UNIT 3 HUMAN PALAEONTOLOGY

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Learning Objectives

Once you have studied this unit, you will be able to understand:

- what Palaeoanthropology aims at;
- what is a Primate;
- which Primates were closer to humans;
- which biological and behavioural characters made us different from other Primates; and
- whether humans are still evolving or the end product of evolution.

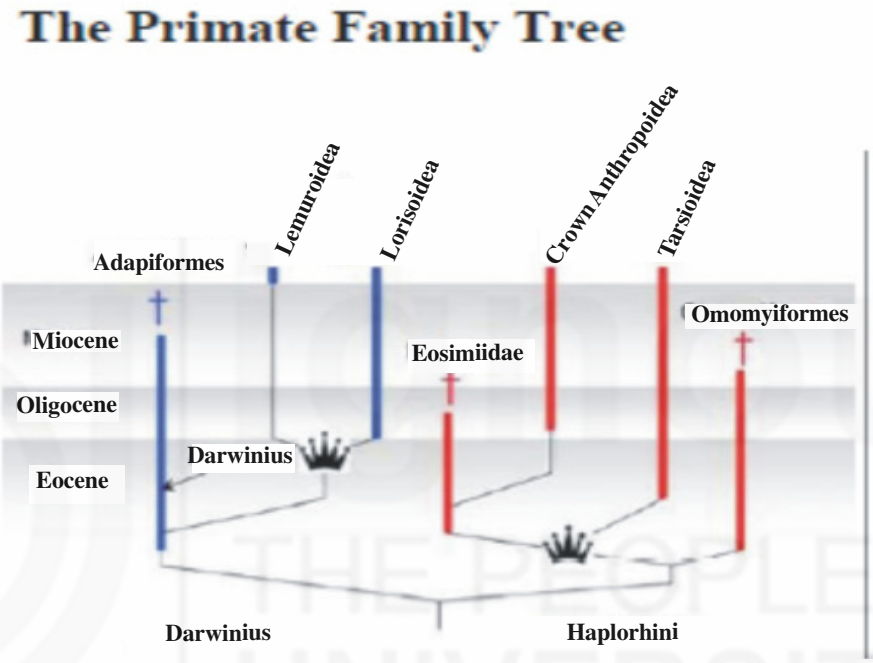
3.1 ORIGIN OF PRIMATES

3.1.1 Introduction

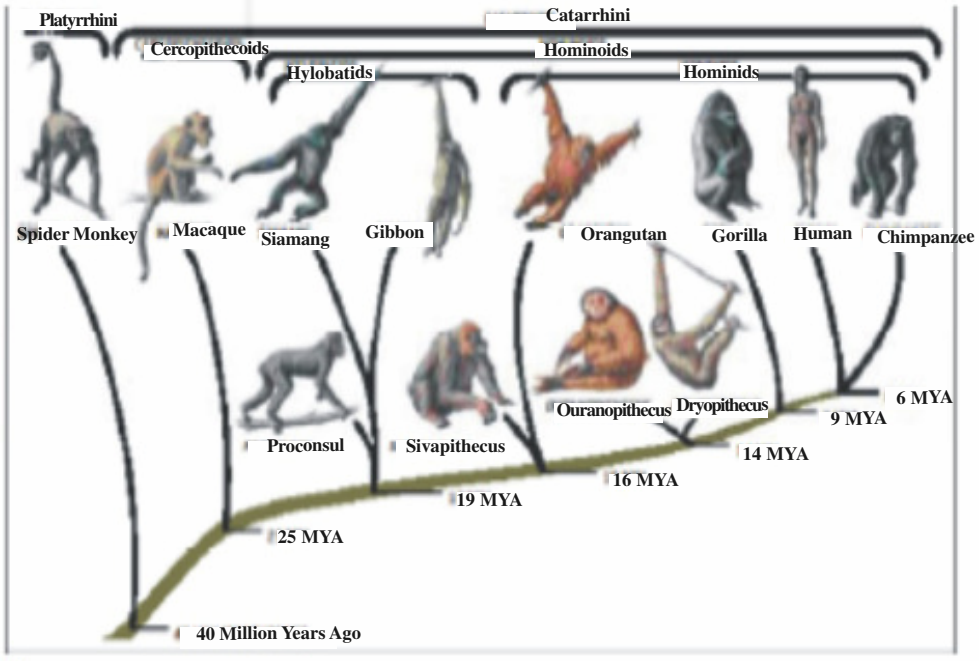
Human Palaeontology or Palaeoanthropology is a very fascinating and challenging subject. Also known as evolutionary anthropology, it aims at the scientific study of human origins in time and space. Palaeoanthropologists seek to illuminate the evolutionary history of the human lineage: when, where, and how our species, *Homo sapiens* evolved. For long palaeoanthropologists confront the creationists or philosophical critics of Darwinian doctrine of evolution as they interpret human "uniqueness" a result of "special creation" without any links with the apes. Their fundamental arguments were that the great apes (chimpanzee, gorilla and orangutan) walk in an inclined quadrupedal fashion and have small brains in contrast to humans who walk in upright bipedal fashion and possess large brains and higher intellectual and ethical standards. But, great progress made in human palaeontology during the nineteenth and twentieth centurie led to amazing discoveries of ape and human fossils from the entire Old World. At large, the fossil record of early apes and humans is now complete enough to make one

visualize how humans evolved from some very peculiar kind of ape or more apelike precursor ('hominoid') which shared traits with early human ancestors ('hominids').

In this section we shall understand why anthropologists study the Primates, and we understand human evolution better or about the lives of our ancestors if we understand more about primate biology, behaviour and ecology since the first members of the human species were more similar to living nonhuman primates than to any other animals on earth. Which seemingly "human" traits are ours alone, and which are shared with various primate relatives? What the different branches of the Primates are and when they split, and which branch or lineage evolved to man.



A simplified early primate evolutionary tree (after Williams etal. (2010)



After David Begun Scientific American Inc. (2003)

It is now fairly established that the hominid and the great ape lineages split around 6 to 8 million years ago, but many of their common traits are much more ancient, and could be traced back to about 20 million years ago when the first "tail-less monkey", known as *Proconsul,* appeared in Africa. In fact, many more common traits of the hominids and hominoids are also shared by the monkeys and can further be traced back to over 40 million years ago when the 'anthropoid' primates (monkeys, apes and hominids together) had not differentiated. We can further visualize the unbroken thread of shared ancestry further back in time to the early primates over 55 million years ago when there was a divergence of the two great branches of the primate family tree. One branch was of the haplorrhines, represented today by tarsiers and the anthropoids, and the second was of the strepsirrhines, the group to which living lemurs, lorises, and 'bush babies' belong. Latest combination of genetic, zoological, and palaeontological data has supported the view that the tarsiers and their omomyid relatives were most closely related to the early anthropoids, whereas the *Darwinius* and its kin were more closely related to the lemurs.

