UNIT-V
EVOLUTION OF HORSE

Horses (**Equus**) are odd-toed hooped mammals belonging to the order **Perissodactyla.** Horse evolution is a **straight line evolution** and is a suitable example for **orthogenesis.** It started from Eocene period. The entire evolutionary sequence of horse history is recorded in North America. "

Place of Origin

The place of origin of horse is **North America.** From here, horses migrated to **Europe** and **Asia.** By the end of Pleistocene period, horses became extinct in the motherland (N. America). The horses now living in N. America are the descendants of migrants from other continents.

Time of Origin

The horse evolution started some 58 million years ago, m the beginning of **Eocene** period of **Coenozoic era.** The modem horse **Equus** originated in Pleistocene period about 2 million years ago.

Evolutionary Trends

The fossils of horses that lived in different periods, show that the body parts exhibited progressive changes towards a particular direction. These directional changes are called evolutionary trends. The evolutionary trends of horse evolution are summarized below:

1. Increase in size.
2. Increase in the length of limbs.
3. Increase in the length of the neck.

4. Increase in the length of preorbital region (face).
5. Increase in the length and size of III digit.
6. Increase in the size and complexity of brain.
7. Molarization of premolars.

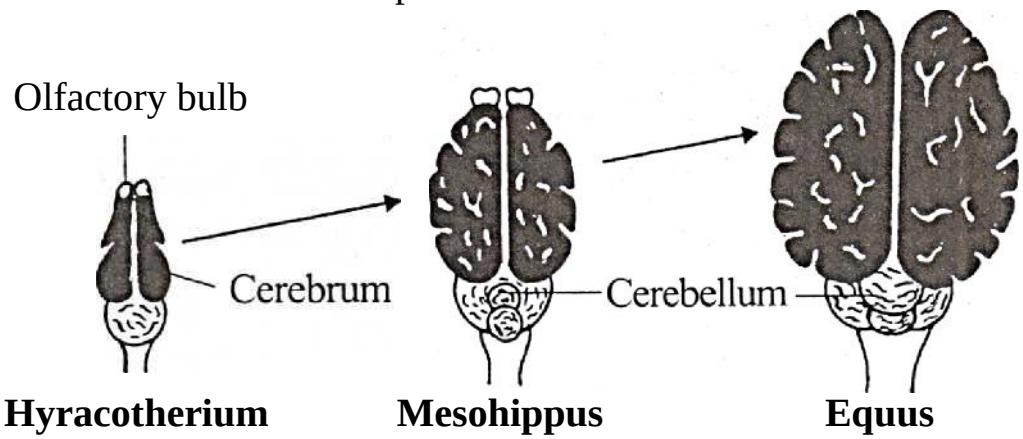


Fig.: Evolution of brain in horse.

8. Development of high crowns in premolars and molars.
9. Change of plantigrade gait to unguligrade gait.
10. Formation of diastema.
11. Disappearance of lateral digits.
12. Enlargement of hoof on the middle digit.
13. Development of springing mechanism.
14. Straightening and stiffening of back.
15. Transition from browsing habit to grazing habit.

Ancestral Stock

The modem horses are the descendents of the class Mammalia form **Tetraclaeonodon** included in the order **Condylartha.** All the mammals included in this order are Five-toed, hoofed ungulates.

Evolutionary Sequence of Horses

Horse evolution occurred in **North America.** It started 58 million years ago in the **Eocene** period of **Coenozoic era.**

The ancestor of horse was **Tetraclaeonodon**, included in the order **Condylartha** of class Mammalia. It lived in old world in the Eocene period. It was a five toed animal.

Tetraclaeonodon gave rise to *Hyracotherium (Eohippus).*

Eohippus gave rise to **Oroliippus** which in turn gave rise to **Epihippus.** All these were Eocene horses.

The **Epihippus** gave rise to **Mesohippus** which in turn gave rise to **Miohippus.** These two were Oligocene horses.

The **Miohippus** gave rise to **Parahippus** which in turn gave rise to **Merychippus.** They were Miocene horses.

The **Merychippus** gave rise to **Pliohippus** which lived in the **Pleistocene** period.

The modem horse **Equus** was descended from **pliohippus** in the Pleistocene period in **North America** about 2 million years ago.

Thus North America was the **Principal theatre** of Horse evolution. From there, they migrated to other countries. By the end of Pleistocene they became extinct from the mother land. The Modem horse in N. America are introduced by man.

