fishes are noted for laying large numbers of eggs. A 25-lb carp in an Iowa lake was found to contain 1,700000 eggs.

It has been calculated that one pair of house flies breeding in April would have by August, if all eggs hatched and all resulting individuals lived to reproduce in their turn, 191, 010, 000, 000, 000, 000, 000 descendents.

Even slow breeding organisms reproduce at a rate which is much higher than required e.g., an elephant becomes sexually mature at 30 years of age and during its life span of 90 years, produces only six offspring's. At this rate, if all elephants survive then a single pair of elephants can produce about 19 million elephants in 750 years.

These examples confirm that every species can increase manifold within a few generations and occupy all the available space on the earth, provided all survive and repeat the process. So the number of a species will be much more than can be supported on the earth.

2. Struggle for existence or competition:

Due to rapid multiplication of populations but limited food and space, there starts an everlasting competition between individuals having similar requirements. In this competition, every living organism desires to have an upper hand over others.
This competition between living organisms for the basic needs of life like food, space, mate etc., is called struggle for existence which is of three types:
(a) Intraspecific:
Between the members of same species e.g. two dogs struggling for a piece of meat.
(b) Interspecific:
Between the members of different species e.g. between predator and prey.
(c) Environmental or Extra specific:
Between living organisms and adverse environmental factors like heat, cold, drought, flood, earthquakes, light etc.
Out of these three forms of struggle, the intra-specific struggle is the strongest type of struggle as the needs of the individuals of same species are most similar e.g., sexual selection in which a cock with a more beautiful comb and plumage has better chances to win a hen than a cock with less developed comb.

4. Variations:

Variation is the law of nature. According to this law of nature, no two individuals except identical (monozygotic) twins are identical. This everlasting competition among the organisms has compelled them to change according to the conditions to utilize the natural resources and can survive successfully.
Darwin stated that the variations are generally of two types—continuous variations or fluctuations and discontinuous variations. On the basis of their effect on the survival chances of living organisms, the variations may be neutral, harmful and useful.
Darwin proposed that living organisms tend to adapt to changing environment due to useful continuous variations {e.g., increased speed in the prey; increased water conservation in plants; etc.), as these will have a competitive advantage.

5. Natural selection or Survival of the fittest:

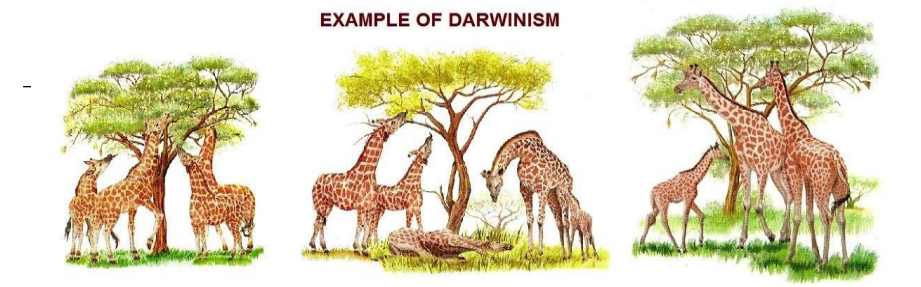
Darwin stated that as many selects the individuals with desired characters in artificial selection; nature selects only those individuals out of the population which are with useful

continuous variations and are best adapted to the environment while the less fit or unfit individuals are rejected by it.

Darwin stated that if the man can produce such a large number of new species/varieties with limited resources and in short period of time by artificial selection, then natural selection could account for this large biodiversity by considerable modifications of species with the help of unlimited resources available over long span of time.

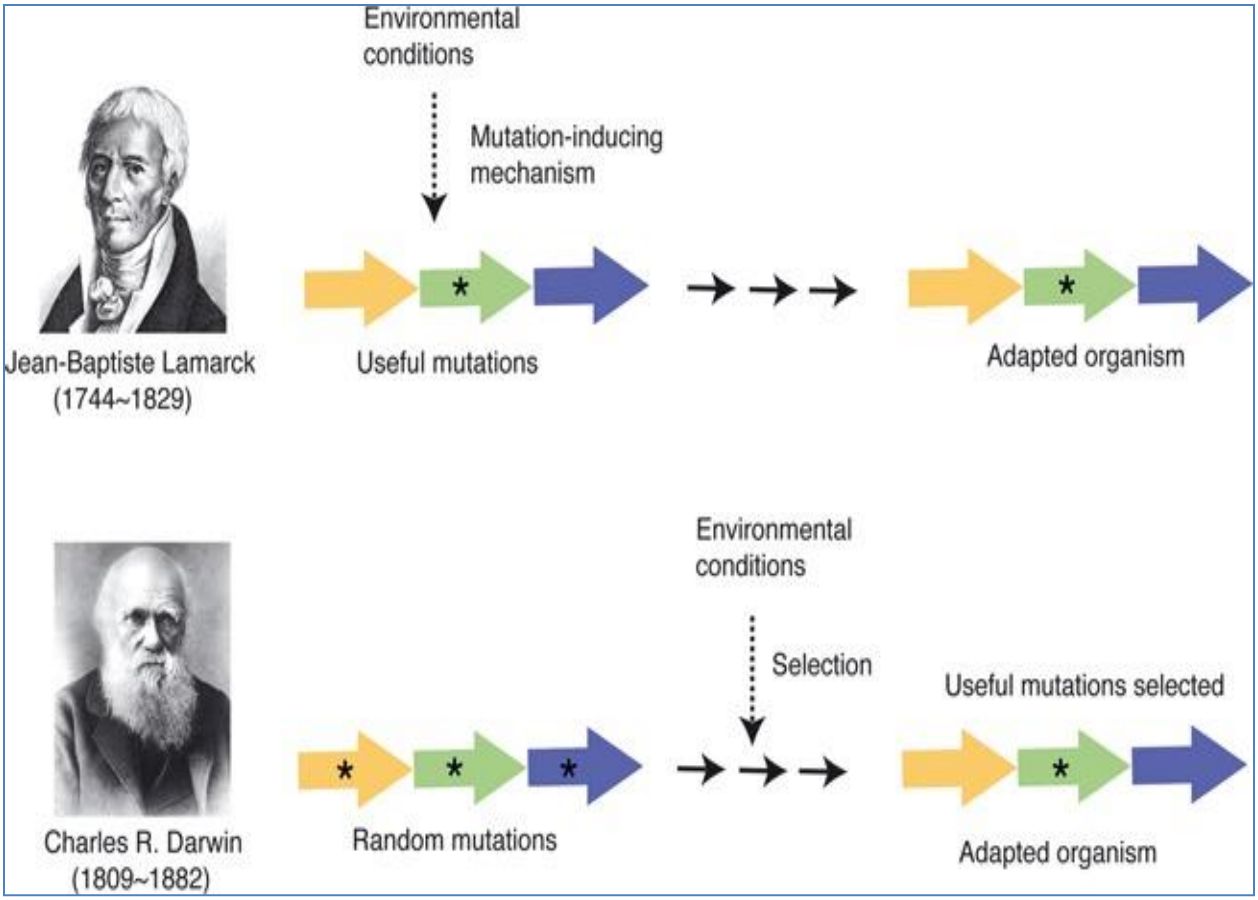
Darwin stated that discontinuous variations appear suddenly and will mostly be harmful, so are not selected by nature. He called them "sports".

