

# Mammals

Derived traits of mammals: Mammary glands, Hair, Big Brains, Differentiated Teeth

Evolutionary trends of mammals

Monotremes, Marsupials, and Eutherians (lots of evolutionary convergence!)

Primate groups

Anthropoids/Hominoids = ALL extant and extinct monkeys and apes

Hominids = ALL extant and extinct Great Apes (i.e., not Gibbons)

Hominins = ALL extant and extinct critters along human line (after split from chimps)

Evolutionary trends of hominins

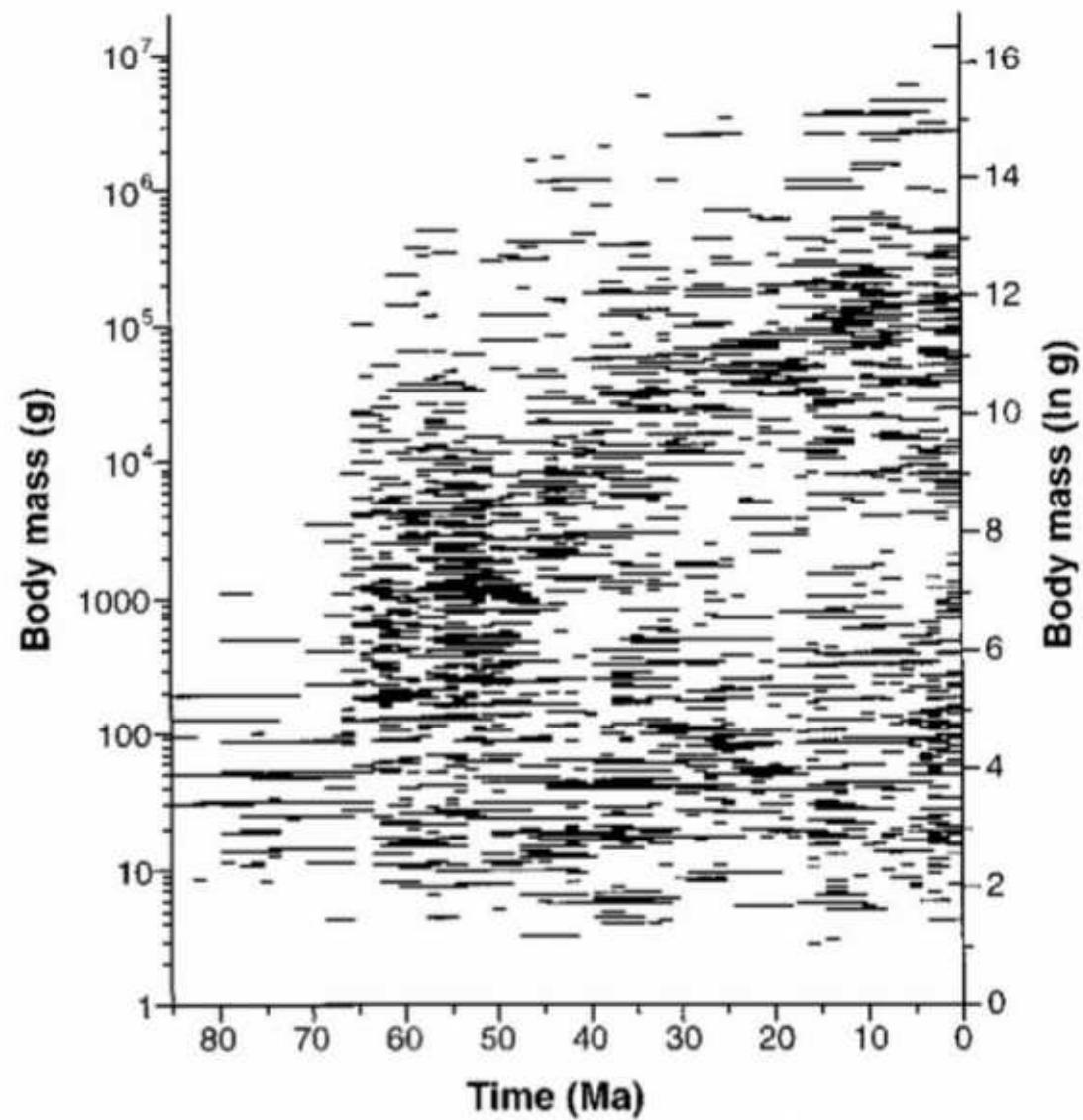
*H. neanderthalensis* – Evidence for interbreeding with *H. sapiens*

