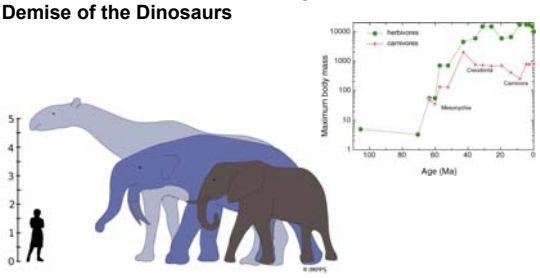
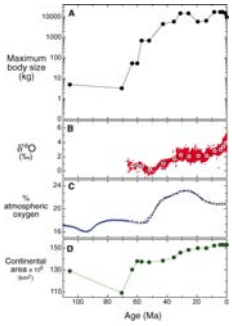
Mammals Grew 1,000 Times Larger After the Demise of the Dinosaurs



The largest land mammals that ever lived, Indricotherium and Deinotherium, would have towered over the living African Elephant. Indricotherium lived during the Eocene to the Oligocene Epoch (37 to 23 million years ago) and reached a mass of 15,000 kg, while Deinotherium was around from the late-Miocene until the early Pleistocene (8.5 to 2.7 million years ago) and weighed as much as 17,000 kg.

F A Smith et al. Science 2010;330:1216-1219

Fig. 3 Global fluctuations in maximum body size and various abiotic factors over the Cenozoic.



F A Smith et al. Science 2010;330:1216-1219

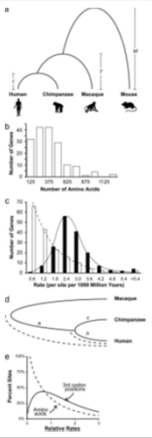
Science AAAS

Published by AAAS

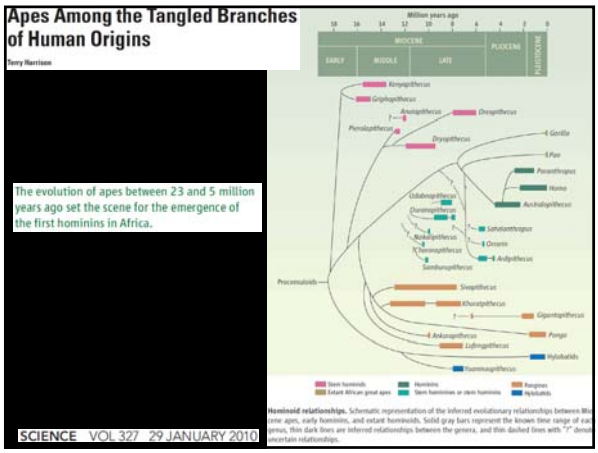
Placing confidence limits on the molecular age of the human–chimpanzee divergence

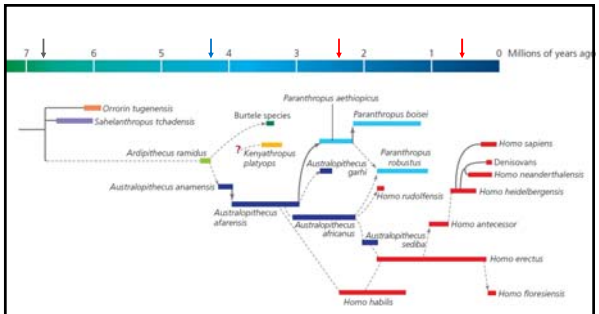
Data from 167 nuclear protein-coding genes, correcting for rate heterogeneity and using 23.8-35 MYA as the date for the Old world Monkey – Ape split as a calibration time, suggest that the 95% confidence interval for the human - chimpanzee divergence is:

