1. Lamarck's Theory: Jean Baptiste Lamarck (1744-1829), a French naturalist, made several valuable contributions to biological science, including the coining of the term 'biology' and using the same in its true sense. He studied comparative anatomy and planned a tree of life for explaining the phylogenetic relationship among organisms. He believed in the fundamental unity of living things and in a progressive development of forms and functions in all organisms. But the most important contribution of Lamarck —his theory of evolution—was framed in 1801 and published in the 'Philosophic Zoologique' in 1809, that is the year in which Charles Darwin was born.

   Lamarckism:

   The essence of the Lamarckian theory or La marckism may be summarised as follows: (1) Necessity in the organism may give rise to new structures or may lead to the disappearance of certain parts. Lamarck expressed this as the **law of use and disuse**. According to Lamarck an organ which is used extensively by the organism would enlarge and be come more efficient, while disuse or lack of use of a particular organ would lead to its degeneration and ultimate disappearance. For example, the webbed toes of aquatic birds such as swans developed due to constant stretching of the skin at the bases of the toes in some ancestral form which lived on land. The necessity of the web of skin arose when the ancestors migrated into the water in search of food. This led to constant use and stretching, thereby a change was induced and a paddle-like foot evolved. Similarly, the ancestors of the snakes were lizard-like creatures with 1 two pairs of limbs and the modern snakes lost their limbs by constant disuse while passing through narrow crevices. Thus by differential use and disuse of various parts, an organism could change a good deal; that is, the organism acquires certain new characteristics.

   (2) The second part of Lamarck's theory postulated that acquired traits induced by use or disuse of organs were transmitted to the offspring; this is the **law of inheritance of acquired characters**. Lamarckism explains evolution of the modern giraffe in the following way. There was a short-necked ancestral stock which used to feed on tree leaves. It stretched its neck further up, to reach higher levels, when the leaves lower down were finished. Due to constant stretching the neck length increased a little and his new trait was inherited by the offspring. The latter in turn kept on stretching their necks and this was continued for many generations. Each successive generation would acquire the gains of the previous generation by inheritance, and would itself add a bit to the neck length. In the course of time, the long-necked modern giraffe evolved out of the short-necked ancestral form.

   Criticism of Lamarckism:

   The first part of Lamarck's theory, that is, the law of use and disuse is acceptable. For example, moderate exercise taken regularly builds big muscles, or a limb put up on splints and not used for a long time undergoes atrophy. But the second part of Lamarckism, that is, inheritance of acquired characters, is not acceptable.

It implies that a man who has developed large muscles by lifelong exercise will beget children with big muscles. Lamarckism was chiefly opposed by Weismann (1834- 1914) who postulated that germ cells are not affected materially by changes in the body cells. In spite of the laborious research of neoLamarckists such as Guyer, Smith and Cope, Lamarckism is untenable. Acquired characters are phenotypic variations. They cannot affect the genes. As such they cannot be transmitted to the offspring.

2. **Darwin's Theory of Evolution**:

The name of Charles Robert Darwin (1809-1882) is a proverb in the history of science. This illustrious grandson of Erasmus Darwin was born in 1809 and his date of birth coincided with that of Abraham Lincoln. In his early life Darwin, like all other scientists of his time, believed in Lamarckism. As a young man he joined the naval expeditionary ship 'H.M.S. Beagle' and undertook a circumglobal voyage for five long years. He spent his time in collecting numerous specimens of plants and animals from different parts of the world. After returning home Darwin spent 20 years in studying his collections. At this time he was greatly in fluenced by the publications of Lyell and Malthus. By studying Lyell's 'Principles of Geology' Darwin learnt about the changing Jonas of the earth, and about the fossils which were known i: that time. The famous essay on population published by Malthus taught Darwin about overpopulation and consequent competition for food and shelter. Having completed his study, Darwin was preparing his theory of natural selection for explaining the mechanism of organic evolution when he received an essay from a younger scientist, Alfred Russell Wallace (1823-1913), who was working independently on the flora and fauna of Malayan archipelago. To his amazement Darwin found that Wallace's views on the origin of species coincided with his own theory.

The natural selection theory was first published as a paper under joint authorship in 1858. Two renowned scientists of that time, Lyell and Hooker, presented the paper at the meeting of the Linnean Society and Darwin was conspicuous by his absence. In the following year, that is in 1859, Darwin published his classical work in the form of a book—"On the origin of species by means of natural selection."

Essence of Darwinism:

Darwin's theory is based on intrin sic analysis of facts in a scientific spirit by induction and deduction.

The following is the essence of Darwinism:

(1) **Prodigality of Production**: The plants and animals have a tendency to increase in geometric progression, but the habitable space and the food supply remain constant. Darwin calculated that starting from a pair of elephants, the herd will increase to about 20,000,000 in 1000 years, and elephants are the slowest breeders producing 4 to 6 calves in their life-time. Such enormous prodigality in production results in struggle for existence.

(2) Struggle for Existence:

This means a keen competition amongst the living forms for food and shelter. It operates in a three fold way: (a) Interspecific, that is, struggle in between different species of organisms, (b) Intraspecific, that is, struggle between members of the same species, and (c) Environmental, that is, struggle against the changes of the environment.

(3) **Variation:** Darwin observed that no two living forms were exactly alike. Diversity tends to appear even among members belonging to the same species. Darwin paid particular attention to small, fluctuating and continuous variations which appeared randomly. According to him these continuous variations help the organism to win the struggle for existence. Large, discontinuous variations, which appeared suddenly, were considered by Darwin as mere 'sports of nature', and therefore ignored.

(4) **Survival of the Fittest:** The organisms possessing suitable variations which helped them to win the struggle for existence were better adapted to their environment. They survived and propagated their variations to the next generation. The others with unsuitable variations perished.

