Post-Darwinian

Post Darwinian theories:

Darwin's explanation of evolution by Natural Selection was followed by various theories where other forces of evolution have been given. They are:

1. Theory of Isolation:

Proposed by Wagner, which says that two or more populations of same species get separated because of some physical or geographical barriers or they may occupy different areas. Natural selection thus occurs independently in each segregating population.

2. Theory of Mutation:

Hugo De Vries stated that evolution proceeds by large, discrete and sudden changes or variations called as mutations. These mutations are inheritable by the progeny.

- Mutations may occur in any direction. Nature selects those which are suitable for survival and continuity. Other unsuitable mutants are eliminated by nature.

- Genetists have shown that origin of species by mutations is common not only among plants but also among animals.

3. Rediscovery of Mendel's laws of heredity:

According to Correns and Tschermak, a) the factors given to the offspring by the parents do not mix but are segregated and b) if more than one pair of contrasting characteristics is considered in the same cross, the factors responsible for these are inherited independently.

4. Theory of continuity of germplasm:

Weismann proposed that somatoplasm makes up all bodily organs except reproductive cells and formation of complex organs during which they lose capacity to reproduce. Germplasm remains undifferentiated and retains its power to generate new life. Thus changes in somatoplasm are not transmitted but those in germplasm are transmitted to next generation.

5. Theory of Orthogenesis:

Haeckel and Lull’s theories point out that variations or evolutionary changes occur along certain definite lines, guided by some undefined or inherent mystical forces.

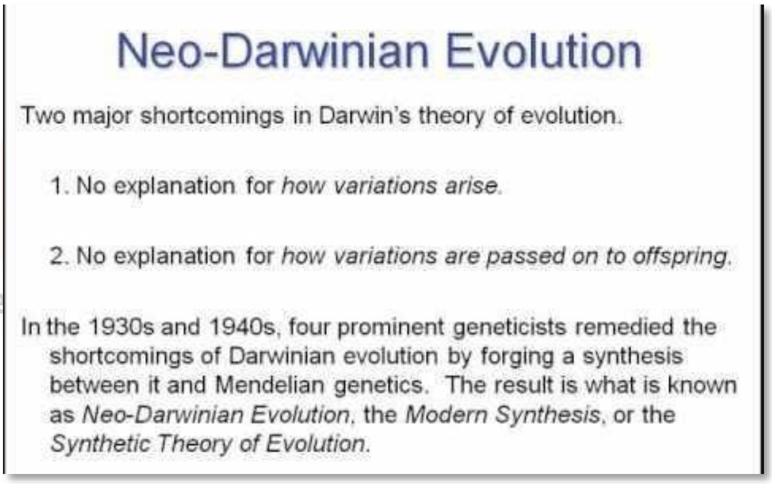
Eimer views that laws of organic growth aided inheritance of acquired characters determine a straight line course of evolution.

6. Theory of recapitulation or embryological parallelism:

Proposed by Serres, it says an individual organism in its development tends to recapitulate or repeat the stages passed through by its ancestors.