3.1.2 Major Features of Primate Behaviour

Besides physical resemblances between us and the Primates, it is important to understand what social behavioural traits we have inherited from the Primate ancestors. Some main traits are briefly described below.

i) *Gregarious*

Primates are social animals, living and travelling in groups that vary in size from species to species. In most species, females and their offspring constitute core of social system.

ii) *Aggression, Dominance/ Hierarchy & Territoriality*

Primates have clear territoriality, especially in forest species. Many primate societies are organised into dominance hierarchies that impose some degree of order with groups by establishing parameters of individual behaviours. Although aggression is frequently a means of increasing one's status, it serves to reduce the amount of actual physical violence; exerts control simply by making a threatening gesture**.**

iii) *Affiliative behaviours*

To minimize actual violence and to defuse potentially dangerous situations, there is an array of affiliative, or friendly, behaviours that serve to reinforce bonds between individuals and enhance group stability, e.g, physical contact (touching), and hand holding, hugging, and kissing in orangutan, gesture of friendliness, submission, appeasement or closeness; most notable primate activities is grooming, the ritual cleaning to remove parasites, shreds of grass or other matter. The mother-infant bond is the strongest and most long-lasting in the group.

iv) *Play*

Frequent play activity among primate infants and juveniles is a means of learning about the environment, testing strength, and generally learning how to behave as adults.

v) *Communication*

Primates have a great range of calls that are often used together with movements of the face or body to convey a message; warning calls, threat calls, defense calls, and gathering calls.

vi) *Tool use*

In the wild, gorillas do not make or use tools in any significant way, but chimpanzees use digging sticks to hunt termites. Bonobos and chimpanzees, provide essential clues in the reconstruction of adaptations and behaviour patterns of our earliest ancestors

3.1.3 Physical Charactersistics that Classify the Primates

Primates are classified broadly into two suborders: the prosimians and the anthropoids.

Suborder: Prosimia

They are the most distant and most varied primate relatives of man. Many are nocturnal (active in the night), hence have more developed sense of smell than other primates (wet, "naked" doglike nose), large eyes, independently mobile ears, sensory whiskers, many arboreal, hence the four non-thumb digits act together, not independently, many have a "grooming claw" on the second toe only; nails on other digits, many have a "dental comb" comprised of the four lower incisor teeth and the lower canines, which are long, narrow, and close together, for use in grooming fur and gathering food, less complex behaviour, less learning, relatively smaller, less developed brains than the anthropoids. Most have the full three premolars. All prosimians, except tarsiers, have the post-orbital bar but lack the post-orbital plate; tarsiers have both, like anthropoids do. Prosimians are further divided into *three infraorders: lemuriformes, lorisiformes & tarsiiformes*

Lemuriformes (lemurs)

They are found only on Madagascar Island and have evolved there in isolation into diverse forms and are therefore regarded as a case of adaptive radiation. Most of the lemurs are small sized, tree-dwelling, nocturnal, quadrupedal as well as vertical clinging and leaping.

Lorisiformes (lorises)

They occur both in Africa and Asia, Sri Lanka and are small, nocturnal, arboreal; mostly eat fruit, gum, and insects. Examples: *galagos* (fast hoppers) and runners ("bushbabies"), slender?*lorises*: slow climbers and creepers.

Tarsiiformes (tarsiers)

They inhabit rain forests of Southeast Asia and Indonesia. They are small, nocturnal, arboreal, vertical clinger and leapers; eat insects and some small vertebrates. They are recently classified in the anthropoid suborder, rather than prosimians.

Suborder: Anthropoidea

We along with the monkeys and apes belong to this Suborder of generally larger bodied, mostly diurnal (active in the day) primates; retina with a fovea (central

area of higher resolution vision)- absent in prosimians except the tarsiers; dry nose, reduced sense of smell, reduced sensory whiskers, independently controlled, dexterous digits, nails on all digits (no claws), generally larger brain relative to body size, generally more complex behaviour, post-orbital bar (like all primates) including the post-orbital plate (absent in prosimians except the tarsiers). Anthropoids are subdivided into *two infraorders: Platyrrhines* and *Catarrhines.*

Infraorder: Platyrrhines

Platy=flat, Rhine=nose; they are "flat nosed": round, forward-facing, widely separated nostrils only in the New World, hence often called "New World monkeys" (NWM), three premolars on top and bottom, almost all diurnal all mostly arboreal, living in forests mostly quadrupedal, some able to swing by arms or tail a few have prehensile tails, which are found only among the New World monkeys specifically, only among one family of NWMs, the Cebids, e.g., the capuchin monkey, which is notable for being one of just four primates that are known to regularly make and use tools- the sticks as weapons, modify twigs and leaves to probe for insect larvae.

Infraorder: Catarrhines

Cata= prominent /raised, rhine= nose. Humans, apes and Old World monkeys fall in this category. They have narrow, downward-facing nostrils, two premolars on top and bottom, rather than three, some have tails, but none are prehensile, more variable adaptations than New World monkeys. Catarrhines have *two superfamilies: Cercopithecoids* (Old World monkeys) and *Hominoids* (apes and humans)

Superfamily: Cercopithecoidea (Old World monkeys: OWMs)

It is a highly variable group, arboreal and/or terrestrial; has many kinds of social organisations and mating strategies, often groups of numerous females and one or several males. *Cercopithecoids* have *two subfamilies: Colobines* and *Cercopithecine.*

Subfamily: Colobinae

It is of arboreal leaf-eaters found in Africa and Asia. E.g., colobus monkeys: no thumbs (apparently an adaptation to moving through trees?); langurs: sometimes called "leaf monkeys", "Miss Waldron's Red Colobus", last seen in 1970's, declared extinct in September 2000.

Subfamily: Cercopithecinae

They are mostly semi-terrestrial, quite varied, found in Africa; macaques also live in Asia typically in large, multi-male, multi-female groups, e.g. baboons, macaques, vervet monkeys.

Subfamily: Hominoidea

It is the branch of the apes and humans; generally the largest primates, with no tails, have relatively larger brains, Y-5 molars, basically forest dwellers, more or less arboreal, wide chest with shoulder blades (scapulae) on the back, rather than on the side as in quadrupeds, so the forelimbs can stick out sideways, rather than just moving forward and back, greater mobility of shoulders, elbows, wrists, these are presumably adaptations for complex climbing in trees, rather than just

walking on top of branches. Traditional classification has *three families: hylobatids* (lesser apes), *pongids* (great apes), and *hominids* (us).

Family: Hylobatidae

It is of the "lesser apes", generally smaller than the pongids, e.g., gibbons and siamangs. They live in tropical forests of Asia; nearly full-time brachiators (overhand swingers through the trees) with very long arms, monogamous mating, little sexual dimorphism, males more involved in infant care than most other primates, especially the siamangs, highly territorial.

Family: Pongidae (great apes): orangutans, gorillas, and chimpanzee (it includes bonobos=pygmy chimpanzees)

Orangutans are only on southeast Asian islands of Sumatra and Borneo; extremely sexual dimorphism in size, face, etc., quadrumanual and arboreal when small, more terrestrial when grown to large size, (especially males), very solitary, fruit, leaf, and bark eater.

Gorillas live in central African forests in small groups of one or two adult males, a few females, some young; they eat leaves, stalks, bamboo; mostly terrestrial (although this may vary depending on their environment).