Hominin expansion from Africa

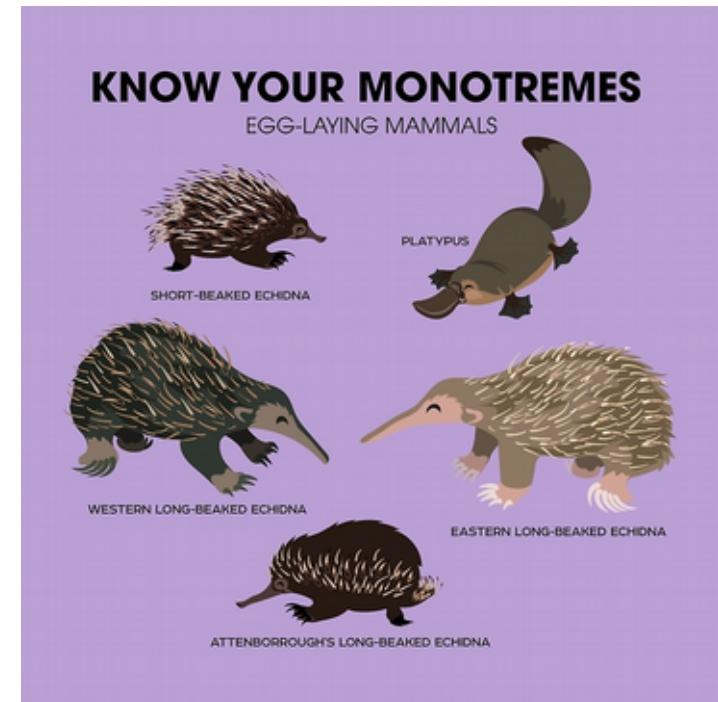
# Derived Characters of Mammals

- Mammals, class Mammalia, are represented by more than 5,300 species.
- *Mammals have*
  - *Mammary glands, which produce milk*
  - *Hair*
  - *A larger brain than other vertebrates of equivalent size*
  - *Differentiated teeth.*