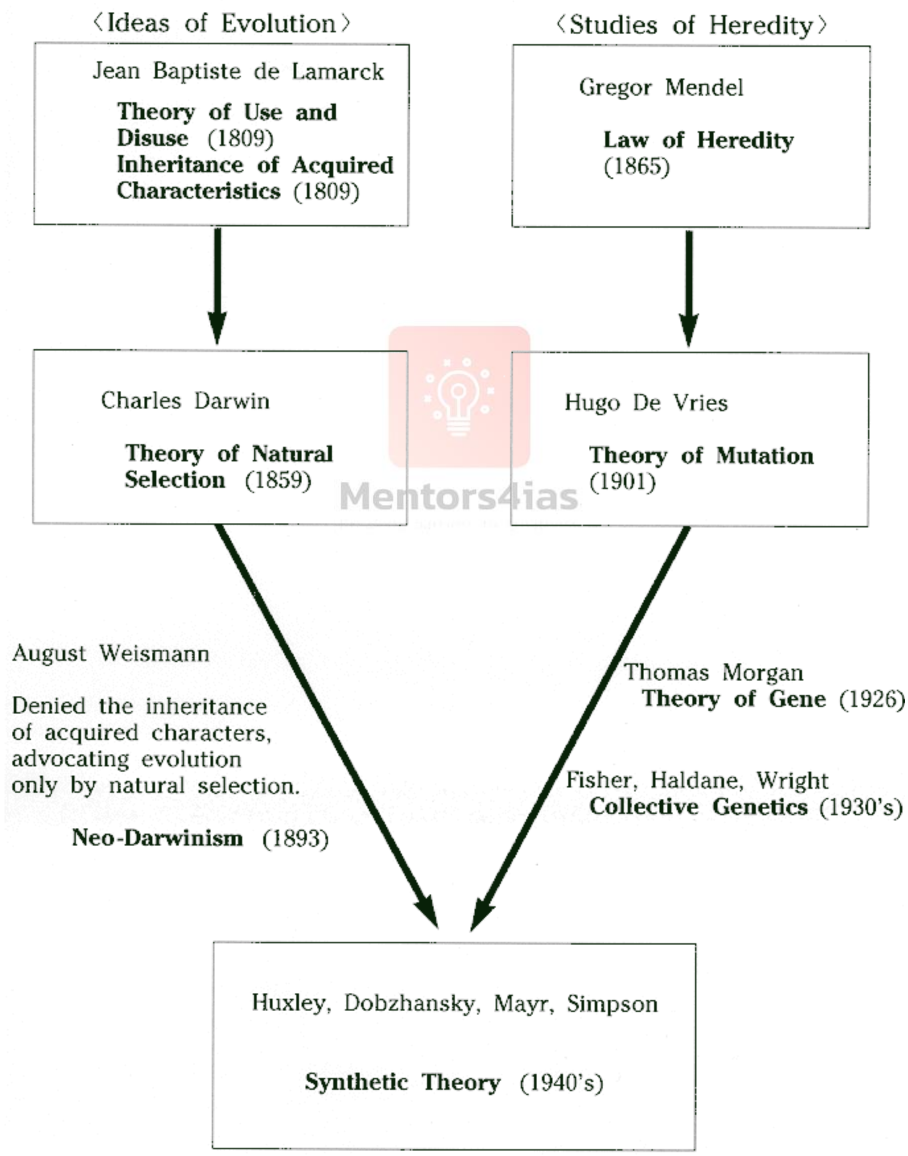
Synthetic Theory Of Evolution

Neo-Darwinism



- The theory of natural selection or Darwinism is a breakthrough in the history of evolution.
- It is a simple concept easy to grasp. In a species, there are individuals that differ genetically from one another as a result of which their ability to adapt and survive to different environment differs.
- Nature is the causative force that sorts out bad adapted ones replaced by best and the their progeny is spread. In this course of nature’s scrutiny, the trait that changed and adapted is selected by nature and the bad ones screened out.
- However, Darwinism also has certain drawbacks. He did not know the mechanism of inheritance. He laid emphasis on individual variation and lack clarity in accounting the sources of variation and ignored the role of recombination.
- This leads to the formation of a new school of thought in the middle of the 20th century by combining all sources of knowledge from genetics, palaeontology, ecology and others.

- Edward O Dodson and David J. Merrill called this new theory of evolution as Neo-Darwinism. George Gaylord Simpson and his followers, however, strongly refuted the labelling of Neo-Darwinism as synthetic theory of evolution. Simpson argued that the synthetic theory had no Darwin.
- However, we shall consider the two labels as synonymous.
- The new concept of evolution is the product of two rival camps of thought. One supporting the traditional Darwinian view centering around natural selection as the key role player of evolution and the camp centering around the central role of mutation and a whole new branches of science, undreamt of by Darwin such as molecular biology.



- The synthesis of these two camps leads to the formation of Modern Synthetic Theory of Evolution. Therefore, the theory has two stages of process: Natural Selection whereby genetic differences in some individuals lead to their higher reproductive success, and production and redistribution of variation which are genetically influenced differences between individuals which are inherited.