Fossil Horses

The fossil record of the evolution of horse is more or less complete. The fossil horses from the first horse to the modern horses are given below:

1. Eohippus or Hyracotherium - Eocene horses
2. Mesohippus - Oligocene horses
3. Miohippus - Oligocene horses
4. Parahippus - Miocene horses
5. Merychippus - Miocene horses
6. Hipparion - Pliocene horses
7. Pliohippus - Pliocene horses
8. Equus - Modem horse

1. Eohippus or Hyracotherium

It was the first horse and hence it is called **dawn horse.** The fossils of these horses are found in abundance in North

America. It lived during Eocene of Coenozoic era. **Hyracotherium** had the following salient features:

1. It was the smallest horse with a height of only 10 inches.

It was about the size of a fox.

2. It lived in the forests and used to eat soft vegetation.

3. The fore limbs were provided with four digits, namely II, III, IV and V. The first toe was represented by **splint.** The hind limbs were provided with three digits, namely II, III and IV; the first and V digits were represented in the form of **splint.**

4. The limbs were digitigrade.
5. The springing mechanism was absent.
6. The back was arched and flexible.
7. The preorbital region was not elongated.
8. Dentition was **brachyodont** i.e. low crowned. It contained 44 teeth.
9. The cerebral hemispheres were small and smooth.

Eohippus or **Hyracotherium** gave rise to several lines during Eocene period. They were **Orohippus, Epihippus** and **Mesohippus.** All the horses, except **Mesohippus,** became extinct during early **Oligocene.**

2. Orohippus

It was an Eocene horse. It originated from **Eohippus.** It became extinct during late Eocene. It was generally called mountain horse. It was slightly taller than Eohippus. The splint bones disappeared from both limbs. It was a browser. In other aspects, it resembled Eohippus.

3. Epihippus

It was the third Eocene horse which originated from Orohippus. It became extinct by the end of Eocene.

It was a little larger than **Orohippus.** The last two premolars were molar-like. It was still a browser.

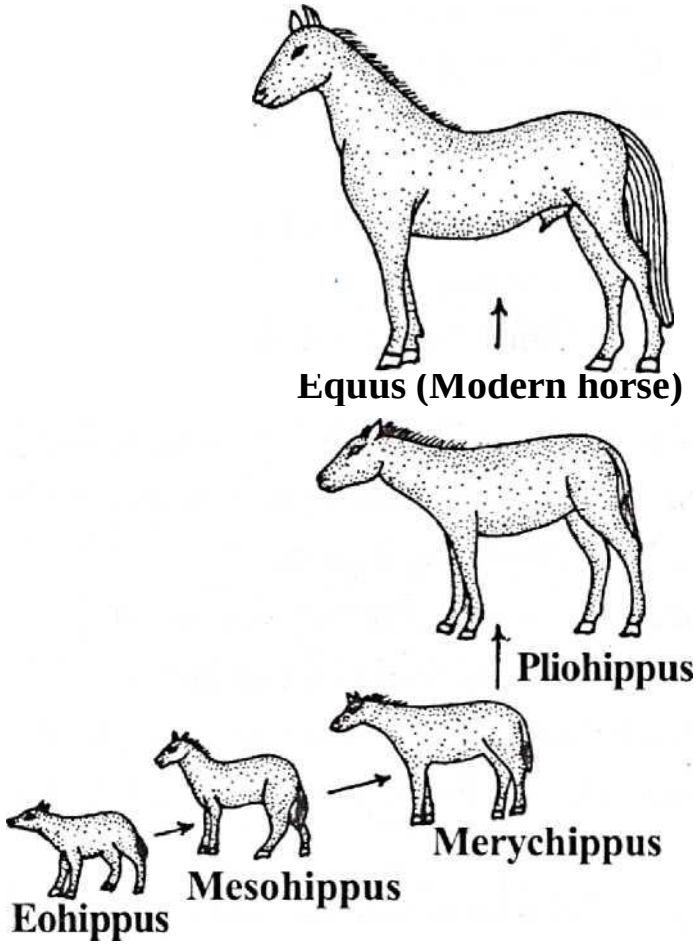


Fig.: Evolution of horse.