(5) **Natural Selection:** This is the most important deduction of Darwin. Natural selection is the process by which individuals possessing favourable variations enjoy a competitive advantage over the others. They are better adapted to their environment, and therefore they survive in proportionately greater numbers and produce more offspring. The rest with disadvantageous variations fail to adapt properly to their environment and therefore eliminated by natural selection.

The favourable variations which are the cause of success are handed down to the offspring by inheritance. Thus the number of the favoured individuals increase rapidly, and if natural selection operates for a long time, those favourable variations which have attained the survival value are intensified successively from generation to generation, until the original ancestral forms are thoroughly changed into a new species. For example, Darwinism explains the evolution of the modern giraffe in the following manner. The original ancestral forms were short-necked, leaf-eating animals. Darwin assumed that as a result of individual variation, some of them had slightly longer or shorter necks in comparison with the population's average neck-length. The longer-necked forms were better adapted to get at foliage's situated a bit higher up. Consequently they were better fed than the shorter-necked fellows, and they produced proportionately greater numbers of offspring.

As a result of natural selection the proportion of the longer-necked population would be doubled in the next generation. This is repeated in successive generations until the entire population would be transformed into individuals with slightly longer necks.

Individual variation would occur in the new population and actual neck-lengths would vary more or less on either side of an average. Long necks would again be favoured in a second round of natural selection and then in successive rounds, until

the modern giraffe with very long neck evolved out of the short-necked ancestral stock.

Criticism of Darwin's Theory:

In spite of strong evidences and critical scanning of facts, Darwinism suffers from certain serious drawbacks. A few objections to Darwinism are briefly discussed as follows: (1) Variations were accepted by Darwin to be the chief tool in the process of evolution of new species, and he believed that small continuous variations of fluctuating type were inherited by the offspring. Unfortunately Darwin had no knowledge about the real cause of variation. At this time the science of genetics was unknown, and the laws of inheritance were unexplored. Most of the fluctuating variations considered by Darwin to be important factors in his theory of natural selection are not genotypic and as such they are not inherited.

(2) Darwin, like Lamarck, believed in the inheritance of acquired characters—a fact which is not proved by genetics.

(3) Darwin's natural selection mainly operates in one direction, and often leads to over-specialisation and ultimate extinction. The canine teeth of the sabretoothed tiger and the antlers of the Irish elk increased progressively in size because the characteristics in both the cases were favoured by natural selection. But ultimately, the structures became so large that instead of being helpful they became hindrance in the struggle for existence, and led to the extinction of the species.

(4) Natural selection theory fails to account for the degeneracy which is very often observed in the parasitic forms.

(5) The essence of Darwinian natural selection is the elimination of the unsuitable forms. Hence it is better to name it as the 'theory of natural rejection'.

(6) Darwin actually observed large, discontinuous variations or mutations to occur in nature. He rejected them as they occurred less frequently. But mutations are genotypic variations and they have now been recognised as important factors in the origin of new species.

In spite of its weakness Darwinism is still accepted as one of the important factors in evolution. Thanks to the untiring efforts of Thomas Henry Huxley (1825- 1895), the great champion of natural selection, and others, such as August Weismann, the theory has been firmly established.

3. De Vries' Theory: The mutation theory was published in 1901 by the Dutch botanist, Hugo De Vries (1848-1935). His theory is mainly based on his experiments on a plant called evening primrose,

Oenothera lamarckiana:

De Vries found that certain strikingly different forms appeared suddenly among a population of normal type of evening primrose. He called them mutants. A mutant is a

variant which arises abruptly among normal forms. A mutant always breeds true, that is, it produces offspring like itself.

The term mutation or psaltation is applied to a sudden large change or discontinuous varia tion in organisms, and this can be inherited. According to the mutation theory, mutations are the real cause for the evolution of a new species.

Numerous mutants may be produced in nature. They are then subjected to natural selec tion .which determines the types that would survive. The mutants which survive in the struggle for existence are responsible for the origin of new species.

Criticism:

(1) Mutation often produces monsters which have no evolutionary significance.

(2) Mutations occur infrequently and they therefore cannot be regarded as the sole factor in evolution.

(3) Mutation theory accepts natural selection as the controlling agent in evolution

4. Modern Theory of Evolution:

This is the product of recent researches in cytology, embryology, and genetics. In the opinion of modern scientists, the heritable characters of an individual rest upon particles of nucleoproteins or genes in the chromosomes of the gametes. Any variation in the characteristics of an individual, whether continuous or discontinuous, must come through changes in the genes.

Such changes that suit well with the environment are advantageous, and individuals possessing advantageous changes get the better chance of living and multiplying. This will continue for successive generation until a final form comes into existence, differing profusely from the ancestral type.

Natural selection acting as a screen leads to differential survival and differential reproduction. In the present outlook about the origin of species, Darwin's struggle for existence may not be in the form of a compe tition, but the selective value has been found to be more important in differential survival of different variations.

The modern theory explains the evolution of the giraffe in the following way: Every generation of the shortnecked ancestral stock must have included a few mutant types, with shorter or longer necks than the average neck-length of the population.

The longer-necked individuals are in a more advantageous position. In the subsequent generation they will produce more longer-necked forms. This will go on through several generations in which changes in the gene would produce mutants, and natural selection acting as a screen would again and again eliminate the short-necked individuals, until the appearance of the modern giraffe with very long neck.

This modern theory is known as the synthetic theory. Several investigators of the synthetic school, such as Haldane, Ford, Waddington, Miller, Dobzhansky, and others

have contributed their bit in its shaping. It is nothing but a completely re-modelled natural selection theory minus its weaknesses