- In order to understand the modern concept of evolution, one has to study and understand the short term events of evolution called microevolution, the slow accumulations of changes seen and unfold in every generation. Using such a modern population genetics perspective, we define evolution as a change in allele frequency from one generation to the next. Alleles are the alternative forms of genes that occur at the same locus.
- The synthetic theory considers evolution to be the result of changes in the gene frequencies of populations that produces variations.

The need for this theory arose as Darwinism doesn't satisfactorily explain the origin and inheritance of variation. This theory consists of three main concepts

1. Production and redistribution of variation

2. Action of Natural selection on this variation

3. Role of isolation.

Synthetic theory defines Evolution as a process of functional adaptation of organism by continuous production of variation and natural selection operating on these variation

Factors that produce and redistribute variations:

1. Genetic Mutations: A mutation is a change on base sequence of DNA. For such changes to have evolutionary significance they must occur on sex cells as evolution is a change in allelic frequencies between generations. Mutations generally happen at gene level and bring about changes in hair, color, skin pigmentation and other somatic changes.

2. Chromosomal Aberrations: If a change happens above a gene level and chromosomes get changed then it's a chromosomal aberration. In this case there would be a change in either the structural aspects of chromosome or in the number of chromosomes present in the organism.

3. Migration and Gene Flow: Animals have a tendency to migrate and when they do that they come into contact with another population, it mates with the inmates of the population. Thus, genes of one population are transferred into another

population which is called Gene flow. Gene flow brings about an addition or loss of genes in the gene pool and change in allele frequencies of the population.

4. Recombination: The genetic information is invariably reshuffled every generation because both parents contributes genes to the offspring in all sexually reproducing species. Such recombination doesn't in itself change allele frequencies but produce a whole array of genetic combinations on which natural selection can act and make every individual genetically unique.

5. Genetic Drift: It is an evolutionary force operating in small populations. In small populations the gene frequencies fluctuate purely by chance. Change in gene frequencies purely by chance is called genetic drift.

Action of Natural selection on Variation:

- The genetic variations produce new phenotypes which may have advantages or disadvantages.
- The organisms having genotype which gives it some advantage in a particular environment is said to be better adopted and the have better adapted genes. Such organisms reproduce at a higher rate and leave more surviving offspring in next generation.
- Such a differential reproduction is due to natural selection where one individuals produces more young ones than others and these adapted organisms contribute a greater percentage of genes to the gene pool. If such a differential reproduction continues for many generations the adopted genotypes will become predominant thus changing the gene frequency.
- Thus natural selection promotes the development of more and more new adaptive genotypes and phenotypes. So natural selection is a creative force which spreads genetic novelty.

Role of isolation in formation of species:

- Isolation is separation of species by some barriers which prevent interbreeding. That prevents the exchange or mixing of genes between populations.
- Geographical isolation causes physical separation of two populations. These separated populations are exposed to different kinds of environmental factors acquiring variation and these variations are processed by natural selection.

The nature and actions of recombinations, natural selection and genetic drift are different in different populations and for different environments.