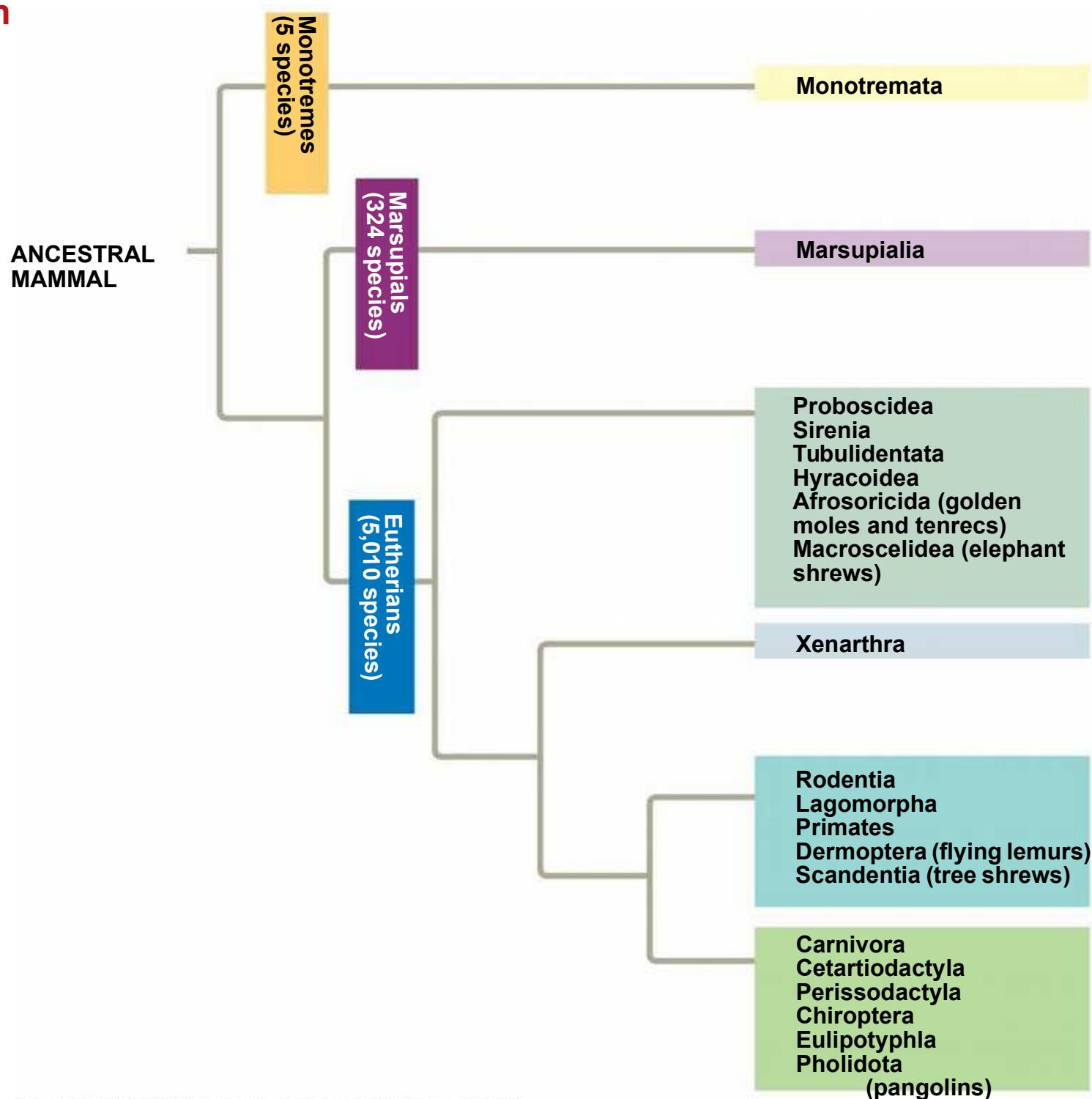
# Mammal body mass



- By the early Cretaceous, the three living lineages of mammals emerged:
  - Monotremes
  - Marsupials
  - Eutherians.



# Mammalian Diversity



## an Australian monotreme



# Marsupials

- **Marsupials** include opossums, kangaroos, and koalas.
- The embryo develops within a **placenta** in the mother's uterus.
- A marsupial is born very early in its development. It completes its embryonic development while nursing in a maternal pouch called a marsupium.

