UNIVERSITY OF MALTA

Archaeology

Evidence for bipedal locomotion allows archaeologists and paleontologists to trace the evolution of the earliest humans. What other evidence is brought to bear on the matter?

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Human lineage is nothing but the fruit of evolution: our genealogical family tree demonstrates that our ancestors were in fact primates. The story of human evolution starts in Africa and dates back millions of years. Archaeologists and palaeontologists use the archaeological evidence obtained from these sites in order to provide us with a framework of the development of the human species.

In 1871, Charles Darwin, the father of the theory of the process of evolution by natural selection, proposed that humans and apes have a common ancestor. Thanks to anatomical and molecular studies we now know that 98% of African chimpanzee DNA is identical to that of humans. However, this does not mean that chimpanzees are our ancestors. This might however imply that we share a common ancestor. During the mid-Miocene period, around 8 million years ago, different apes dominated most of the African continent which was covered in lush vegetation. As these apes abounded in the African forests, their bodies adapted to the environment, hence developing grasping toes and joint mobility in arms and shoulders. These features provided them with brilliant surviving tools. By 6 million years ago, the world started experiencing a climate change which transformed these lush forests into open woodland. While most apes were becoming extinct, some were adapting to these changes in the environment. One of the species that was to adapt to these changes was to become our ancestor.

Early hominids that branched off since the last common ancestor are identified on one of the following two criteria: 1) postorbital evidence of bipedality, or 2) dentition which resembles that of later humans rather than that of apes. Having said that, before 4 million years ago the story is not so clear-cut: although the journey from *Sahelanthropus tchadensis* to *Ardipithecus ramidus* does see a change in dentition, dentition which gradually starts to resemble that of humans as one can see the appearance of enamel and small canines as well as the eventual emergence of premolars with a single cusp. Eventually these early hominids also came down from the trees and started walking on two legs.

Did bipedalism change the destiny of our ancestors? Our ancestors' footsteps are enshrined in Laetoli, Tanzania, where one can find footsteps dating back to 3 500 000 years ago. These footsteps were identified as an australopithecine's footsteps after finding a skeleton belonging to the same epoch. Indeed, the australopithecines slowly mastered bipedal locomotion, that which separated them from the other primates. Bipedal locomotion provided

them with a more efficient way of travelling. Bipedalism also meant having two free hands which enabled them to carry foods, to feed in an easier manner, to play, to put their hands in front of their eyes and hence with the aid of their opposable thumb and stereoscopic vision in colour they could manipulate objects and exploit their environment, eventually leading to making and using stone tools.

Yet, since the early hominids needed to keep their heads positioned in the mid-line of the body, their upper-body weight on the pelvis and the leg stable to support the weight of the body in order to maintain balance, bipedal locomotion also meant that their bodies had to undergo evolutionary changes. These evolutionary changes have deliberately played a huge role in determining the evolution of these australopithecines into us modern humans. Moreover, in order to acquire a profound understanding of these evolutionary changes, with the help of material culture, we must compare the early hominids' anatomy to ours.

The discovery of Lucy in 1974 proved to be a benchmark in archaeology. Even though only her partial skeleton survives, this petite female provides us with a mesmerizing insight of the past. This *Australopithecus afarensis* dates back 3.2million years ago, weighs 30kg and is 1metre tall; whilst males weighed 50kg and topped up 1.5m, thus suggesting sexual dimorphism. Her partial skeleton shows that her vertebral column already had human-like curvatures. Her foramen magnum demonstrates that with bipedalism came the change in the positioning of the skull: the skull was set on the spinal cord and did not just hang as can be seen in the other primates; this feature is still apparent in the modern humans. Although her walking patterns were not exactly identical to ours, her legs still had to undergo transformations due to walking upright: her knee could lock, her femur slanted inwards and her big toe was in line with her other toes; thus promoting bipedal locomotion. In order to maintain their balance, just like us modern humans, stability of the upper-body weight on the pelvis was required. Furthermore, even the pelvis had to undergo evolutionary changes: since it is closer to their new centre of gravity, the articular ball of the hip joint exerted only half of the pressure on the joint that a human's does. Debates between paleoanthropologists have arisen: some arguing that due to the long arms and the curved phalanges our early ancestors were partly arboreal, others claim that the foramen magnum, the broad and short pelvis, the femur with a long neck and the changed leg anatomy prove that they were committed to bipedal locomotion. Nonetheless, it is a fact that the Australopithecines' first steps have led to the evolution of the human species: as they walked upright, they moulded their destiny with their evolutionary anatomical changes which were to be passed on to us modern humans.