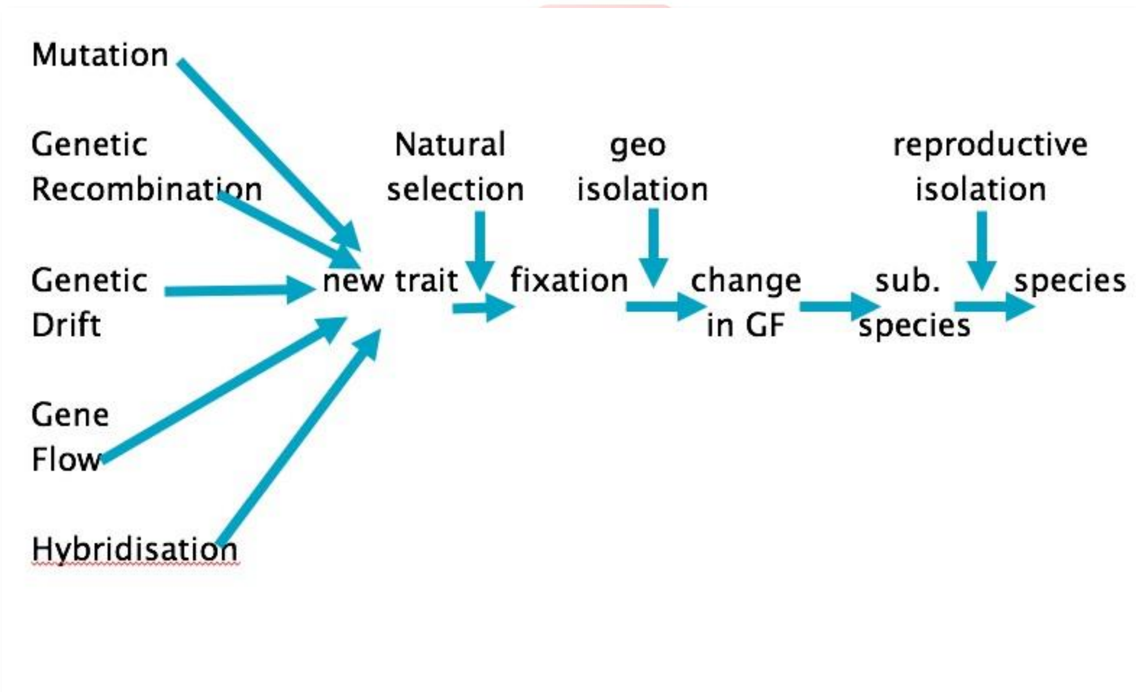
- This independent occurrence of elemental forces of evolution on those isolated populations leads to progressive genetic divergence. This divergence leads to reproductive isolations. When this happens populations fail to interbreed even if geographical isolation disappears. Thus a new species is formed and the cycle of evolution repeats.

Operation of Modern Synthesis:

I. Population develop genetic variations through mutation, hybridization, recombination etc.

II. Natural selection allows the favorable genetic variations to spread in the population through differential reproduction in successive generations

III. The populations are isolated geographically and reproductively and this leads to the failure of interbreeding. When interbreeding does not occur, the isolated populations are grouped into new species