# Australian marsupials

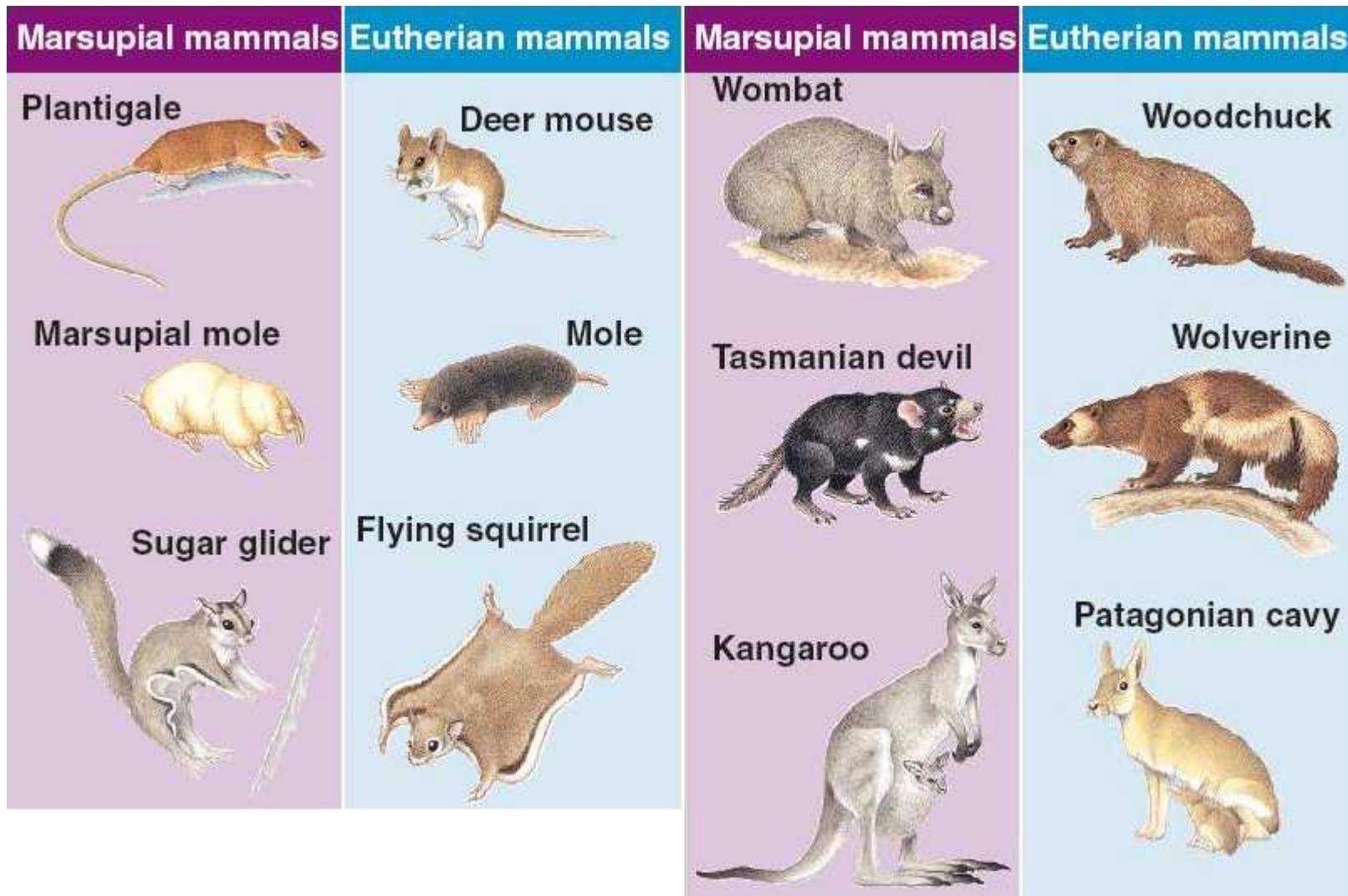


(a) A young brushtail possum



(b) Long-nosed bandicoot

# Evolutionary convergence of marsupials and placental mammals



# Eutherians - Placental Mammals

- Compared with marsupials, **eutherians = placental mammals** have a longer period of pregnancy.
- *Young complete their embryonic development within a uterus, joined to the mother by the placenta.*
- Molecular and morphological data give conflicting dates on the diversification of eutherians.
- In Australia, convergent evolution has resulted in a diversity of marsupials that resemble the eutherians in other parts of the world.

# Mammalian diversity

Orders and Examples	Main Characteristics	Orders and Examples	Main Characteristics
<b>Monotremata</b> Platypuses, echidnas	Lay eggs; no nipples; young suck milk from fur of mother  Echidna	<b>Marsupialia</b> Kangaroos, opossums, koalas	Embryo completes development in pouch on mother  Koala
<b>Proboscidea</b> Elephants	Long, muscular trunk; thick, loose skin; upper incisors elongated as tusks  African elephant	<b>Tubulidentata</b> Aardvarks	Teeth consisting of many thin tubes cemented together; eats ants and termites  Aardvark
<b>Sirenia</b> Manatees, dugongs	Aquatic; finlike forelimbs and no hind limbs; herbivorous  Manatee	<b>Hyracoidea</b> Hyraxes	Short legs; stumpy tail; herbivorous; complex, multichambered stomach  Rock hyrax