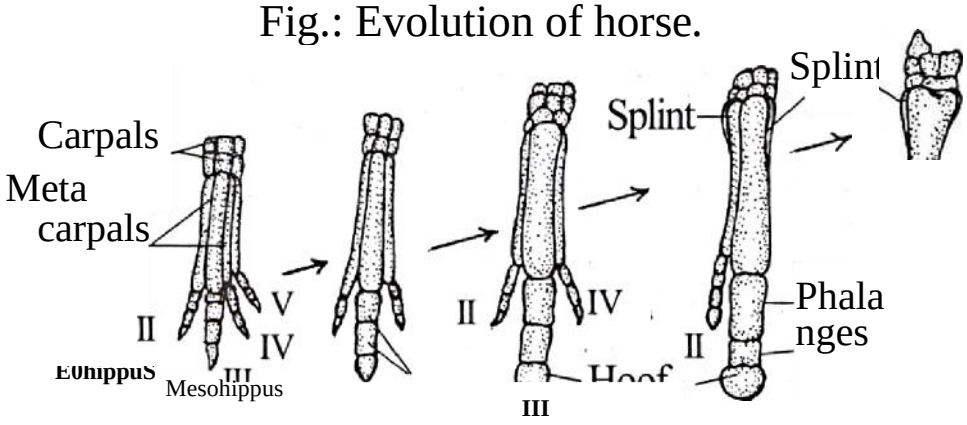


Fig.: Changes in the fore limb of horse.

4. Mesohippus

It was an Oligocene horse. It originated from Epihippus. It was on the main line of evolution, leading to the modem horses. It became extinct by the end of oligocene. The salient features of **Mesohippus** are summarized as follows:

1. It was generally called an **intermediate horse**.

2. It was about the size of a sheep. It had a height of 18 to 24 inches.

3. The back was arched.

4. All the legs were provided with only three digits. But in the fore limbs V digit was represented by a splint. The middle digit was prominent.

5. The limbs became elongated because of the lengthening of metacarpals and metatarsals.

6. The pre-orbital region was in the process of elongation.

7. The elongation of pre-orbital region led to the formation of **diastema.**

8. The last two premolars were molar-like.

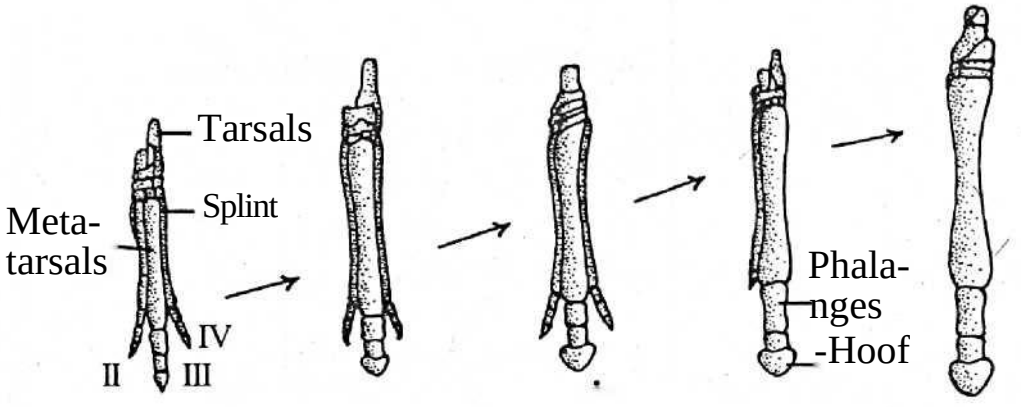
9. It was a forest dweller and browser.

10. The brain exhibited some complexity over that of **Hyracotherium.** The cerebral hemispheres were enlarged and convoluted.

5. Miohippus

It was another horse that lived at the end of Oligocene. It was more or less like the **Mesohippus.** But it was slightly larger in size. It was a forest dweller and browser.

Miohippus was the direct ancestor for modem horses and many extinct horses. It gave rise to two lines. One line led to **Parahippus** which gave rise to the modem horses. A side line gave rise to **Anchitherium.** The **Anchitherium** gave rise to **Hypohippus.** The Anchitherium became extinct by the end of Miocene and **Hypohippus** became extinct by the beginning of Pliocene.



Eohippus Mesohippus parahippus Pliohippus Eques

Fig.: Changes in the hind limb of horse.