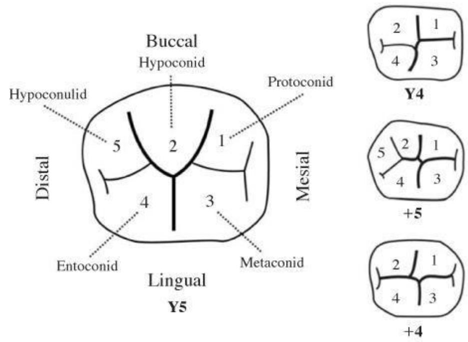


Fossil Primates

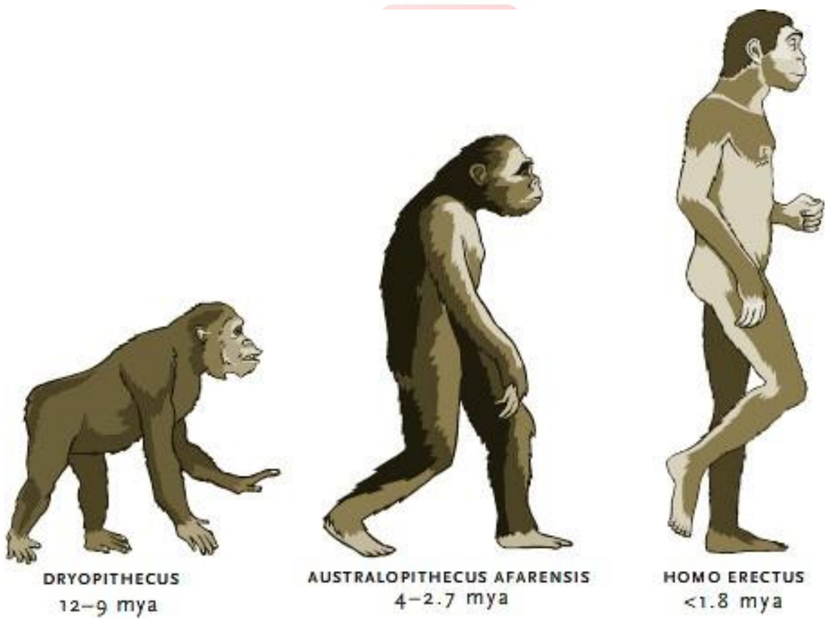
Dryopithecus

- Dryopithecus was genus of extinct apes that lived during the Miocene (22.5 to 5.5 million years ago).
- The fossils of Dryopithecus have been found in the region ranging from Spain to the Republic of Georgia.
- Dryopithecus fontani was the first fossil great ape discovered.
- It was discovered in Saint Gaudens, France, by Edouard Lartet in 1856.
- During miocene epoch the family Hominoidea **diverged into two sub-families the Pongidae (apes) and the Hominidae (humans).** The exact point of divergence between ape line and the human line is debatable. In general Dryopithecus is considered to be ancestor of both apes and human
- Dryopithecus species (referred to as dryopithecines) flourished in Europe between 13 and 7 million years ago.
- About 9 million years ago, the climate became cooler and dryer, causing a disappearance of tropical regions in Europe.
- Many of the Miocene apes became extinct at this time. Dryopithecus was one of two lineages (Sivapithecus and Dryopithecus) that survived this climatic change.
- Dryopithecines presumably survived by migrating with their preferred ecological zones to Africa.
- Many dryopithecine fossils have been discovered, and much of the skeleton is represented.
- Like all living apes, dryopithecines possessed relatively large brains. They also show apelike characteristics associated with a reduced reliance on smell and an increased emphasis on vision: they had shortened snouts and forward-facing eye sockets with overlapping fields of vision.
- Like all living apes, dryopithecines also lacked a tail.
- The skeletal remains indicate that dryopithecines were quadrupeds, walking on four legs.
- They also possessed adaptations to suspensory locomotion: Their stable yet fully extendable elbow joint allowed them hang and swing below branches.
- In addition, remains of the hands and feet show that they possessed powerful grasping capabilities.

- All of these characteristics suggest that Dryopithecus moved about the forest canopy in a way that is similar to modern great apes.
- The lower molar teeth of Dryopithecus have long had significance for paleoanthropologists. Their five cusps are arranged in a pattern that is observed in all fossil and recent apes as well as humans. It is known as the Y-5 pattern, because the fissures separating the five cusps form a "Y." This is one of many characters that are used to distinguish apes from monkeys. The size and shape of the other teeth, including large incisors and bladelike canine teeth, suggest that dryopithecines were adapted to a diet of soft, ripe fruits.



- Aspects of the skeleton that reflect life history variables, including tooth microstructure and brain size, suggest similarities to living apes.
- Drypothecines apparently lived relatively long lives, matured relatively slowly, and gave birth to one large offspring at a time.