Chimpanzees and their close relatives bonobos called "pygmy chimps", even though they are not consistently much smaller mostly eat plants, especially fruit, but sometimes insects and other animals

Common chimps: *Pan troglodytes* large multi-male, multi-female groups centered on a stable group of related males who stay in their natal group

Bonobos: *Pan paniscus,* female-centered groups; regularly use tools and modify objects to serve as tools, strip twigs to "fish" for termites, wad up leaves to sponge water out of cavities in tree trunks; crack nuts using a stone in one hand and a larger stone or root as an anvil.

Family: Hominidae

The family of man and his Plio-Pleistocene ancestors, traditionally placed in their own family, probably more closely related to chimps (and / or to orangutan) than to gorillas, bipedal, have reduced canines, huge brains for body size. More discussion follows in other section.

3.1.4 Early Fossil Primates and their Evolution

Primates arose as part of a great adaptive radiation that began more than 100 million years after the appearance of the first mammals and the flowering plants about 65 million years ago.

Palaeocene Primates

By 65 million years ago, primates were diverging from other mammalian lineages (such as those which later led to rodents, bats and carnivores). For the period between 65-55 Mya, it is extremely difficult to identify the earliest members of the primate order since the available fossil material is scarce, and they were not easily distinguished from other early (generalised) mammals.

Eocene Primates

First fossil forms that are clearly identifiable as primates appeared during Eocene (55-34 Mya). From this period have been recovered a wide variety of primates, which can all be called prosimians. Lemur-like adapids were common in the Eocene, as were species of tarsier-like primates. They were insect eaters and adapted to tree-dwelling. They had larger, rounded braincases; nails instead of claws, eyes rotated forward, binocular vision, presence of opposable large toe.

This time period exhibited the widest geographical distribution and broadest adaptive radiation ever displayed by prosimians. In recent years, numerous finds of Late Eocene (36-34 Mya) suggest that members of the adapid family were the most likely candidates as ancestors of early anthropoids.

Oligocene primates

The center of action for primate evolution after Eocene is confined largely to Old World; only in Africa and Eurasia. We trace the evidences of apes and hominids during Oligocene (34-23 Mya) the vast majority of primate fossils coming from just the Fayum area of Egypt with 21 different species. The main genera are:

Apidium

The most abundant of all Oligocene forms, adapted to fruit and seed diet, they were a small arboreal quadruped, adept at leaping and springing, like a squirrel.

Propliopithecus

Morphologically quite primitive, small to medium in size, likely fruit eaters.

Aegyptopithecus

It was the largest of Fayum anthropoids, similar to modern howler (6-8 kg) with primitive skull, short-limbed, heavily muscled, slow-moving arboreal quadruped. It bridges the gap between the Eocene prosimians and the Miocene hominoids.

3.1.5 Advanced Hominoid Primates and Common Ancestors

Early Miocene

Large-bodied hominoids first evolved in Africa ~ 23 Mya. Then they migrated into Eurasia, dispersed rapidly and diversified into a variety of species. After 14 million years ago, we have evidence of widely distributed hominoids in many parts of Asia and Europe. The separation of the Asian large-bodied hominoid line from the African stock (leading ultimately to gorillas, chimps and humans) thus would have occurred at about that time.

They are presently classified into at least 23 species, lived in dense rain forests to more open woodlands, were partially terrestrial (ground living) and even occasionally bipedal, and most of them were fruit eaters, some included leaves as well. Currently recognised African Early Miocene (20- 17 Mya) fossil taxa are: *Proconsul (P. heseloni, P. majus,* and *P. nyanzae); Afropithecus, Turkanopithecus, Otavapithecus, Equatorius Nacholapithecus*

Middle to Late Miocene

The well-known Middle Miocene African hominoid is *Kenyapithecus* that falls on the threshold of the "advanced" hominoids, appeared by 14.5 Mya at Fort Ternan Kenya. Hominoids are rare in African Later Miocene; the known one is S*amburupithecus* around 8-9 Mya followed by *Sahelanthropus* ~7-8 Mya in Chad, regarded as the 'Chimpanzee-hominid' last common ancestor, but still debated.

Not all African apes evolved into hominines. Those that remained in the forests and woodlands continued to develop as arboreal apes, although ultimately some of them took up a more terrestrial life. These are the bonobos, chimpanzees and gorillas, who have changed far more from the ancestral condition than have the still arboreal orangutans.

European and Eurasian Hominoids

They appeared during Middle Miocene (14-11 Mya) and currently recognised fossil taxa are:

Dryopithecus (=Rudapithecus),

*Ankarapithecus (*earlier *Sivapithecus meteai)*

*Graecopithecus (*earlier *Ouranopithecus)*

Griphopithecus, Heliopithecus, Oreopithecus

Some scholars regarded *Dryopithecus* as the common ancestor to Chimpanzee-hominid clade, but others as ancestor to African apes only. *Ankarapithecus* is on the orangutan clade; *Heliopithecus* is closer to the gibbons, whereas the, *Oreopithecus* is debated either a monkey or a side-branch of the hominoids.

South Asian (Siwaliks) and East Asian (Chinese) Taxa

Hominoids appeared in South Asia (Siwaliks) and their fossils have been found in India and Pakistan at ~12.3 Mya and survived there until ~5.5 Mya; spread eastward to southern China ~ 8 Mya. Currently the following species are recognised:

Sivapithecus (*S. parvada, S. indicus, S. punjabicus (= Ramapithecus*)

Krishnapithecus (= *Pliopithecus*)

Gigantopithecus (="*Indopithecus*")

Lufengpithecus (L lufengensis), L. keiyuanensis & L. hudienensis

- They varied in size from moderately small (*Ramapithecus*) to large (*Sivapithecus indicus)* and very large (*Sivapithecus parvada*). Indian *Gigantopithecus* (*G. bilaspurensis*) and Chinese (*G. blacki*) were great giant "aberrant hominids" of gorilla-size, sometimes speculated as the ancestors of the illusive "Himalayan Snowman".

- *Ramapithecus,* earlier considered hominid, is now lumped in *Sivapithecus* genus, but recognised a separate species, *S. punjabicus* or *S. sivalensis*.

- *Sivapithecus indicus* face has a concave profile and projecting incisors bearing striking similarities with the orangutan. But, dentition and lower jaw are closer to early hominids.

- But, *Sivapithecus* forelimbs indicate a unique mixture of arboreal quadrupedalism and no suspensory component of the orangutan. *Sivapithecus* possessing a mosaic of hominid and 'pongid' (orangutan) characters are regarded some scholars their exclusive last common (or generalised) ancestor.

- *Lufengpithecus* in China is similar to *Sivapithecus*.

- *Krishnapithecus* (=*Pliopithecus)* was probable ancestor of the gibbons.

3.2 ORIGIN OF MAN

3.2.1 Plio-Pleistocene Hominids

Plio-Pleistocene hominids are presently known from Africa only. The following hominids genera and species are currently recognised indicating a great diversity:

Australopithecus: (i) A. africanus, (ii) A. aethiopicus

Kenyanthropus: i) K. rudelfensis (ii) K. platyops

Paranthropus: (i) P. walkeri (ii) P. bosei (iii) P. robustus

Praeanthropus: (i) P. anamensis (=A. anamensis), (ii) P. afarensis [=A. afarensis (Lucy)], (iii) P. garhi = (A. garhi), (iv) P. bahrelghazali (=A. bahrelghazali)

Ardipithecus: A. ramidus

Traditionally, three genera were recognised, viz., *Australopithecus*, *Paranthropus*, and *Ardipithecus,* the last one is currently regarded closer to *Homo.* They are collectively recognised as australopithecines.