6. Parahippus

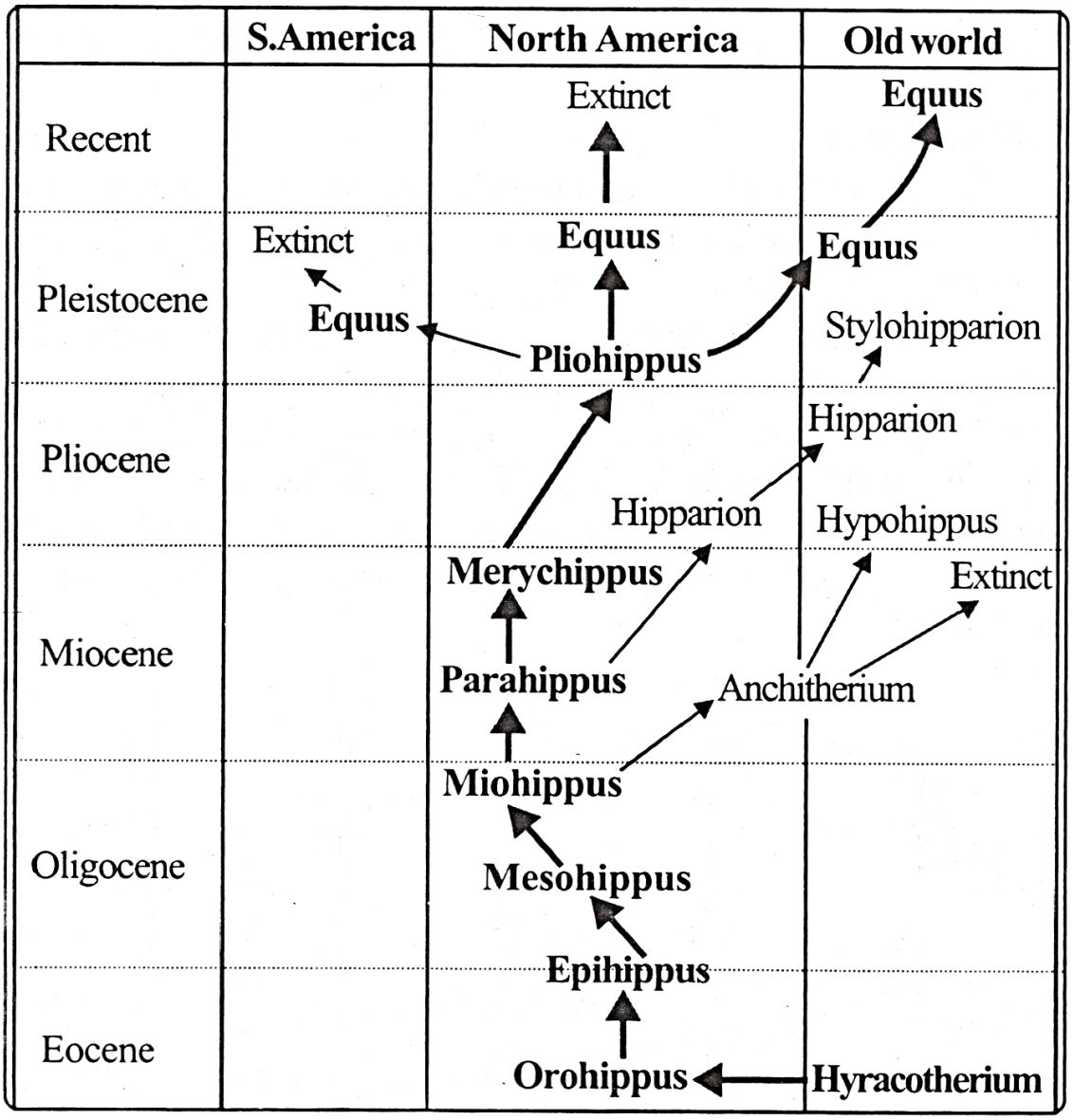
It descended from **Miohippus.** It lived during Miocene. The salient features of **Parahippus** are summarized below:

1. It was a **browser.**
2. The **preorbital** region was much elongated.
3. The **premolars** were molar-like.
4. **Dentition** was hypsodont i.e. high-crowned.
5. There were three toes in the legs. The middle toe was prominent and the side toes were slender.

7. Merychippus

It was a Miocene horse descended from **Parahippus.** It was the **first three-toed grazer.** The salient features of **Merychippus** are given below:

Table.1: Showing the evolution of horse.



1. It was adapted to live on grassland. It fed on grasses. It was the **first grazer** in horse evolution. Hence it formed the transitional stage between browsers and grazers.

2. The legs contained three toes. The middle toe alone touched the ground. The hoof was well-developed in the middle digit.

3. The muscles of the limbs formed an efficient **spring mechanism.**

4. The pre-orbital region was progressively elongated.

5. The diastema was well developed.

6. Dentition was hypsodont i.e high crowned.

7. The cerebral hemispheres were still more complex and convoluted.

8. Hipparion

It was a Pliocene horse. It was a side line from **Parahippus**. It was a three-toed grazer. It has a height of 40". It gave rise to **Stylohipparion** during the early Pleistocene and became extinct by the upper Pleistocene.