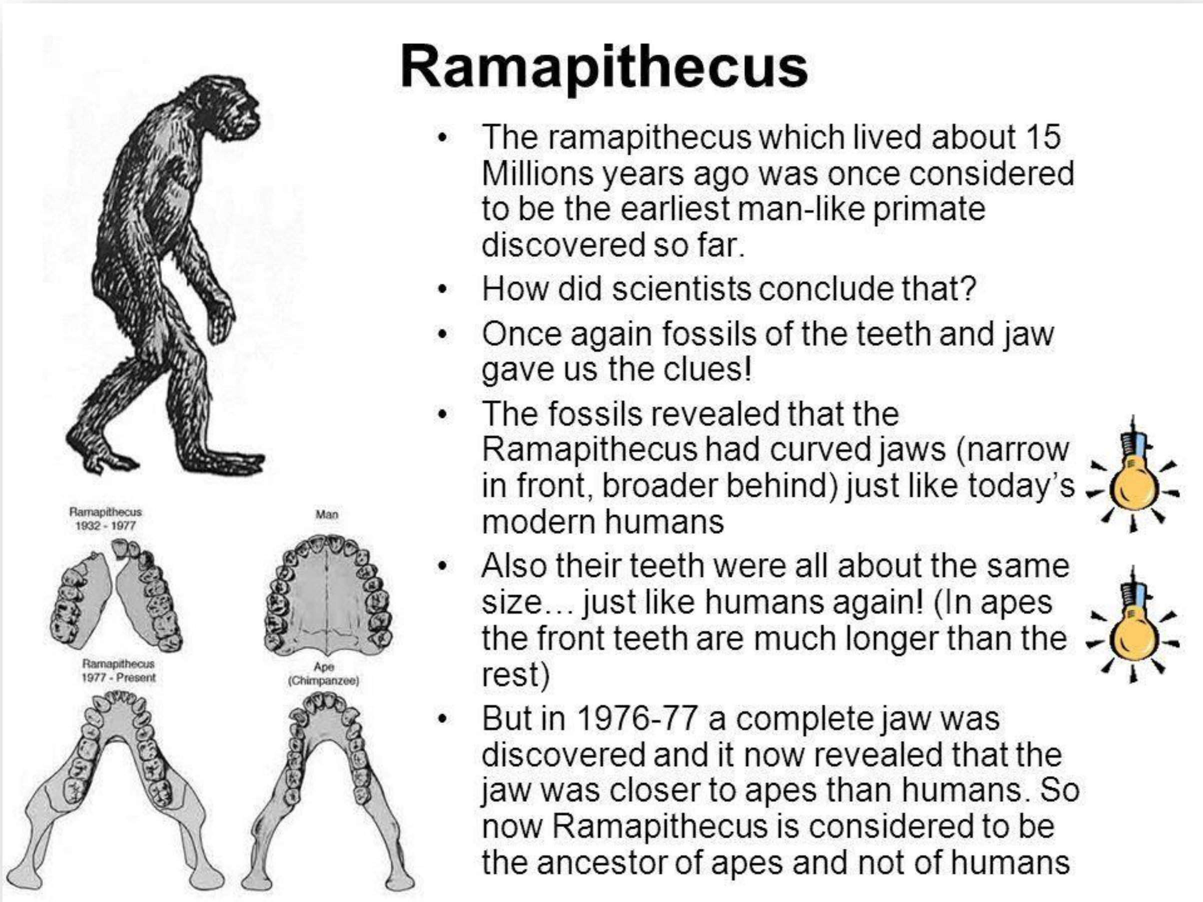


The place of Dryopithecus in human and ape evolution is still debated. A recent discovery (1999) of a new Dryopithecus skull from Hungary shows that the cranium is more similar to that of African apes and early fossil humans than to Asian apes. Thus, scientists suggest that Dryopithecus (or its close relative Ouranopithecus) was the likely ancestor of African apes and humans. If this were the case, the common ancestor of African apes and humans would have originated in Eurasia and later migrated to African to establish separate African ape and human lineages sometime during the late Miocene.