The first member of australopithecines was discovered in 1924 in a limestone cave at Taungs in South Africa by Raymond Dart. It was named as *Australopithecus africanus* ("Southern ape of Africa" regarded as a "missing link" between apes and humans. They had hominid upright stance; the molar teeth were very large whereas the front teeth very small unlike apes. In 1959 a nearly complete skull, well-dated to 1.8 Mya was discovered at Olduvai Gorge, Tanzania by Mary Leakeys, named as "*Zinjanthropus boisei*" (now *Paranthropus boisei*). Major findings came from Kenya, Ethiopia, and other areas of the Great Rift Valley East Africa, dated to 4.2 Mya with the earliest evidence for bipedalism in *Australopithecus anamensis* (later *Praeanthropus anamensis*). The 3.5 Mya *Ardipithecus* ("Little Foot") is currently regarded closer to humans. Hominid footprints of 3.8 Mya were discovered at Laetoli in Tanzanian are the hallmarks of bipedalism.

In the mid-1970s, "Lucy" skeleton (*Australopithecus afarensis*) was discovered by Donald Johanson, dated to 3.2 Mya having long arms and short legs yielding 3½ feet stature. But her pelvis and knee was fully biped human like, but her toes and fingers were long and curved like an ape's, the brain too small like an ape. Her molar teeth were large and with thick enamel like humans, but the rib cage was conical, neither precisely like known apes nor humans. So, Lucy possessed a mosaic, partly ape, partly human, and partly intermediate.

The other australopithecines is "*Kenyanthropus platyops*" found near Lake Turkana in 1999 and dated to 3.5 Mya, was a small-brained biped with small front teeth and large rear teeth.

A new species dated at ~2.5 Mya, *Australopithecus garhi* (now *Praeanthropus garhi*), was "robust" australopithecines. Robust hominids evolved gradually as the climate of Africa underwent a prolonged period of cooling and grasslands expanded at the expense of forests. They developed large (megadont) molar teeth, and strong bones and muscles to enable them to crack and grind down energy rich hard nuts and seeds. *Paranthropus* represents such an extreme robust lineage discovered by Mary Leakey in 1959 and dubbed as "Nutcracker Man".

Did australopithecines make tools? *A. garhi* had associated evidence of butchered gazelle bones and supported tool use.

Three major stages may be recognised in Hominid Evolution. The stages in sequence, the stage of Australopithecus, the stage of Homo erects and the stage of Neanderthal man.

3.2.2 Pleistocene Hominins: Distribution and Bio-Cultural Characteristics

In this section you will learn the evolution of our genus, *Homo,* and its various species through time and their distribution in the Old World. Several species have evolved and preceded the modern *Homo sapiens* and these are listed in the box.

A Recent count of the various species of Man (*Homo*):

1) *H. habilis* (Africa)
2) *H. ergaster* (Africa)
3) *H. erectus* (Asia: Java, China, India)
4) *H. georgicus* (Europe)
5) *H. antecessor*(Europe)
6) *H. cepranensis* (= European*H. erectus*)
7) *H. heidlebergensis* (Old World)
8) *H. neanderthalensis* (Europe, West Asia)
9) *H. sapiens* (Old World)
10) *H. floresiensis* (Indonesia)

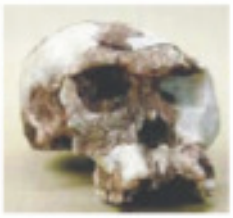
We shall understand the variation of morphological characters of various fossil species generally referred to as 'hominins' with special reference to the cranial traits that changed during the course of hominin evolution.

1) ***Homo habilis***

   The earliest indications of the genus *Homo* are recorded at about 2.4 to 1.8 Mya in East Africa at the same time and place as the earliest recognisable simple stone tools, known as Oldowan, made on small rounded pebbles. *Homo habilis* is the earliest known *Homo* showing anatomical evolutionary continuity from the preceding *Australopithecus* to the following *Homo ergaster*.

The most famous specimen of *Homo habilis* lineage is ER-1470 discovered in 1972 Richard Leakey's expedition in the Lake Turkana in Kenya. Its reconstructed skull showed brain volume of ~ 735 cc but a flat face. Another and better skull is ER-1813 but with a relatively smaller brain ~600 cc, also found in Olduvai Gorge and in South Africa, initially called "Telanthropus" .

The 1st Stone Tool-maker ~2mya: Homo habilis-though still small- brained but intelligent scavengers and tool- makers (slide by A.R. Sankhyan)



Oldowan Chopper made by Homo habilis

The most interesting feature of *Homo habilis* is its facial reduction and cranial increase (compared to australopithecines). But, its limb proportions – the long arms and short legs, are quite primitive fitting somewhere between the Great apes and the *Australopithecus* indicating imperfect bipedal locomotion.

2) **Home ergaster**

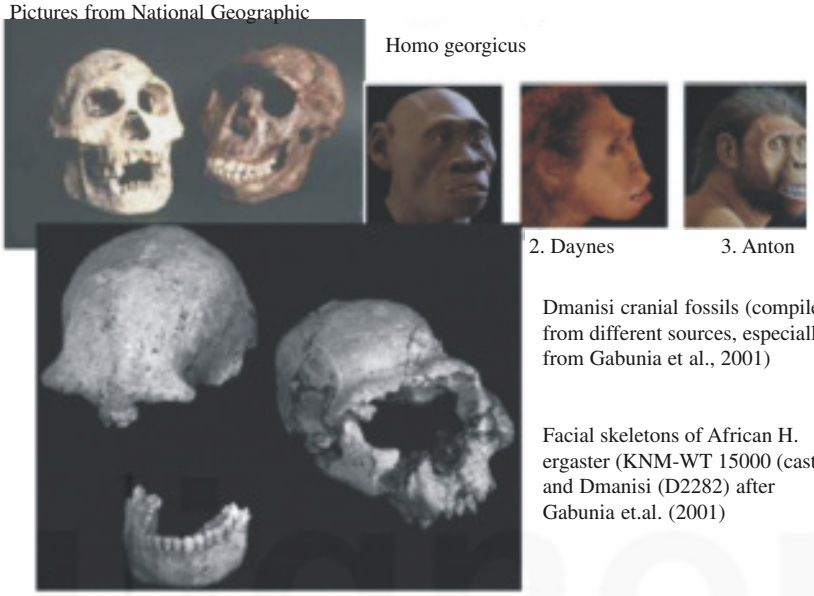
Compared to the very gracile *Homo habilis, Homo ergaster* (ER-3733) discovered in 1974 was taller and large brained (850 cc), and efficient tool-maker who hunted with choppers and crude handaxes. It firmly established that enlargement of brain occurred but with robust body about 1.8 Mya.