However, these evolutionary changes were not the only ones taking place during the course of time. As time unravelled itself, we can see that the stature of *Homo sapiens* is not the same as that of a chimpanzee, or even of that of an *Ardipithecus ramidus*. As said before, due to changes in the spine, changes of the centre of gravity, a change in the positioning of the foramen magnum, changes in the distribution of weight- hence, forcing changes in the pelvis as well as in leg anatomy, have drastically contributed to our present stature. This also means that the vital organs are exposed. *Homo sapiens* also had a barrel-shaped rib cage to the contrary of the conical shaped rib cage of apes and tree climbers. The early *Homo sapiens* must have been physically active unlike the Australopithecines; thus suggesting that *Homo* was a runner while the Australopithecines were a more physically-inactive species. This can be supported by the fact that the *Australopithecus* had a more 'stocky' build for their height, while *Homo sapiens* has more of an agile build of humans.

Since they were no longer climbing trees, the arms of *Homo sapiens* became much shorter whilst their legs got longer. Moreover, the ball and the joint of the femur were modified for easier mobility. The divergent toe of apes is lost in *Homo sapiens* and instead the big toe is perfectly aligned to the other toes. An arched foot in *Homo* instead of an ape-like flat foot also promotes walking. On the other hand, the anatomy of the hand did not change that much: *Homo sapiens'* hands still resemble primate hands, yet *Homo*'s hands are much shorter and straighter, so their grip was better than that of apes. Although they both had five digits, damaging one digit meant that the movement of the whole hand would be restricted. Undoubtedly so, the opposable thumb played an important role in having a good grip. *Homo habilis* was in fact the first to exploit the anatomy of his hand by producing stone tools. The Oldowan tools portray the extreme intelligence and skills of the early *Homo*.

The production of stone tools was however preceded by an expansion in brain size. As the front limbs became free, the hominids had a wider variety of food to choose from. *Homo habilis* has in fact consumed meat and this has thus led to a chain reaction. This increase in protein meant a bigger brain. It is because of this new found intelligence that the shift from instinct to reason was made possible. In return, this encephalization lead to a bigger skull which also experienced changes for example the gradual disappearance of the Sagittal Crest and of the brow ridges. This change in diet, coupled with the effect of having tools to do the job for them, also meant a change in dentition: the big incisors and canines of the *Australopithecus afarensis* were replaced by small, generalized enamel-covered teeth in *Homo* with the appearance of the two cusps on the lower premolar. Perhaps this larger brain

also put demands on the broadening of the hips as well as the change of the pelvis in order to better accommodate childbirth and to support the abdominal organs.

Another crucial step in the evolution of humans is the production of an articulated language. The left cerebral part of *Homo habilis* resembles the faculty of speech found in Homo sapiens. The throat anatomy of *Homo erectus* also suggests this possibility. The production of an articulated language facilitated the process of socialization amongst *Homo*- it helped them to organize their 'clans' and warn off predators, it enabled them to communicate their ideas and thoughts and to express their needs in a more accurate, way rather than relying on gestures, etc. Our articulated language is another huge evolutionary leap that separates us from the other living creatures on the planet.

By around half a million years ago, Homo sapiens was the only human species that survived and occupied most of the world. Homo, the species which has undergone so many evolutionary changes as it branched out from its ancestors whilst emerging victorious in the battle of the survival of the fittest, is still subject to the process of evolution. In the meantime, while some ponder about the future and wonder what might become of us and our planet, archaeologists and palaeontologists will keep shaking the pediments of our theories by discovering more treasuries concerning the human past.