9. Pliohippus

It was a Pleistocene horse. It descended from **Merychippus** and was on the main line of evolution, leading to the modem horse. It had a height of 40". It was the **first one-toed** horse. The side toes were much reduced and were represented by splint bones. This fossil horse gave rise to the modem horse, **Equus.**

10. Equus

It is the modem horse. It descended from **Pliohippus**. It appeared in Pleistocene. The transition from **Pliohippus** to **Equus** involves the following changes:

1. The height is increased from 40" to 60".
2. The middle toe is enlarged and has a well-developed hoof.
3. The side toes (II &IV) are represented as splint bones.
4. It is well adapted for grazing.

5. The brain is enlarged and the cerebral hemispheres are much folded.

6. The main course of evolution of horse occurred in N. America. The modem horse also evolved first in N. America during Pleistocene. So N. America is the motherland of horses. But it became extinct in the motherland by the end of Pleistocene. The horses now living in N. America were introduced by man.

Orthogenesis in Horse Evolution

The evolutionary history of horse represents a very good example of orthogenesis, straight line evolution.

Eventhough most of the evolutionists believe in the straight line evolution of horse, there are also oppositions. It should be remembered that the fossil horses given above are only a few among many. The few selected fossils show the direct line of evolution. But there were many side lines which became extinct at different periods. This made **Simpson** (1953) to come to the conclusion that "orthogenesis is a product rather of the tendency of the minds of scientists to move in straight lines than of a tendency of nature to do so".

EVOLUTION OF MAN

Human evolution is a combination of biological and cultural evolutions. He has certain attributes which are not found in other animals. He is unique because man can achieve his

destiny; he can control his environment in which he lives; he has the ability to think, ***remember*** and profit from the past; he has the ability to look ahead and imagine the future and he has the ability to ***talk*** with others and work with others to achieve a better way of life.

The evolution of man can be conveniently discussed under three headings, namely

1. Organic evolution
2. Cultural evolution

1. ORGANIC EVOLUTION

Man's place in the Animal kingdom

- ✓ Man occupies the highest place in the animal kingdom.
  His position is represented as follows
  Phylum: Chordata
  Class: Mammalia
  Order: Primates
  Genus: Homo
  Species: sapiens
- ✓ The order primates includes not only man but also ***lemurs, tarsiers, monkeys*** and ***apes***

Place of human evolution

- ✓ The available fossils indicate that human beings originated first in ***East Africa.*** This is based on the conclusion that the oldest fossils were collected from here

Time of human evolution

- ✓ It is assumed that human evolution started 15 million years ago.
- ✓ But man appeared only ***3 million*** years ago

Ancestor man

- ✓ ***Apes,*** which lived in the past, were the ancestors of man. Modem apes such ***as gibbons, orangutans, chimpanzees*** and ***gorillas*** are also originated from these primitive apes. Thus modem apes are our ***cousins***.
- ✓ The belief held by many people that man has descended from monkeys is not correct

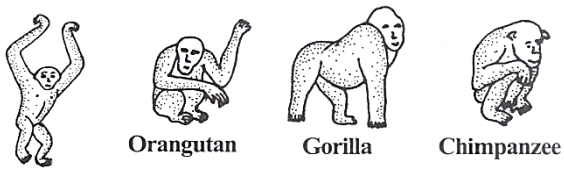
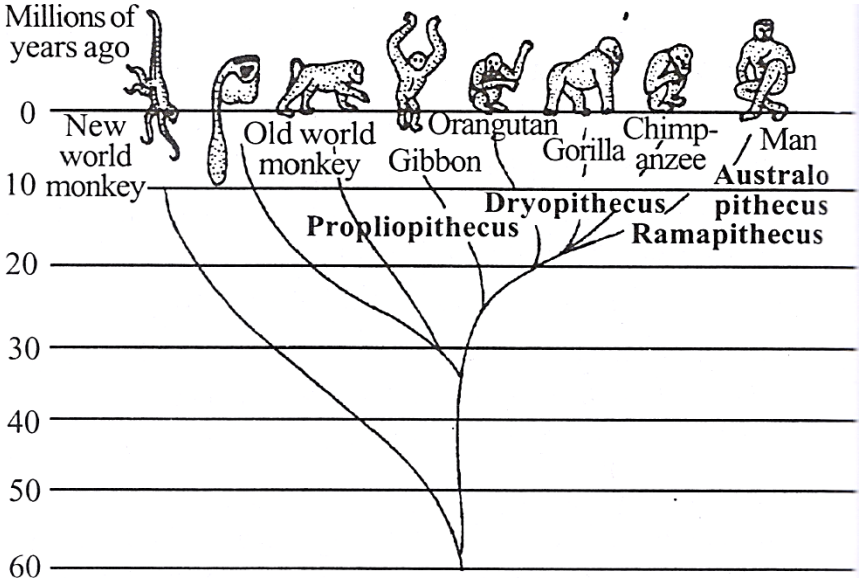