A nearly complete skeleton (WT-15000) of an adolescent male (ER-3883) was discovered in 1984 by Richard Leakey's team on the western side of Lake Turkana, famous as the 'Nariokotome Boy'- who lived and died about 1.6 Mya. He had heavily muscled arms, prognathous face, no forehead and strong supra-orbital torus. He stood about 5½ feet tall even at ~12 years age and if fully grown it could have become the first six-footer of Pleistocene. This indicates running over long distances, and therefore, *Homo ergaster* is considered the first hominin to venture out of Africa.

3) ***Homo georgicus***

Homo georgicus was similar to *Homo ergaster* in many ways and therefore regarded the descendant of the latter. Discovered in 1983 in the southeast Europe in Georgia at Dmanissi site at 1.8 Mya, *Homo georgicus* is the first earliest representatives of *Homo* outside Africa. Later on, stone tools and at least six individuals were found along with stone tools and cut marks on animal bones indicating the possibility of meat processing.

1. D 2700 (Dmanisi) and WT 15000 (Nariokotome)- Homo ergaster are two similar small and quite lightly- built adolescent skulls. Pictures from National Geographic



2. Daynes 3. Anton

Dmanisi cranial fossils (compiled from different sources, especially from Gabunia et al., 2001)

Facial skeletons of African H. ergaster (KNM-WT 15000 (cast)) and Dmanisi (D2282) after Gabunia et.al. (2001)

Morphology

The Dmanissi crania are similar but about 90% smaller than African *H. ergaster*. They were stout and short (stature ~150 cm) as they lived in the temperate zone, whereas African *H. ergaster* was lean and tall since it lived in a relatively dry and hot steppes environment. Other salient features are:

- Moderate supraorbital tori, relatively tall, thin-walled, narrow cranial vaults
- Small cranial capacities (600-800 cc) like *Homo habilis* and unlike the Asian *Homo erectus* (~1000).
- Mandible has primitive bucco-lingually narrow anterior teeth and P/3; The D2282 face similar to *H. ergaster*, but small and pyriform (nasal) aperture.
- Limb proportions similar to modern humans: legs (femurs) longer than arms; vertebral column S-shaped, the foot well arched- indicating long distance walking and running.
- *S*houlders and arms were unique; hands resting outwardly.
- They exhibit a unique mosaic of "primitive" (ancestral) and "derived" (novel, descendant) features, while almost modern in their body proportions.
- They were associated with core-and-flake industry indicating that the Oldowan Industry associated with foraging strategy was also as efficient in facilitating dispersal as the Acheulian technology.

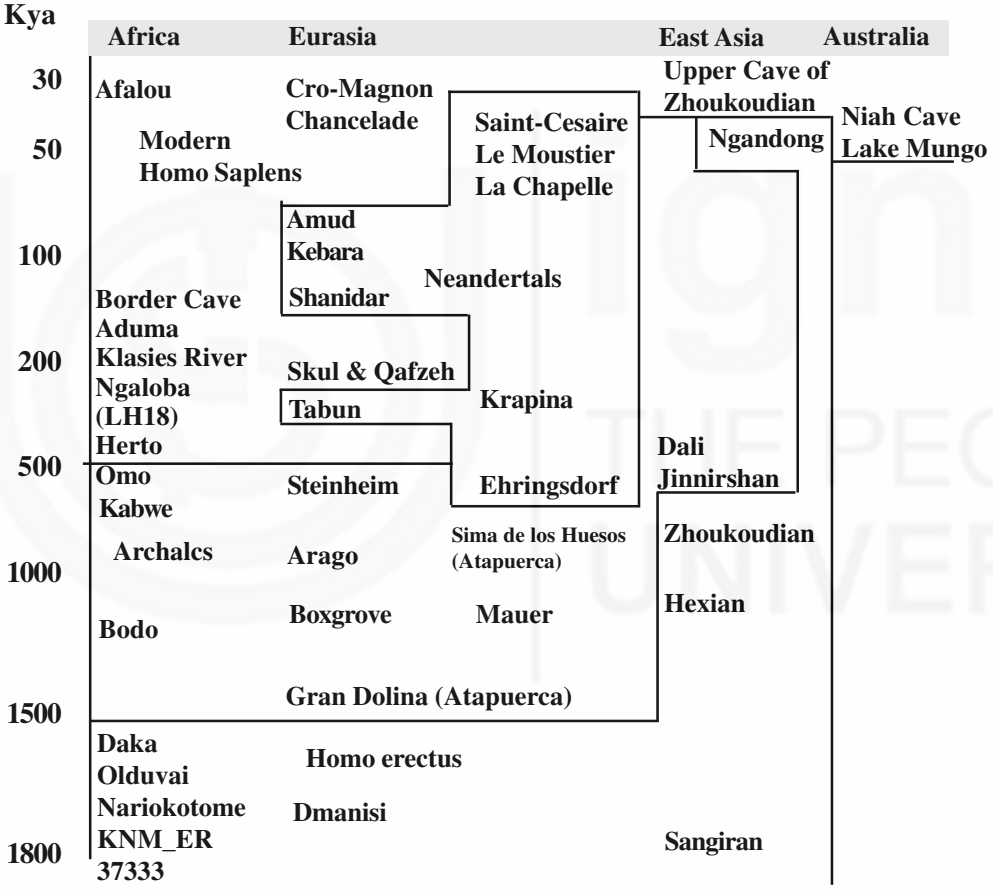
4) ***Homo erectus***

Homo erectus evolved from *Homo georgicus* and was higher-brained and versatile tool-maker, skilled organised hunter and therefore the widest spread species having colonized most of the Old World one million year ago. Typical *Homo erectus* first appeared in China and Java at ~1.6 Mya and survived as late as 200 – 300 Kya (K= kilo=thousand, ya=years ago), even later at Ngandong (Java) at ~100 Kya. Earlier presence of *Homo erectus* was debated in Western Europe, but the skull from the Tautavel Arago Cave besides Palaeolithic evidences from Lazaret cave and Terra Amata at Nice in southern France attest their presence.

Distribution

The box below displays the main *Homo erectus* and other hominins.

Temporal and Special Distribution of H. erectus, Archaic & Modern H. sapiens and H. neanderthalensis (adapted from Conroy, 2005)



Box 1: Distribution sites of Homo erectus

an early African fossil (KNM-ER 3733 from Kenya, which is dated to 1.78 mya)
an early Indonesian fossil (Sangiran 17 from Java and dated to between 1.7-1.0 mya)
a late Chinese fossil (Zhoukoudian reconstruction that is dated to between 600-300 kya)
a late Indonesian fossil (Ngandong from Java dated to 53-27 Kya)
and even an immature individual (the 8-11 year old Nariokotome boy from Kenya that dates to 1.6 mya).