Ramapithecus

- Ramapithecus, fossil primate dating from the Middle and Late Miocene epochs (about 16.6 million to 5.3 million years ago).
- For a time in the 1960s and ’70s, Ramapithecus was thought to be a distinct genus that was the first direct ancestor of modern humans (Homo sapiens) before it became regarded as that of the orangutan ancestor Sivapithecus.
- The first Ramapithecus fossils (fragments of an upper jaw and some teeth) were discovered in 1932 in fossil deposits in the Siwālik hills of northern India.
- No significance was attached to those fossils until 1960, when American anthropologist Elwyn Simons of Yale University began studying them and fit the jaw fragments together. On the basis of his observations of the shape of the jaw and of the morphology of the teeth—which he thought were transitional between those of apes and humans—Simons advanced the theory that Ramapithecus represented the first step in the evolutionary divergence of humans from the common hominoid stock that produced modern apes and humans.
- Simons’s theory was strongly supported by his student English-born American anthropologist David Pilbeam and soon gained wide acceptance among anthropologists.
- The age of the fossils (about 14 million years) fit well with the then-prevailing notion that the ape-human split had occurred at least 15 million years ago.
- The **first challenge to the theory** came in the late 1960s from American **biochemist** Allan Wilson and American anthropologist Vincent Sarich, who, at the University of California, Berkeley, had been comparing the molecular chemistry of albumins (blood proteins) among various animal species.
- They concluded that the ape-human divergence must have occurred much later than Ramapithecus. **(It is now thought that the final split took place some 6 million to 8 million years ago.)**
- Wilson and Sarich’s argument was initially dismissed by anthropologists, but biochemical and fossil evidence mounted in favour of it.
- Finally, in 1976, Pilbeam discovered a complete Ramapithecus jaw, not far from the initial fossil find, that had a distinctive V shape and thus differed markedly from the parabolic shape of the jaws of members of the human lineage.
- He **soon repudiated his belief in Ramapithecus as a human ancestor**, and the theory **was largely abandoned by the early 1980s**.
- Ramapithecus fossils subsequently were found to resemble those of the fossil primate genus Sivapithecus, which is now regarded as ancestral to the orangutan; the belief also grew that Ramapithecus probably should be included in the Sivapithecus genus.

- Recent paleontological analysis of the Higher Primate subfamily Dryopithecinae shows that fossils in this group can be referred to two genera, Ramapithecus and Dryopithecus.
- Dryopithecus is a pongid and contains as subgenera (Dryopithecus), (Proconsul), and (Sivapithecus).



Q1. Write a short note on Ramapithecus.

In the year 1934, G.E. Lewis discovered the fossilized remains of Ramapithecus in the Siwalik hills of India. Later in 1930s, Lewis assigned an upper jaw from Haritalyangar (Siwalik hills, India) to a new genus Ramapithecus brevirostris i.e. Lord Rama's ape. The specimen includes first two molars, both premolars and the root of the lateral incisor.

- The fossil finds of Ramapithecus are regarded as the most important addition to the knowledge relating to human evolutionary development.

- Most of the Ramapithecus fossil specimen consists of teeth and jaws and they principally come from two areas – the Siwalik hills in India and Fort Ternan in Kennya.
- A mandible is also found from Pakistan and this may be the most complete fossil yet found known as Ramapithecus. Other specimens have been found from Turkey, Hungary and Greece.
- The Fort Ternan fossil have been absolutely dated to 14 million years ago, while the Siwalik hill specimens are younger being dated to about 10-12 million years ago.
- The striking feature of this Miocene fossil is that the dental arcade was rounded, the canines small and, probably, the incisors small and spatulate. It can be deduced from these features that the front teeth were no longer used for tearing the food and that this was a function of the hands freed by bipedalism for the task.
- Ramapithecus certainly provides a possible link between the definitely ape like Dryopithecus and the later Pliocene and Pleistocene hominids.
- The molar teeth of the Ramapithecus are relatively much larger than those of Homo, but are smaller than those of Dryopithecus.
- The whole animal was gibbon size.

Write some important anatomical features of Ramapithecus.

1. Incisors and canine are inserted vertically and not in slight procumbent position as in apes.
2. Little or no canine diastema.
3. The canines of the Ramapithecus are not projected and they possess narrow faces.
4. The dental arcade was rounded.
5. The palate of the Ramapithecus is arched as in man.
6. Flattened and thick enameled premolars and molars that appear to be adapted for heavy chewing and processing of hard food stuffs.
7. The molars possess the Dryopithecus Y-5 cusps pattern.
8. The ratio between the sizes of front tooth (incisors and canine) and those of cheek teeth (premolars and molars) is roughly the same which indicates the human position.
9. Shelf like ridges are present inside the lower jaw of Ramapithecus.
10. Large inferior torus on mandiblde.
11. Facial profile is orthognathus.