- **4.98 – 7.02 MYA**



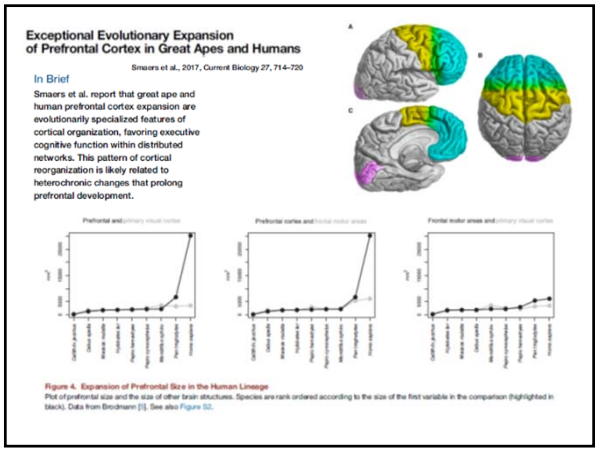
Kumar et al. 2005 *PNAS* 102:18842-18847





Roughly 20 different Hominin species have been described. Understanding the Phylogenetic relationships among these species remains a major research challenge.

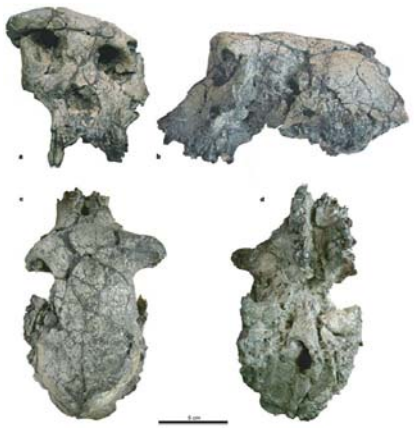
Fig. 17.5 Z&E



Sahelanthropus tchadensis

6-7 mya

2002 discovery of hominid from Chad with a mosaic of primitive (very small brain) and derived (small canines) features.



- ***Orrorin tugenensis* Femoral Morphology and the Evolution of Hominin Bipedalism**

Richmond & Jungers

Morphological comparisons among femora of or attributed to (**A**) *P. troglodytes*, (**B**) *O. tugenensis* (BAR 1002'00), (**C** and **D**) *Paranthropus robustus* (SK 97 and SK 82, reversed), (**E**) *A. afarensis* (A.L. 288-1ap), (**F**) *Paranthropus boisei* (KNM-ER 1503, reversed), (**G**) early *Homo* (KNM-ER 1481), and (**H**) modern *H. sapiens*. Like other early hominin femora (C to F), BAR 1002'00 (B) is distinct from those of modern humans (H) and great apes (A) in having a long, anteroposteriorly narrow neck and wide proximal shaft. Early *Homo* femora (G) have larger heads and broader necks compared to early hominins. In addition to these features, modern human femora (H) have short necks and mediolaterally narrow shafts. Scale bar, 2 cm

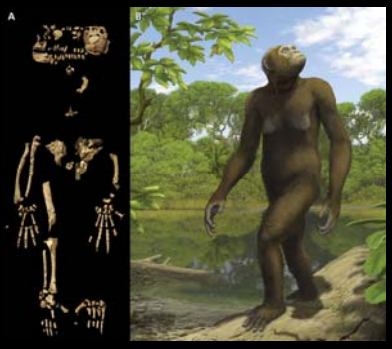
Bipedalism is a key human adaptation and a defining feature of the hominin clade. Fossil femora discovered in Kenya and attributed to *Orrorin tugenensis*, at **6 million years ago**, purportedly provide the earliest postcranial evidence of hominin bipedalism, but their functional and phylogenetic affinities are controversial. We show that the *O. tugenensis* femur differs from those of apes and *Homo* and most strongly resembles those of *Australopithecus* and *Paranthropus*, indicating that *O. tugenensis* was bipedal but is not more closely related to *Homo* than to *Australopithecus*. Femoral morphology indicates that *O. tugenensis* shared distinctive hip biomechanics with australopiths, suggesting that this complex evolved early in human evolution and persisted for almost 4 million years until modifications of the hip appeared in the late Pliocene in early *Homo*.