Figure 1.A Australopithecine footsteps in Laetoli, Tanzani

(http://www.dinosoria.com/dossier020.htm)

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(http://www.dinosoria.com/dossier020.htm)

Figure 2 The partial skeleton of Lucy

(http://www.dinosoria.com/lucy_australopitheque.htm)

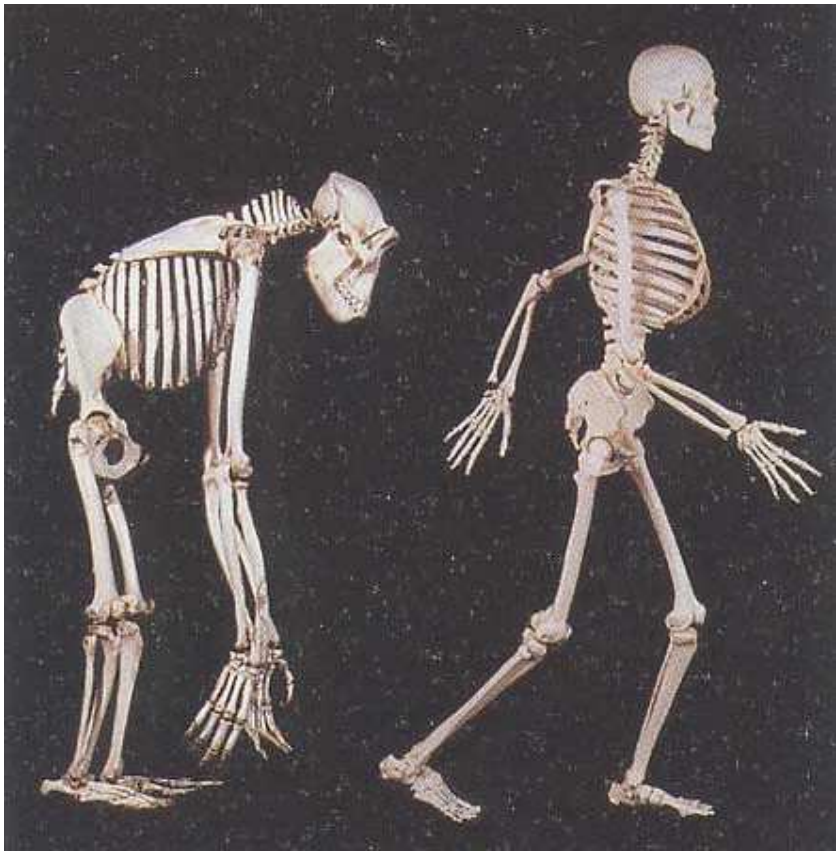

Figure 3 A gorilla on the left and a human being on the right.

(http://www.dinosoria.com/dossier020.htm)

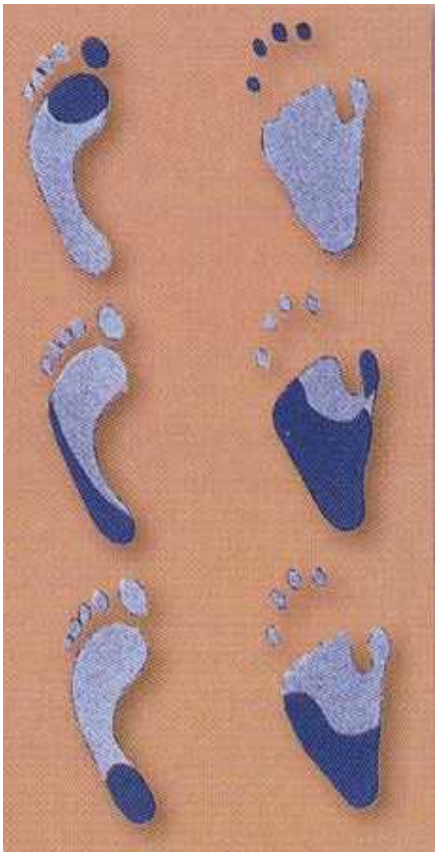

Figure 4 Reconstruction of the footsteps in Laetoli, Tanzania.