Box 2: Distinguishing Cranial Characteristics of Homo erectus

1.	Cranial capacity > Australopithecus but <Homo sapiens 750 - 1225cc. mean = 900cc. EQ 3.3-4.0 (Mchenry, 1994)
2.	Long, low cranial vault with thick cranial walls (nearly twice as thick as modern humans)
3.	Face is short but massive, nasal aperture projecting forward relative to the lateral facial regions (not a dished or concave face) the lower part of the face protrudes (prognathism)
4.	Large supraorbital torus (usually in the form of a bar) and supraorbital sulcus
5.	Frontal bone low and receding
6.	Postorbital constriction greater than Homo sapiens but less than Australopithecus
7.	Variable development of a sagittal keel along midline
8.	Angular occipital with occipital (nuchal) torus
9.	Broad base cranium - maximum breadth of skull low on temporal bone (about the level of the external auditory meatus - ear) = pentagonal-shaped skull (when viewed from behind) - Not Bell Shaped
10.	Basicranium moderately flexed
11.	Tooth size is smaller than Australopithecus (reduced megadonty) but greater than Homo sapiens
12.	No chin

5) The Archaic *Homo sapiens*

The later ("evolved") *Homo erectus* and early ("archaic") *Homo sapiens* are indistinguishable. The terms "evolved" and "archaic" are not taxonomically accepted, but often applied to a Old World widely occurring Middle Pleistocene hominins living during 600 -150 Kya. So, many scholars consider these a single species, *Homo heidlebergensis,* which is transitional between *Homo erectus* and *Homo sapiens*.

Box 3: Dates and distribution sites of late Homo erectus/early Archaic Homo sapiens or Homo heidlebergensis

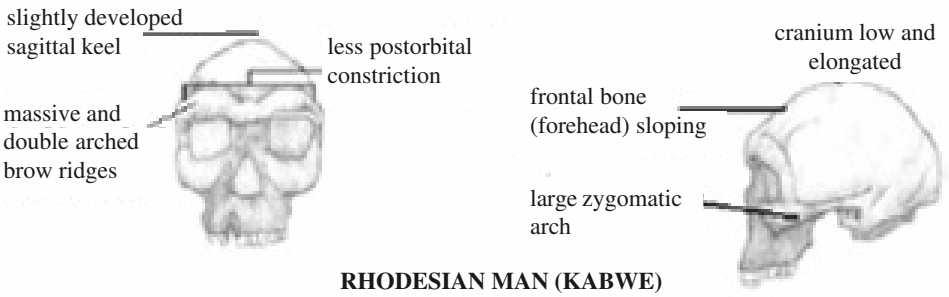
African specimens	European specimens	Asian specimens
Kabwe cranium (Zambia), 125 kya? or 500 kya - 200 kya Bodo cranium (Ethiopia), 600 kya	Steinheim cranium (Germany), 200-250 kya Sima de los Huesos - Ata-puerca numerous specimens (Spain), 300-400 kya Arago face and partial cranium (southern France), 320-470 kya Mauer mandible (Germany) 500 kya	Dali cranium (China), 180-230 kya Jinniushan (China) (200-280 kya

In their overall morphology, *Homo heidlebergensis* are similar to *Homo erectus* in thick cranial vault, low sloping forehead, long low skull and a large robust face with heavy brow ridges. But, they have two important differences, a larger braincase (1210 cc) and lesser development of three *Homo erectus* bony ridges:

(a) the double arched supraorbital torus, (b) the reduced occipital torus, and (c) the sagittal keel. So, they would seem to be more advanced towards modem *Homo sapiens*.

Important fossils of the *Homo heidlebergensis* or "archaic" *Homo sapiens* are: Kabwe (Zambia), Petralona in Greece, Steinheim in Germany, Dali in China, and Narmada in India.

The Homo heidlebergensis have some Neanderthal-like specialized listed in the box.



RHODESIAN MAN (KABWE)

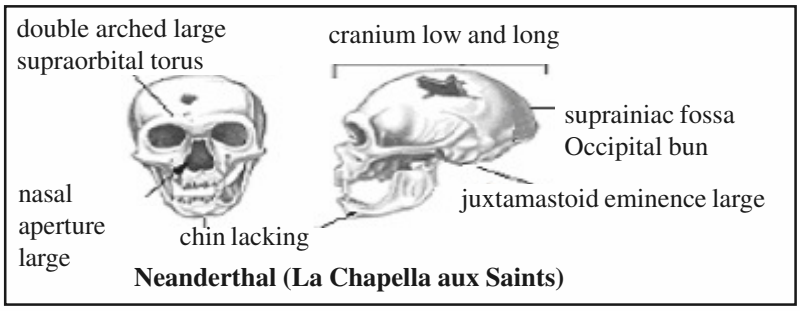
1.	Larger average brain size, 1212 cm3 (Campbell, Loy, & Cruz-Uribe, 2005)
2.	Rounded parietal bones, giving the cranium a barrel shape from posterior view
3.	Development of an occipital bun, a rounded bony protrusion on the occipital bone in the region of the occipital torus
4.	Development of midfacial prognathism produced by inflation of the maxillary bones
5.	The presence of large noses
6.	Development of a retromolar gap (a space between the lower third molar and the ascending ramus of the mandible)

6) **Neanderthals – *Homo neanderthalensis***

'Neanderthal' is an informal term, referred to a unique population with a distinctive morphology found in Europe and the Middle East ~150- 27 Kya. They are currently classified as *Homo neanderthalensis* but earlier as *Homo sapiens neanderthalensis.*

Postcranially Neanderthals were very well built with many unique features, namely, shortened distal segments (radius and ulna in forelimb, tibia and fibula in hind limb), large joint surfaces, and pronounced anterior posterior curvature of the femur and radius, likely representing adaptations to the colder climates. The salient cranial and postcranial characters of the Neanderthals are shown in the figure and listed in the boxes.

Salient Features of Neanderthal Cranium



Neanderthal (La Chapella aux Saints)

Neanderthal Features: Cranial &

1.	Large cranial capacity, mean = 1498 cc (Ruff et.al. 1997), male range = 1524-1640cc and female range = 1270-1425 cc (McKee, 2005), EQ = 4.78 (Ruff et.al., 1997).
2.	Long, low and wide cranial vault
3.	Cranial base is often relatively flat (often not highly flexed)
4.	Large face characterized by midfacial prognathism, inflated maxilla, big nose and no canine fossa
5.	large supraorbital rorus often forming a double arch
6.	occipital bun (chignon with a suprainiac fossa
7.	Maximum breadth at midparietal
8.	Small mastoid but a large juxtamastoid eminence
9.	Chin usually absent
10.	Teeth size smaller than Homo erectus but larger than ours, molars with enlarged pulp chamber (taurodont) and a retromolar gap (gap between M3 and the anterior margin of the ascending ramus of the mandible).