Science 21 March 2008:
Vol. 319. no. 5870, pp. 1662 - 1665

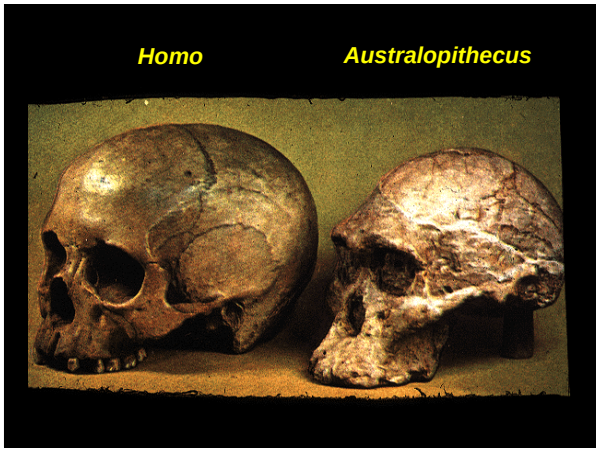
Ardipithecus ramidus

- **4.5 mya**
- **Soon after the human-chimp split**
- **More ape-like than Australopithecus**

Ardipithecus ramidus (4.4 mya) adapted for both bipedal walking and arboreal life



***Ardipithecus* fossils from 5.3 - 5.8 mya**
On the lineage to modern chimpanzee???



Earliest Homonids

- ***Australopithecus anamensis*** **3.9 – 4.2 mya**
- ***A. afarensis*** **'Lucy"** **3.0 – 3.9 mya**
- ***A. africanus*** **&** ***A. garhi*** **2.4 – 2.8 mya**
- ***A. robustus / boisei / aethiopicus*** **1.0 – 2.7 mya**

"Lucy"

Australopithecus afarensis

3 mya

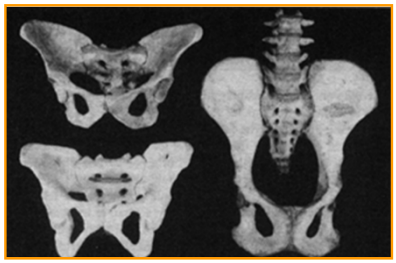
Laetoli Tracks - 3 mya

- **Lack of a splayed big toe suggests full bipedalism by 3 mya**

- **Lack of a splayed big toe suggests full bipedalism by 3 mya**

= bipedality in *A. afarensis*

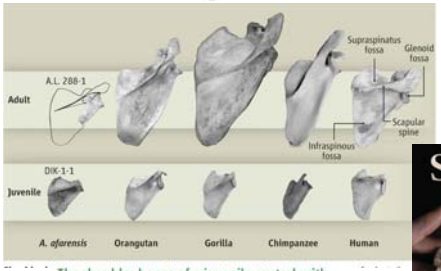
Lucy



Modern Human Chimp

Recent analysis of fossil wrist bones suggest the *A. afarensis* may have occasionally used knuckle walking like modern chimps and gorillas.

Did Australopiths Climb Trees?

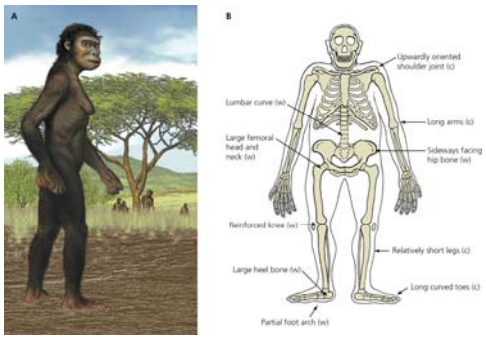


The shoulder bones of a juvenile australopith resemble those of extant apes, suggesting that tree climbing continued to be important for these bipedal early human ancestors.