Footsteps of an Australopithecine on the left and that of a human being on the right.

(http://www.dinosoria.com/lucy_australopitheque.htm)

Figure 5 From left to right: a chimpanzee's hand, a gorilla's hand, a baboon's hand and a human hand.

(http://www.dinosoria.com/habilis_enfants.htm)

Figure 6 Oldowan stone tools

(http://www.lithiccastinglab.com/gallery-pages/oldowanstonetools.htm)

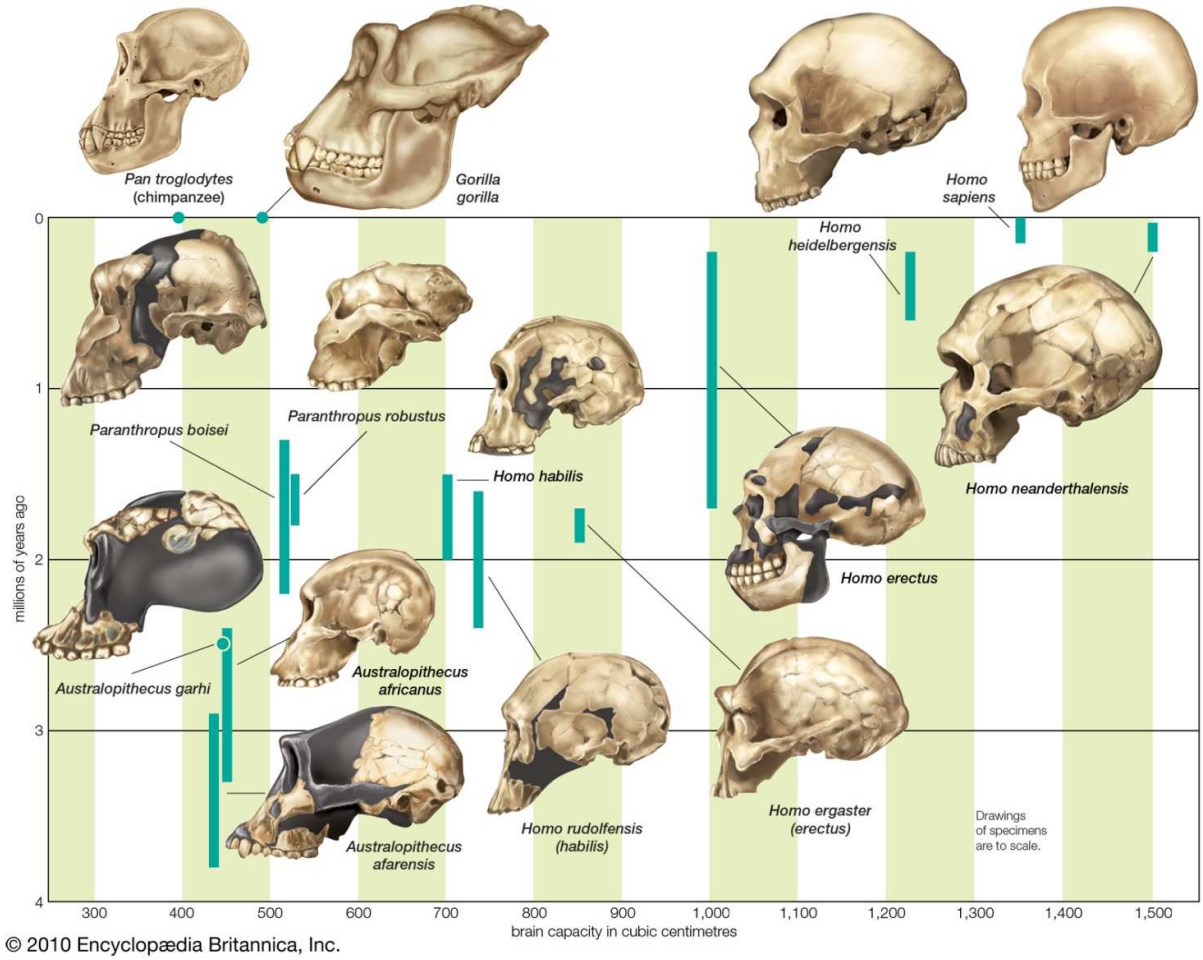

Figure 7 The increase in hominin cranial capacity over time

(http://www.britannica.com/EBchecked/media/71609/The-increase-in-hominin-cranial-capacity-over-time)