Fig.: Apes

Salient Features of Apes, our Ancestors

- ✓ Apes are mammals placed in the sub order ***Anthropoidea*** of order ***Primates.*** The apes which resemble man more are the great apes, gorilla and chimpanzee.
- ✓ The salient features of apes can be summarized as follows
    - They are arboreal
    - They have no tail
    - They have a narrow nose with nostrils close together
    - Apes have two premolar teeth on each side of both the jaws



- ✓ They have a long canal connecting the external ear with, the middle ear
- ✓ The occipital condyles are posterior in position
- ✓ They have large incisors and canines
- ✓ Their pelvis is narrow and elongated

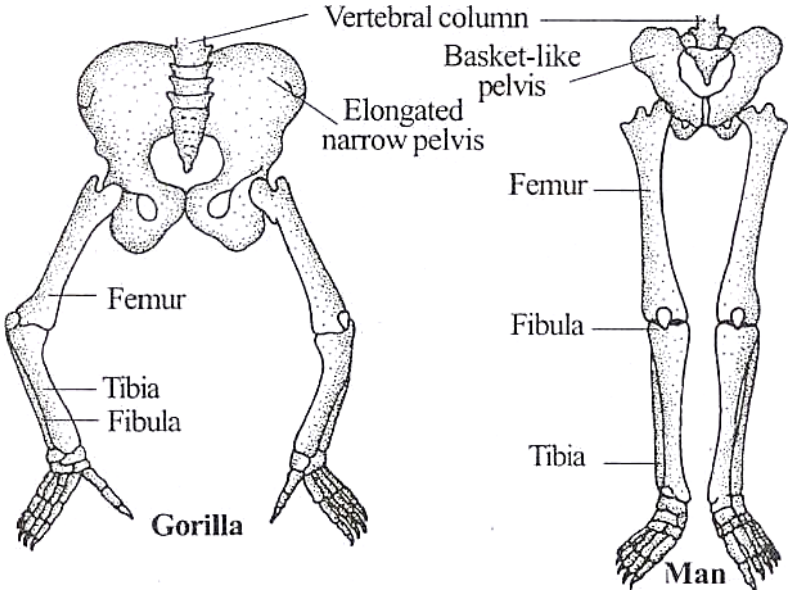


Fig.: Bipedalism in man and gorilla

Salient Features of Man

- ✓ Man has many unique features that enable us to say, "this specimen (man) before us is a human being, not a gorilla or a chimpanzee". The features are as follows
    - Bipedal gait
    - Erect walk
    - Freeing of hands for non-locomotory purposes
    - The hand is specially devised for making and using tools
    - Large cranium
    - Steep and high brow
    - The pelvis is expanded to form a basket
    - Distinct chin
    - Permanently enlarged breasts
    - Enormous penis, compared to that of apes
    - Man is naked without a hair-coat
    - Speech
    - Historic behaviour and culture

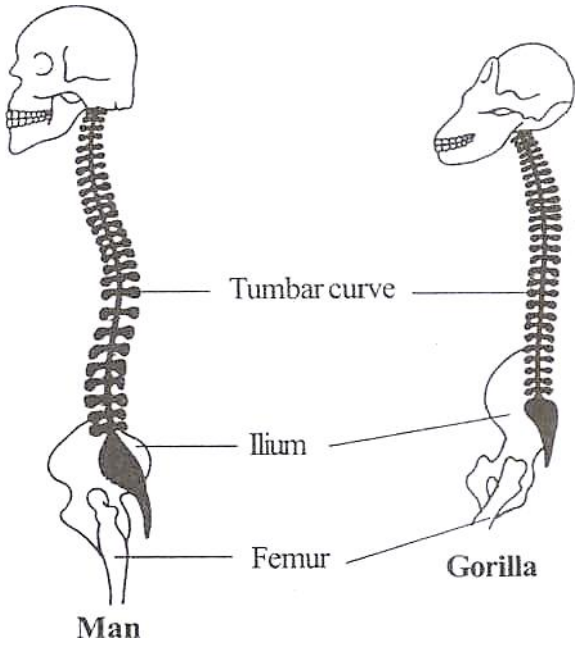


Fig. : Vertebral column of man and gorilla

Causes for Human Evolution

- ✓ The ancestors of man lived on trees. But man is a permanent terrestrial animal. So, the first step in human evolution is his descend from trees to the ground
- ✓ Man descended from the trees for the following reasons
    - To get a constant supply of food, man descended from trees
    - The shrinkage of forests
    - To give increased protection to young ones
    - Competition in arboreal life
    - Plenty of food on land
    - Change in behaviour caused by recombination of genes