Science AAAS

***Australopithecus afarensis* Scapular Ontogeny, Function, and the Role of Climbing in Human Evolution**
David J. Green and Zeresenay Alemseged
Science **338**, 514 (2012);
DOI: 10.1126/science.1227123

- Changing environment may have selected for transition to bipedalism



- *Australopithecus* shows a mixture of traits adapted for walking (w) and for climbing (c)

Fig 17.11 Z&E

Lucy's 'Big Brother' Reveals New Facets of Her Species

An early *Australopithecus afarensis* postcranium from Woranso-Mille, Ethiopia

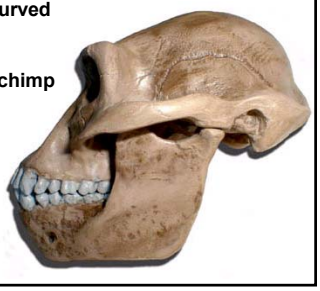
Haile-Selassie et al.

Dated to 3.6 million years ago,the robust male stood between 1.5 and 1.7 meters tall, **about 30% larger than Lucy**. Isolated bones of other individuals suggest that some males were even larger, so the new skeleton doesn't settle a long-standing debate *over just how much sexual dimorphism there was in A. afarensis*

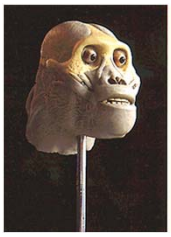
PNAS | July 6, 2010 | vol. 107 | no. 27 | 12121–12126

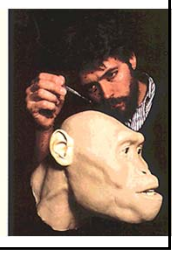
Australopithecus afarensis

- **~4 ft. tall (sexually dimorphic?)**
- **Mixed Bipedal / climbing, curved phalanges**
- **Brain size MUCH closer to chimp than Modern Human**

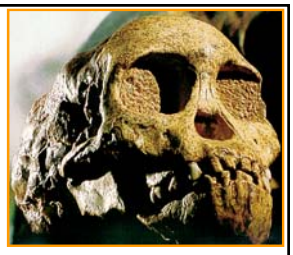


RECONSTRUCTIONS BASED ON MUSCLE ATTACHMENTS





A. africanus



2.5 mya "Taung" child

Approx. 3-4 years old

A. africanus

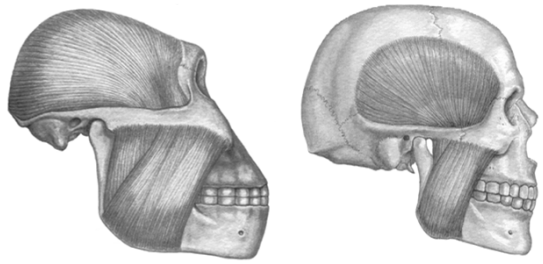
Robust Australopithecines: *Paranthropus*

P. aethiopicus
2.6 mya

P. boisei
2.6 - 1.0 mya

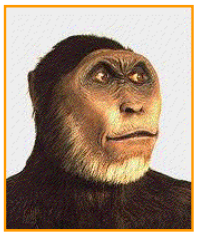
P. robustus
2.0 – 1.2 mya

- Large sagittal crests, massive jaw muscles and teeth
- Small brains
- Number of biological species???



P. boisei

2.6 - 1.0 mya



P. aethiopicus

The "Black Skull"

Kenya

2.5 mya

***Australopithecus sediba*: A New Species of *Homo*-Like Australopith from South Africa**

Lee R. Berger,[1,2]* Darryl J. de Ruiter,[1,3] Steven E. Churchill,[4,1] Peter Schmid,[5,1] Kristian J. Carlson,[1,6] Paul H. G. M. Dirks,[2,7] Job M. Kibii[8]