<b>Xenarthra</b> Sloths, anteaters, armadillos	Reduced teeth or no teeth; herbivorous (sloths) or carnivorous (anteaters, armadillos)  Tamandua	<b>Rodentia</b> Squirrels, beavers, rats, porcupines, mice	Chisel-like, continuously growing incisors worn down by gnawing; herbivorous  Red squirrel
<b>Lagomorpha</b> Rabbits, hares, pikas	Chisel-like incisors; hind legs longer than forelegs and adapted for running and jumping; herbivorous  Jackrabbit	<b>Primates</b> Lemurs, monkeys, chimpanzees, gorillas, humans	Opposable thumbs; forward-facing eyes; well-developed cerebral cortex; omnivorous  Golden lion tamarin
<b>Carnivora</b> Dogs, wolves, bears, cats, weasels, otters, seals, walruses	Sharp, pointed canine teeth and molars for shearing; carnivorous  Coyote	<b>Perissodactyla</b> Horses, zebras, tapirs, rhinoceroses	Hooves with an odd number of toes on each foot; herbivorous  Indian rhinoceros
<b>Cetartiodactyla</b> <b>Artiodactyla</b> Sheep, pigs, cattle, deer, giraffes	Hooves with an even number of toes on each foot; herbivorous  Bighorn sheep	<b>Chiroptera</b> Bats	Adapted for flight; broad skinfold that extends from elongated fingers to body and legs; carnivorous or herbivorous  Frog-eating bat
<b>Cetaceans</b> Whales, dolphins, porpoises	Aquatic; streamlined body; paddle-like forelimbs and no hind limbs; thick layer of insulating blubber; carnivorous  Pacific white-sided porpoise	<b>Eulipotyphla</b> "Core insectivores"; some moles, some shrews	Diet consists mainly of insects and other small invertebrates  Star-nosed mole