Evolution of Man as seen in the Fossil Record

- ✓ Man evolved by gradual evolution. Darwin believed on the gradual evolution of man
- ✓ Man originated in East Africa
- ✓ Human evolution started 15 million years ago. Man appeared only 3 million years ago
- ✓ Man originated from ancient apes. Ancient apes were our ancestors
- ✓ During the evolution of man, the following changes occurred
    - Man left the arboreal life and descended to the ground
    - Opposability of great toes
    - Development of erect posture
    - Bipedal locomotion
    - Basin-like pelvis
    - Development of chin
    - Increase in the size of brain
    - Development of intelligence
    - Use of fore limbs for non-locomotory functions
    - There are four main stages in the origin of man
        - ❖ Apes
        - ❖ Ape-men
        - ❖ Primitive men
        - ❖ Modern men

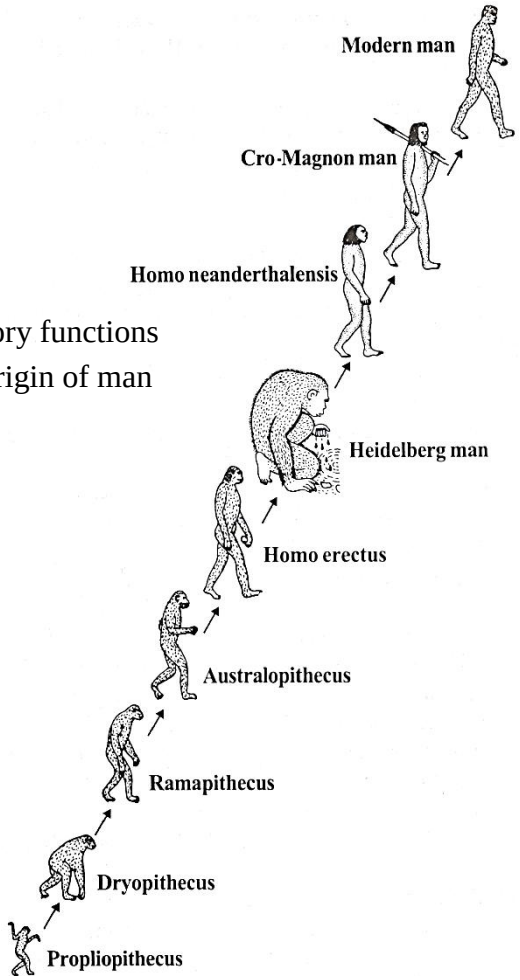


Fig.: Evolution of man as seen in the fossil record

2. CULTURAL EVOLUTION OF MAN

Introduction

- ✓ Cultural evolution is unique to human species. It is a state of intellectual development in human beings
- ✓ The concept of culture is used to cover all those skills and ways of life that are transmitted by interpersonal communication and tradition rather than by genetic means.
- ✓ It includes many different aspects of the life of people, their knowledge and language, their religion, beliefs and laws, their customs, rituals and arts, their tools, food, utensils, science, technology, agriculture, medicine, human society and other means of getting a living**.**
- ✓ The essential feature of culture is that it has to be acquired by each individual from others like classmates, playmates, friends, etc. It is not transmitted from parents to offspring through gametes
- ✓ Cultural evolution is an inevitable consequence of man's biological evolution

Speed of Cultural Evolution

- ✓ The cultural evolution has occurred and is still occurring at a rapid speed.
- ✓ The change from the Stone Age existence to modem civilization took only a tiny fraction of time when compared to the time needed for man to evolve from his ape like ancestors.
- ✓ Human evolution as such went on at a rapid speed when compared to the evolution of other organisms.
- ✓ In the last 25,000 years, it has speeded up tremendously

Culture of Early Man

- ✓ The culture of the earliest man can be summarized as follows
    - The earliest men were nomadic
    - They lived in caves
    - They were small in numbers
    - They used leaves for their clothing
    - They got their food by hunting game and gathering wild fruits, seeds, nuts and roots
    - They manipulated and manufactured tools made of stones and bones
    - They had to protect themselves from wild animals like lions, tigers, mastodons, mammoths, etc
    - They had belief in after-life and a supernatural power
    - They communicated with speech
    - They had elaborated religious ceremonies
    - They made arts and paintings on the walls of caves
    - They suffered a lot by changes in their environment such as floods, sudden storms, drought, famine, volcanoes, etc.