Postcranial

1.	Overall short and robust people, Body mass mean = 75 kg, F mean = 67.2 kg (Rosenberg et al., 2006). Stature estimates = 1.5-1.7 meters (4'1111-5'7") (Conroy, 2005), M=169 cm (5'6.5"). F = 160 cm (5'3") (Stringer & Gamble 1993).
2.	Barrel-like chest cavity with broad scapula and large shoulder joint.
3.	Pelvis wide with by a long narrow pubic ramus
4.	hand with wide fingertips and strongly griping
5.	Femur and tibia have large spiphyses (end joints) with robust, cortically thick shafts (although not as thick as Homo eroctus). The radius and femur are curved antero-posteriorly. patella (kneecap) large and thick.
6.	Shorten distal limb segments (fore-arm and tibia)

lineage leading to Neanderthals

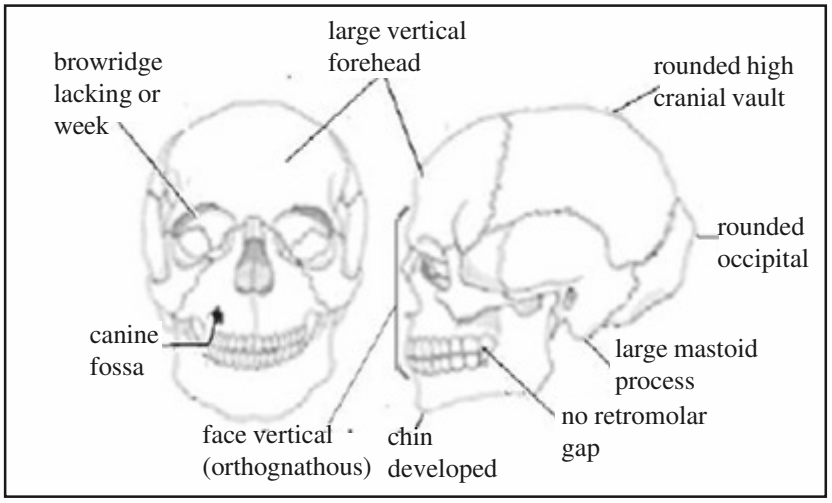
There are two specimens that date from 800 kya to 650 kya (Gran Dolina of Atapuerca Spain and Ceprano of Italy), somewhat from *Homo heidlebergensis* and placed into a separate species, *Homo antecessor*, but treated on the lineage leading to Neanderthals.

7) Anatomically Modern *Homo sapiens* (AMHS)

Modern *Homo sapiens* or earlier *Homo sapiens sapiens* (we) evolved with many changes over the archaic type that include the enlargement and rounding of the cranial vault by the expanding brain, at the same time reduction in the size of the face. Earlier view was that modern humans had not appeared until 35 – 40 Kya, but several fossils were discovered with modern features between 195 and 100 Kya in Africa and subsequently at 90 Kya in the Middle East.

Distribution

The specimens to represent modern humans or nearly modern humans include: at Omo, Herto, Klasies River Mouth Cave (Laetoli Hominid 18), and Ngaloba Border Cave in Africa, at Middle East (Israel), namely Qafzeh, and Skhul Caves, Chancelade and Cro-Magnon (France), Upper Cave of Zhoukoudian (China) or Lake Mungo (Australia).



Salient Features of Early Modern Humans

Morphology

Early AMHS were essentially like modern humans *albeit* somewhat more robust in some specimens. The salient features of these early modern humans are listed in the boxes below.

Cranial

1.	tall rounded cranial vault with a large brain, mean = 1349cc and EQ = 5.28, (Ruff, 1997)
2.	small, vertical face with canine fossa
3.	relatively vertical frontal bone (forehead)
4.	brow ridge development is absent or relatively small
5.	large mastoid process
6.	highly flex cranial base
7.	gently rounded occiput (no torus or bun)
8.	when viewed from behind the skull in widest near the top of the parietal region
9.	chin
10.	small teeth
11.	no retromolar gap

Postcranial

1.	generally less robust postcranial skeleton, mean body weight - F = 58kg (127.6 lbs), M = 49kg (107.8 lbs) (McHenry & Coffin, 2000) mean stature - F = 175cm (≈5'9"), M = 161 cm (≈5'3") (McHenry & Coffin, 2000)
2.	limb bones can vary from small and delicate to very large and robust however, they are still significantly less robust than earlier people
3.	scapula is characterized by a bisulcate or ventral sulcus on the lateral margin
4.	thumb distal phalange 2/3 the length of the proximal phalanx
5.	distal limb segments usually longer relative to entire limb
6.	cortical bone of the femur and tibia thinner than in earlier people
7.	pubic bone is shorter and thicker than that of the neanderthals

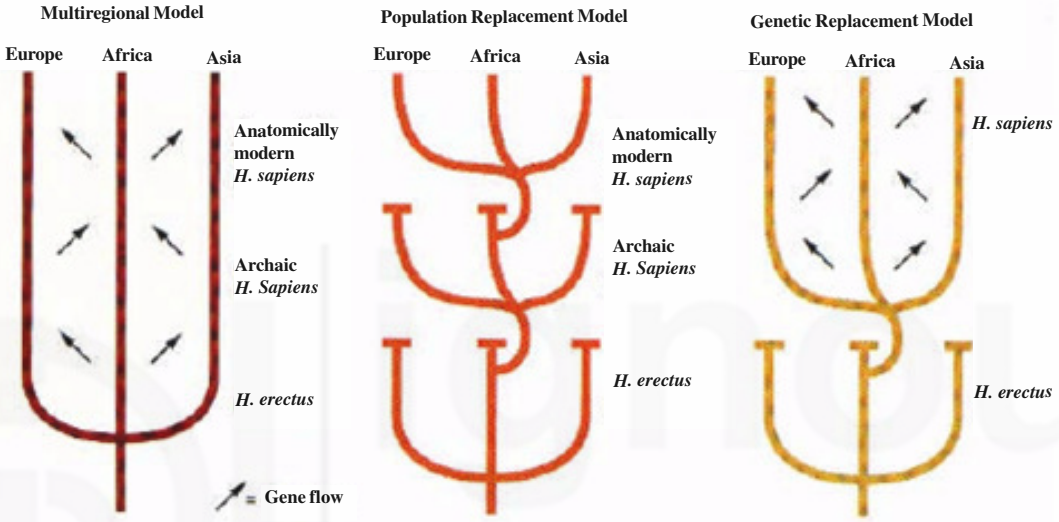
The fundamental question still debated in palaeoanthropology are where, when and how did modern humans arise. There are basically two models that address these questions:

1) **Multiregional Model:** It suggests that there was an early migration of *Homo erectus* to Asia, eventually into Europe, and during this period of geographic expansion, the hominin populations maintained enough gene flow between populations in the various regions of the world to preserve species integrity. This widely dispersed hominin population evolved from early *Homo erectus* to archaic and eventually into modern *Homo sapiens*. So, there is continuity of characteristics in each region shared by the entire humanity.

2) **Single Origin or Replacement or Out of Africa Model**

It postulates that hominins exited Africa early in the Pleistocene and occupied Asia and eventually Europe, and that gene flow was occurring within each region of the world but not extensively between the different regions. But, modern humans arose in Africa around 150 Kya, and later colonized Asia and Europe replacing the resident archaic populations of those regions. This model postulates that modern humans first evolved and there is no continuity of *Homo erectus* traits to archaic hominins to modern humans in each region of the world. One would also expect to see some overlap in resident archaic populations and the immigrant modern human populations.

Partial Replacement/Assimilation Model



It is basically the Out of Africa Model, but postulates some gene exchange between migrant modern humans and local archaic humans. This model still argues that most of our ancestry is African but it allows for some contribution of the more ancient local populations.

3.3 NARMADA MAN

Narmada Man, rather men, is known by the cranial and postcranial fossil remains representing two types of archaic hominins or human populations.