- **So the natural selection is an automatic and self going process and keeps a check on the animal population.**
- **This sorting out of the individuals with useful variations from a heterogeneous population by the nature was called Natural selection by Darwin and Survival of the fittest by Wallace. So natural selection acts as a restrictive force and not a creative force.**



6. Inheritance of useful variations:

Darwin believed that the selected individuals pass their useful continuous variations to their offspring's so that they are born fit to the changed environment.



DRAWBACKS OF DARWINISM

Although Darwin's theory paved the way for the better understanding of the process of evolution, it failed to answer certain problems like

i) **It does not account for presence or origins of variations among living organisms.**

ii) Natural selection cannot carry a species beyond its natural range of variability.

This is because variation is a progressive course in evolution which causes modification, but heredity acts as a conservative force that tends to preserve the variations as such.

Neo Lamarckism

This is reinvention of the Lamarck's theory of Inheritance of acquired characters. Where constant use tend to strengthen the organ whereas failure of the use leads to atrophy

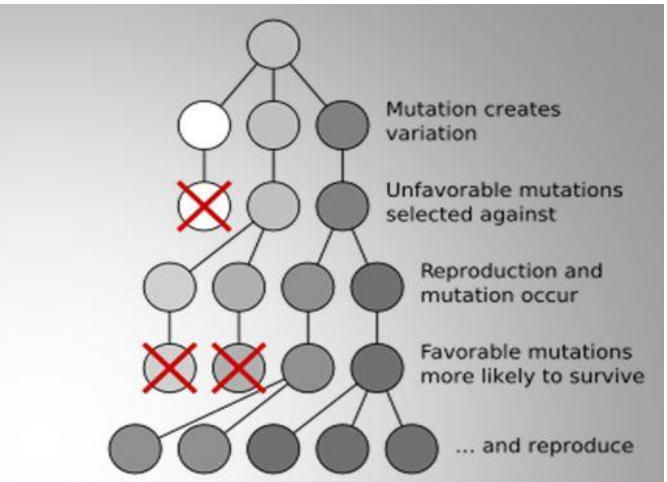
Lamarck rejected the notion that the environment would directly affect organismal traits and neo lamarckism incorporates these things.

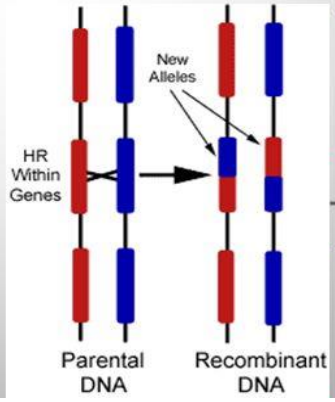
Neo-Darwinism

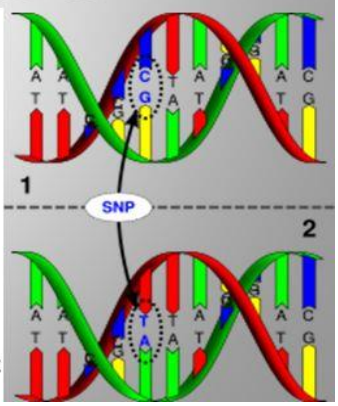
Neo-Darwinism is incorporated in the modern synthesis theory. Darwinian evolution through Natural selection with Mendelian genetics, the latter being a set of primary tenets specifying that evolution involves the transmission of characteristics from parent to child through the mechanism of genetic transfer, rather than the 'blending process'

Neo-Darwinism

- Refined version Darwin's theory
- Combines Mendel's genetics
- Evolution is driven by chance
- 2 ways
  - Small scale mutations (single nucleotide polymorphisms)
  - Large scale mutations (recombination)
- Creates new DNA by lucky accidents







Summary of Darwin's Theory

1. **Individual organisms differ**, and some of this variation is inheritable

2. Organisms produced more offspring that can survive and there is **competition for limited resources**

3. Individuals **best suited** to environment survive and **reproduce**. Others die or leave fewer offspring. This process of natural selection causes **species to change over time**.

4. **Species** alive today are **descended with modifications**.