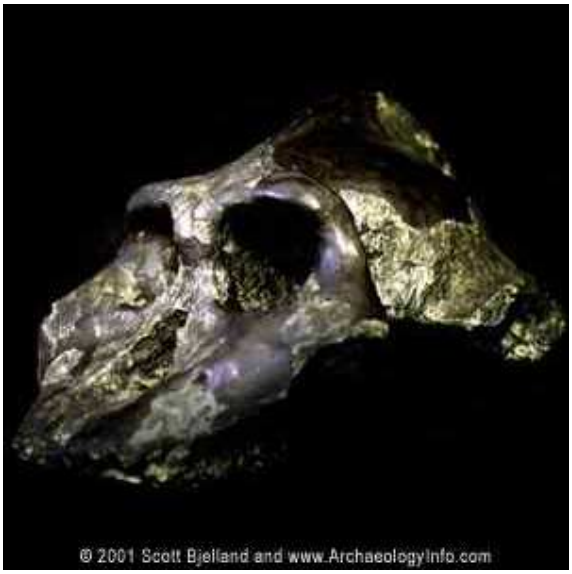

Figure 8 Sagittal Crest and Heavy brow ridges in *Australopithecus aethiopicus*

(http://www.archaeologyinfo.com/17000.htm)

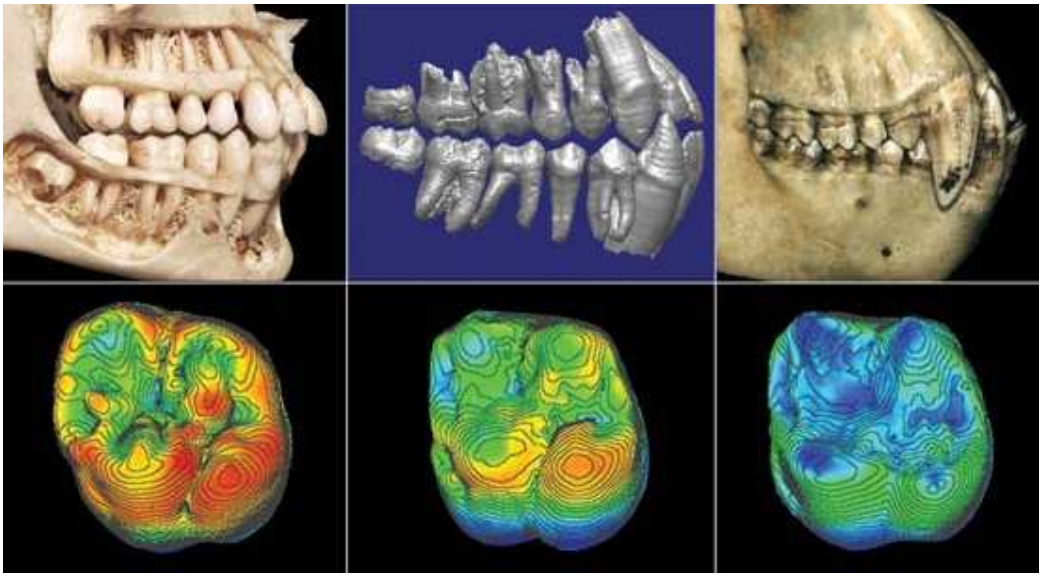

Figure 9 A comparison of images of dentition from *Homo sapiens sapiens* (left), *Ardipithecus ramidus* (middle), and *Pan troglodytes* (right). Red coloration (below) highlights regions of thick enamel in the corresponding samples of the maxillary first molar of each species.