3.3.1 Cranial Remains

A partial right portion of the skullcap (calvaria) Narmada Man was discovered from Hathnora in Central Narmada valley during 1982 by Arun Sonakia of the Geological Survey of India, who reported the finding in 1984 in the *Records of the* Geological Survey of India. Detailed studies on it were conducted by M.A. de Lumley in France during 1985, and in USA during 1991 by Kenneth A.R. Kennedy. The calvaria show a mosaic of *H. erectus* and "archaic" H. *sapiens* characters. The main *Homo erectus* characters include:

1) Small mastoid process
2) Narrow post-orbital constriction
3) Maximum breadth across the mastoid
4) Prominent *torus angularis*

The important *Homo sapiens* characters traits include

1) A relatively high elevation of the cranial vault
2) The landmarks *bregma* and *vertex* are not coincident
3) The most posterior point in the instrumental calibration of maximum cranial length falls superior to the landmark *inion (*where it lies in *erectus* skulls)
4) The estimated cranial capacity is between 1155 and 1421 cubic centimetres. This on the contrary averages at about 1000 cubic centimeters in erectus.

Important "unique features" in Narmada Cavaria infrequent/absent in er*ectus* and modern *sapiens* are:

1) The furrowing of the sagittal ridge along the top of the Cranial Vault.
2) A large external auditory meatus (ear hole)
3) An unusually long temporal bone.

But, scholars remained divided on the status of Narmada calvaria as either "evolved" *H. erectus* or "archaic" *H. sapiens,* but, recently many favour it as H. heidlebergensis (for details see reference).

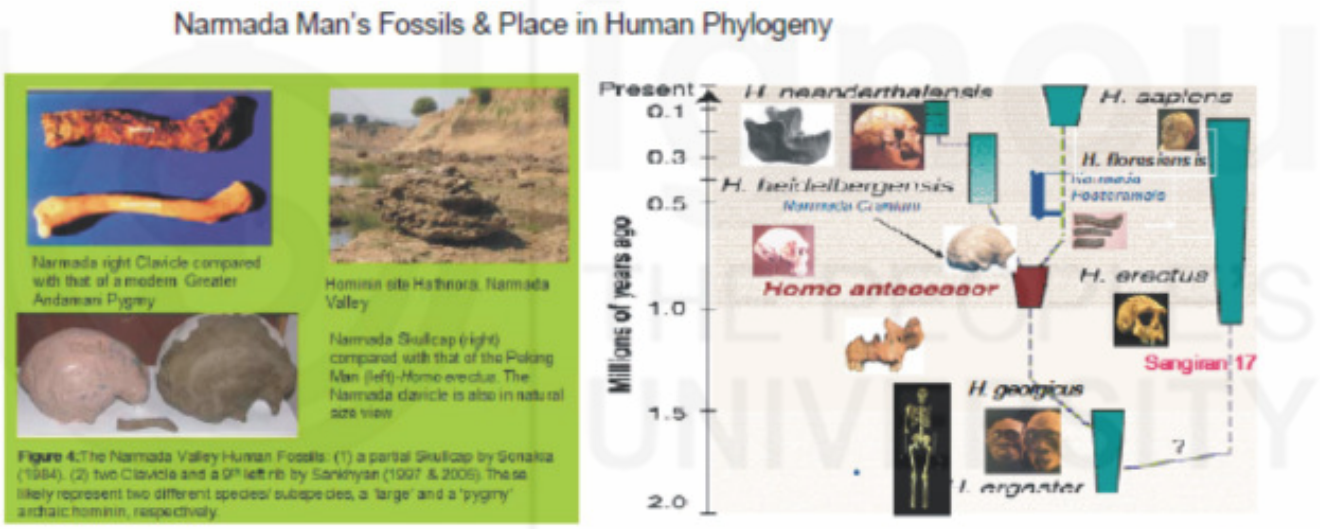


Figure 4:The Narmada Valley Human Fossils: (1) a partial Skullcap by Sonakia (1984). (2) two Clavicle and a 9th left rib by Sankhyan (1997 & 2005). These likely represent two different species/ subspecies, a 'large' and a 'pygmy' archaic hominin, respectively.

3.3.2 Postcranial Remains

Another discovery of Narmada Man was made by A. R. Sankhyan of the Anthropological Survey of India, reported in January 1997 in Journal of Human Evolution from the vicinity of the Calvaria site of Hathnora but slightly younger bed to it. It was of three postcranial fossils, namely right and left clavicles and a partial 9th left rib. These fossils revealed very short, robust and stocky archaic hominin, with a stature (134 cm) and shoulder width (30 cm) found in the shortest female Andaman Pygmy.

Thus, the cranial and postcranial bones from Narmada valley come from two types of Middle to Late Pleistocene archaic hominins. They were found associated with Late Acheulian handaxes, cleavers and choppers, and Middle Pleistocene mammalian fauna indicating about 250-200 Kya (for details see references).

3.4 SUMMARY

There is no science other than human palaeontology or palaeoanthropology which through the hard fossil evidences studies man as a species in time and space. It seeks to understand the natural origins of mankind and how humans are biologically and behaviourally related to other animals, e.g. the primates. After two centuries' struggle with orthodoxy, thanks to palaeoanthropology that we have now understood that we are the product of a long evolutionary past, and that the entire present humanity belongs to a single highly adaptive species, *Homo sapiens*, which could succeed over several species which went extinct during the course evolution. For over 10 million years we remained undifferentiated from the apes, and got splitted about eight million years ago. We were small-brained hominids until two million years ago, and acquired modern brain and physique just over 150,000 years back. Like the physique, human mind, myths, superstitions and other behaviours are also the products of evolution. Our evolutionary wisdom- a gift of palaeoanthropology-can potentially serve the humankind in a befitting way since it cuts across the continental, regional, racial, ethnic, cultural and socio-religious biases.

Suggested Reading

Kennedy, K. A.R. (2000). *God-Apes and Fossil men: the Paleoanthropology of South Asia.* Michigan: The University of Michigan Press.

Sankhyan, A.R. and Rao, V.R. (2007). *Human Origins, Genome & People of India: Genomic, Palaeontological & Archaeological Perspectives.* New Delhi: Allied Publishers.

Sankhyan, A R. (2009). *Asian Perspectives on Human Evolution*. New Delhi: Serials Publications.

Williams, B., Kay, R., & Kirk, E. (2010). *New Perspectives on Anthropoid Origins. Proceedings of National Academy of Sciences.*

Sample Questions

1) How would you define a Primate?
2) Which Primates were closer to humans?
3) Name the currently recognised last common Ape-Hominid ancestor in the fossil record?
4) Discuss the status of the Siwalik, European and African hominoids in understanding the last common ancestor.
5) Do fossil evidences support the Chimpanzee as the closest ape to man?
6) Discuss the Evolutionary hypotheses-'Out of Africa' 'African Eve' or 'Out of Asia' in brief.
7) Distinguish between the Multiregional and the Single Origin hypotheses.
8) Was *Homo erectus* a dead evolutionary end in Asia?
9) Who were the probable ancestors of Hobbits- *Homo floresiensis?*
10) What is the status of Narmada man/men in the broad Old World perspective of early human evolution?

11) Do the Cranial and Postcranial fossils of Narmada Man belong to a single species or archaic population?

Write short note on the following

i) Missing Link

ii) Heidelbergenesis