Sivapithecus

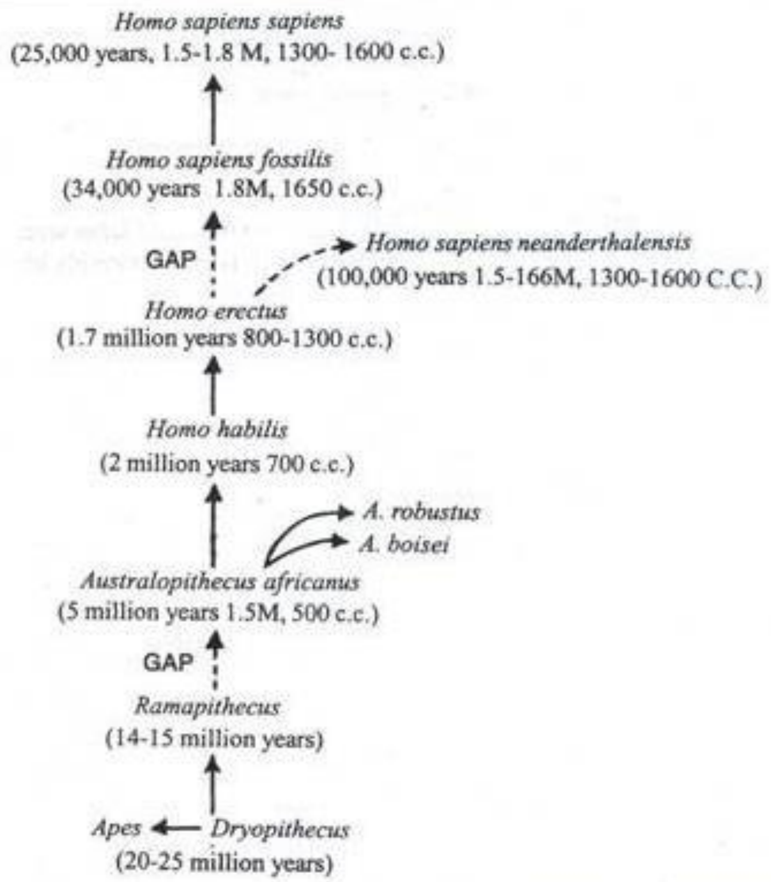
- Sivapithecus, fossil primate genus dating from the Miocene Epoch (23.7 to 5.3 million years ago) and thought to be the direct ancestor of the orangutan.
- Sivapithecus is closely related to Ramapithecus, and fossils of the two primates have often been recovered from the same deposits in the Siwālik Hills of northern Pakistan.
- Other Sivapithecus remains have been found at sites in Turkey, Pakistan, China, Greece, and Kenya.

- Some authorities maintain that Sivapithecus and Ramapithecus are in fact the same species.
- Though Sivapithecus was slightly larger than Ramapithecus, it was only a small-to-medium-sized ape about the size of a modern chimpanzee.
- The fossil remains of Sivapithecus reveal that it shared many of the same specialized facial features of the orangutan—i.e., eyes set narrowly apart, a concave face, a smooth nasal floor, large zygomatic bones, and enlarged central incisors.
- Sivapithecus' place in primate evolution was poorly understood until the 1980s.

- ***Prior to this, the genus, along with Ramapithecus, was interpreted as having both apelike and humanlike features and thus was presumed to be a possible first step in the evolutionary divergence of humans from the common hominoid stock of the apes***. But new Sivapithecus finds and the reinterpretation of existing remains convinced most authorities in the 1980s that Sivapithecus was the ancestor of the modern orangutan and diverged from the common lineage of the African apes (i.e., chimpanzees and gorillas) and humans more than 13 million years ago.

Features:

- Sivapithecus was about 1.5 metres (4.9 ft) in body length, similar in size to a modern orangutan.
- In most respects, it would have resembled a chimpanzee, but its face was closer to that of an orangutan.
- The shape of its wrists and general body proportions suggest that it spent a significant amount of its time on the ground, as well as in trees.
- It had large canine teeth, and heavy molars, suggesting a diet of relatively tough food, such as seeds and savannah grasses.



Schematic representation of Evolution of Man. Age, height and cranial capacity are also given.