Milestones of Cultural Evolution

i. Tools

- ✓ Manufacture and the manipulation of tools began when the hands were freed from locomotory function. Early man made and used crude tools; they were made of stones and bones.
- ✓ During the several hundreds of thousands of years before metals were discovered man had made his tools from *stones, bones, ivory, antler,* and *wood.* During the greater part of the longer history, stone tools were used. Hence this period is called *Stone Age*

ii. Cannibalism

- ✓ In the Choukoutien caves, there are numerous skulls of ***Homo erectus,*** which have been broken apart at the base in such a way as to suggest that the brains were removed for eating.

iii. Fire

- ✓ Man 'stole' his first fires. Fires occur naturally as a consequence of lightning, volcanoes and from spontaneous combustion of gases. A fire, once captured was probably tended carefully and carried from place to place
- ✓ It is not known when man first learned to make fire. It could have come about in the form of ***sparks*** as a by-product of his tool making. The first fire making instrument is a stone disc with a hole in its centre. It dates back to 30,000 years
- ✓ It has been said that fire was first used as a protection against cold weather and carnivorous animals. The first sign of the use of fire came during a cold period about 4,50,000 years B.P. in ***Hungary*** and in ***Peking.*** At first, man used natural fire; then he learned to make fire

iv. Hunting and Food Gathering

- ✓ Ancient people got their food by hunting game and gathering fruits, nuts and vegetables. When nature failed, they had to starve. They used tools made of stones and bones. They knew how to lit fires; they cooked their food in open fires or in huge pits. Forest and grass fire were used to drive game animals into places where they could be captured. When nature failed, there was scarcity of food and hence they had **to** move to other places in search of food. This made them follow a nomadic life

v. Burials

- ✓ A further major sign of cultural advance that is left to us is the burial of the dead, first without additions and then with decorative ornaments, beads, tools, etc. More complex burials began to appear around 25,000 years ago. Burial with ornaments and tools suggests that the ancient people had belief in after-life

vi. Carvings and Art

- ✓ Carvings were found on the cave walls and small statues. The carvings show a preponderance of animals, but human figures were not rare. Among the oldest is a

large statue of man, carved in mammoth ivory got from a burial in Brno, probably 25,000-30,000 years old

vii. Agriculture

- ✓ It is believed that the cultivation of plants and animals began between 7000 and 10,000 years ago only. How it began? It was accidental and connected with a settled life. People first settled along lakes, great rivers and got their food by fishing
- ✓ Cultivation requires extra skill and care. The method of modem cultivation might have developed gradually step by step. The various steps are summarized below
    - The people, first of all, came to have the detailed knowledge of plants and animals they ate
    - They learned to select better seeds for planting
    - They knew how to clear the ground to make the soil loose and well-aerated
    - They learned the appropriate time or season for planting. They avoided the extremes of freeze and draught which would kill the seedlings
    - They protected their crops from domestic animals and wild animals
    - They also protected their crops from tribes who had not yet started to learn agriculture
    - They also knew how to harvest the crops as soon as they become ripe
    - They also stored the edibles from decay and destruction
    - They knew artificial selection of plants. If the seeds were to be eaten, plants with as large and as many seeds were selected

viii. Clothing

- ✓ The early men of Europe used the skins of animals they killed for their clothings. The Cro-Magnan man cut the hides and stitched them together with strings of rawhide, just as Eskimos make their clothes today. They used bone-needles for stitching. Then weaving was invented in Egypt. They used strong fibres of the stalks of flax plants. Wool and cotton fabrics were the later inventions

ix. Writing

- ✓ The invention of writing seems to have occurred only after the beginning of settlement. There is some evidence of symbolic code signs on bones at Palaeolithic sites, but the first undoubted tablets are from the ***Sumerians,*** about 5,500 B.P**.**
- ✓ The invention of language and of writing marked an important stage in his life. His language and his capacity to write led to the Bronze, Iron, Machine and Atomic Ages

x. Speech

- ✓ Man is able to speak which other animals cannot do. By speech, we mean the formulation and articulation of abstract ideas. Most higher animals can communicate the concept "I am hungry now". Only man can express "I was hungry yesterday

xi. Family

- ✓ In most human societies, a single male had exclusive sexual rights to one or more females. He was the headman or chief of the tribes. He was most skilled and intelligent man. He had more wives than other males**.**

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