(http://www.britannica.com/bps/media-view/137783/0/0/0)

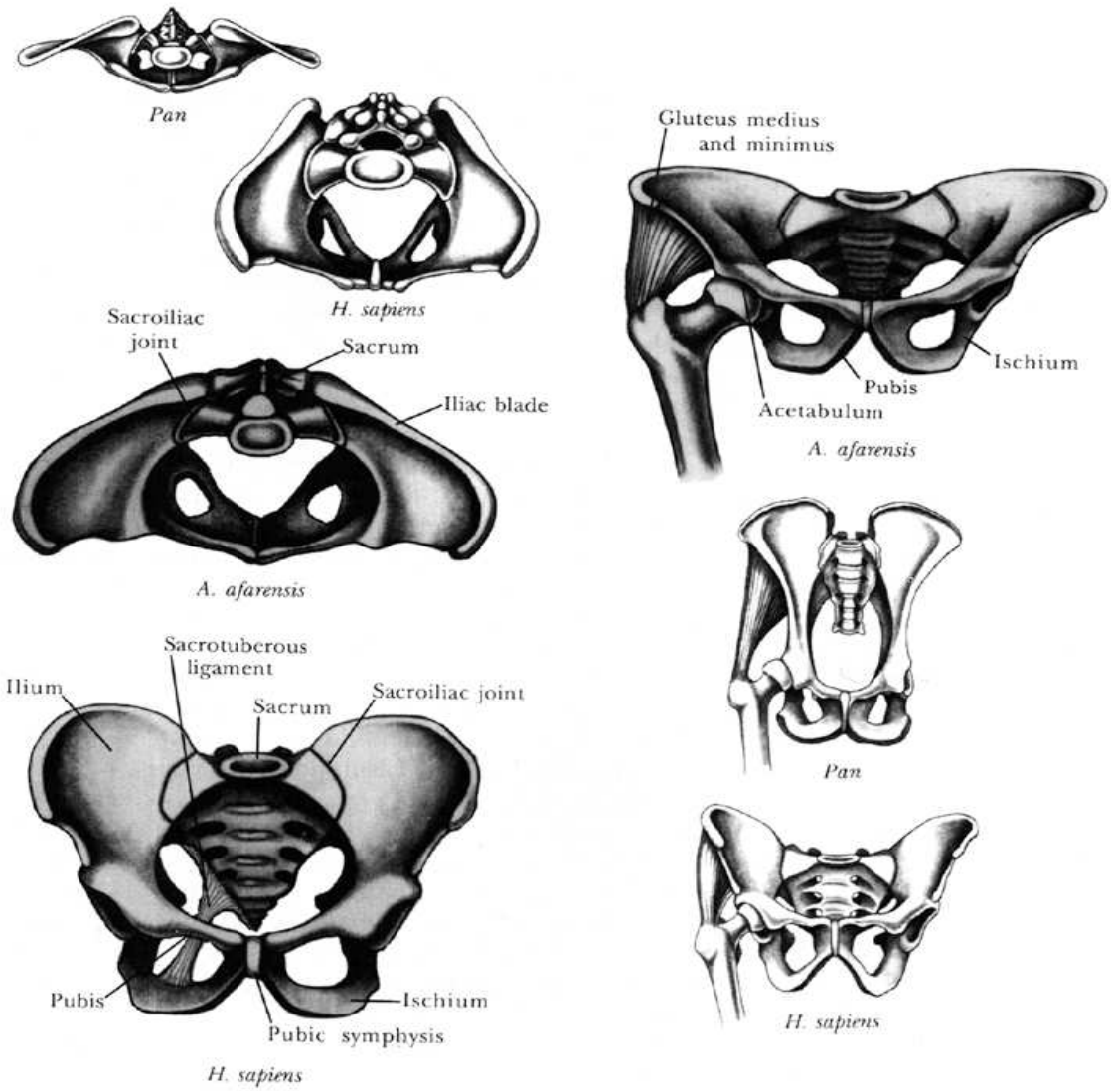

Figure 10 Pelvis Comparison

(Conroy 1990)