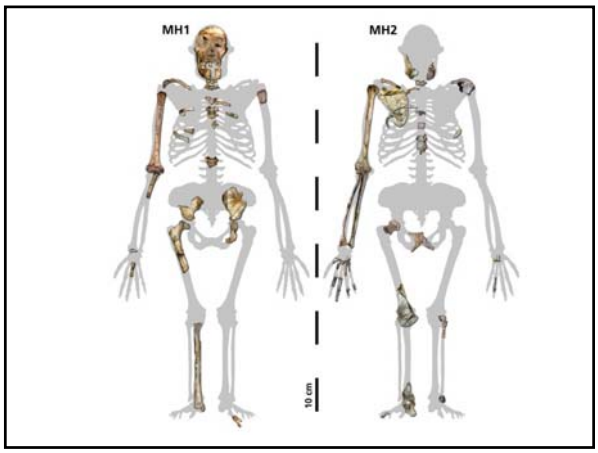
Despite a rich African Plio-Pleistocene hominin fossil record, the ancestry of *Homo* and its relation to earlier australopithecines remain unresolved. Here we report on two partial skeletons with an age of 1.95 to 1.78 million years. The fossils were encased in cave deposits at the Malapa site in South Africa. The skeletons were found close together and are directly associated with craniodental remains. Together they represent a new species of *Australopithecus* that is probably descended from *Australopithecus africanus*. Combined craniodental and postcranial evidence demonstrates that this new species shares more derived features with early *Homo* than any other australopith species and thus might help reveal the ancestor of that genus.

Science **328**, 195 (2010)

Australopithecus sediba

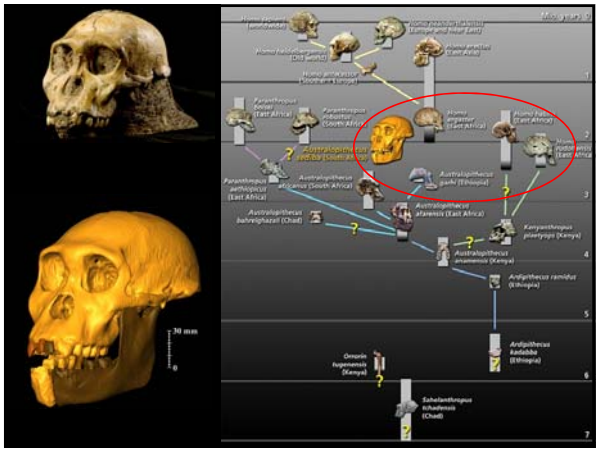
1.98 mya

Implications for the Origins of the Genus *Homo*



Pelvic tilt. The pelvic blades of *Au. africanus* (*left*) flare more widely than those of the younger *Au. sediba* from South Africa (*right*; reconstructed parts are in gray or white).

Au. sediba's hand has some humanlike traits, but its arm is long and primitive.



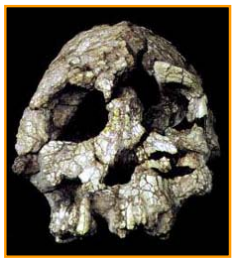
Australophitecus garhi
(n=1)

Possible ancestor to Homo?

2.5 mya from eastern Africa

HOMONID FROM 3.5 MYA

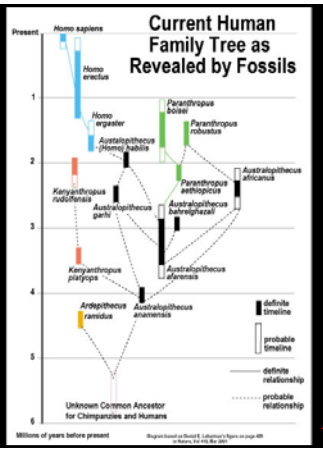
- **Mosaic of primitive and derive characters**
- **Flat face and smallish teeth**



Kenyanthropus platyops

MULTIPLE HOMONID SPECIES BETWEEN 3.5 – 2.0 MYA

K. platyops ***K. rudolfensis***



- Multiple co-occurring hominid species
- Early co-occurrance

Sahelanthropus tchadensis

6-7 mya