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 Coyote		 Indian rhinoceros	
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 Pacific white-sided porpoise		 Star-nosed mole	



# Primate groups

Lemurs



Monkeys



Lorisises



Apes



Tarsiers



# Primate groups

Lemurs



Monkeys



Lorisises



Apes



Tarsiers



“Anthropoids”





# Nonhuman apes

Gibbons



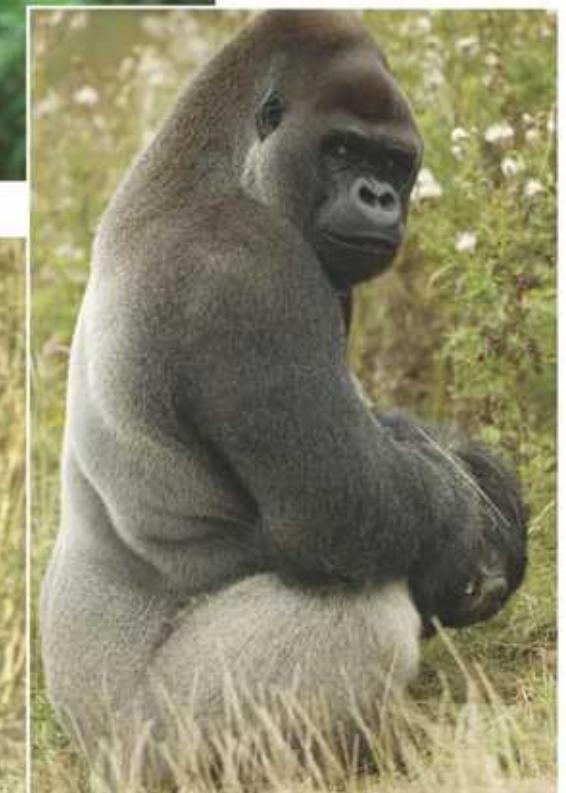
Cimpanzees



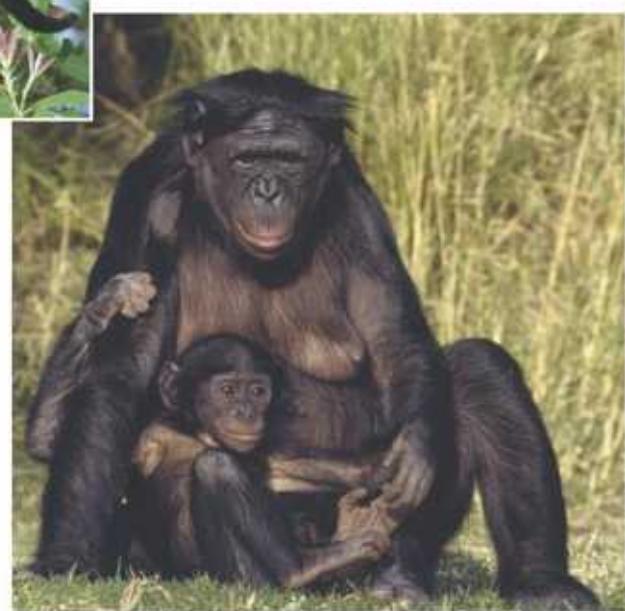
Orangutans



Gorillas



Bonobos



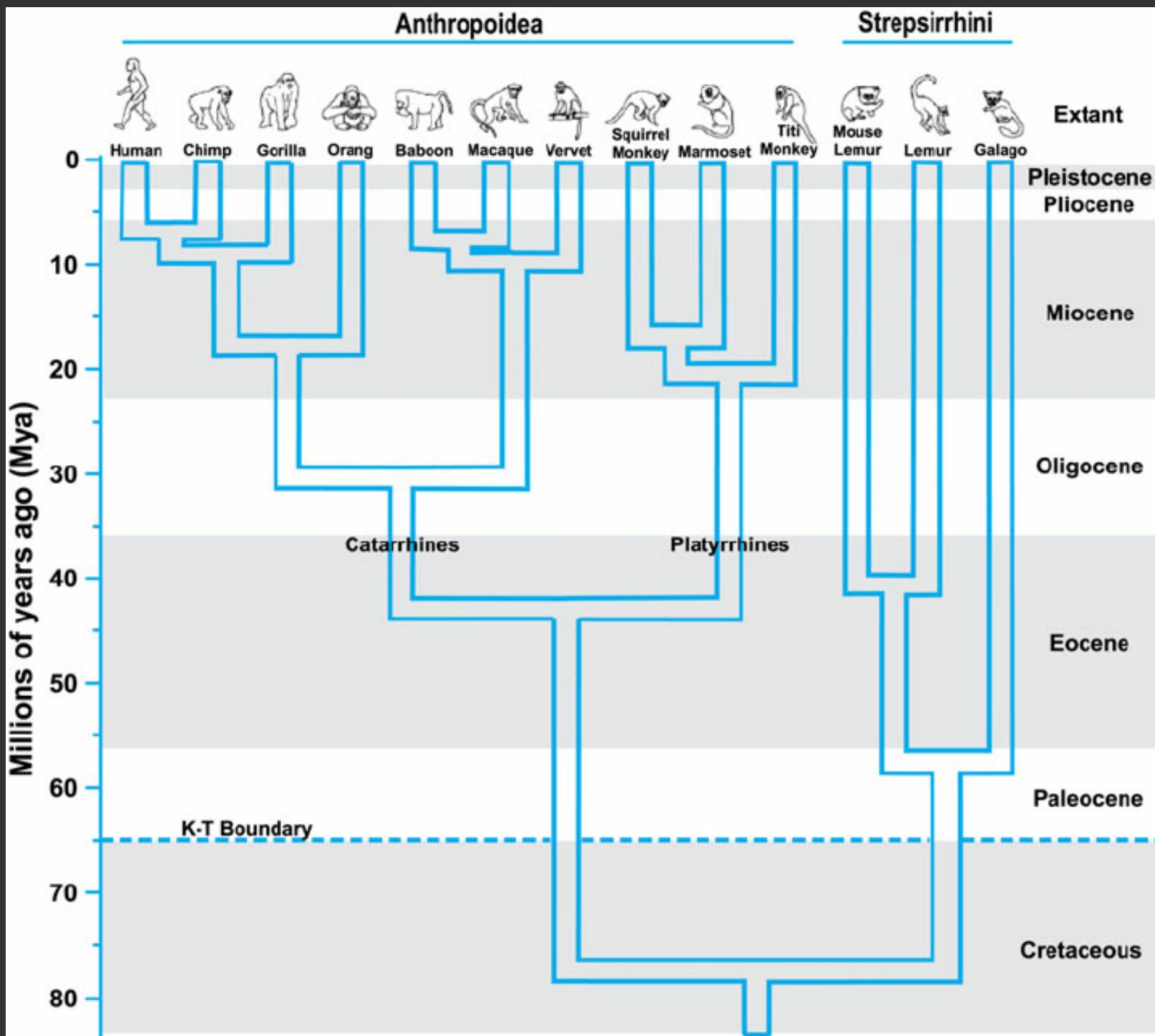
# Allopatric speciation (~2 MYA)

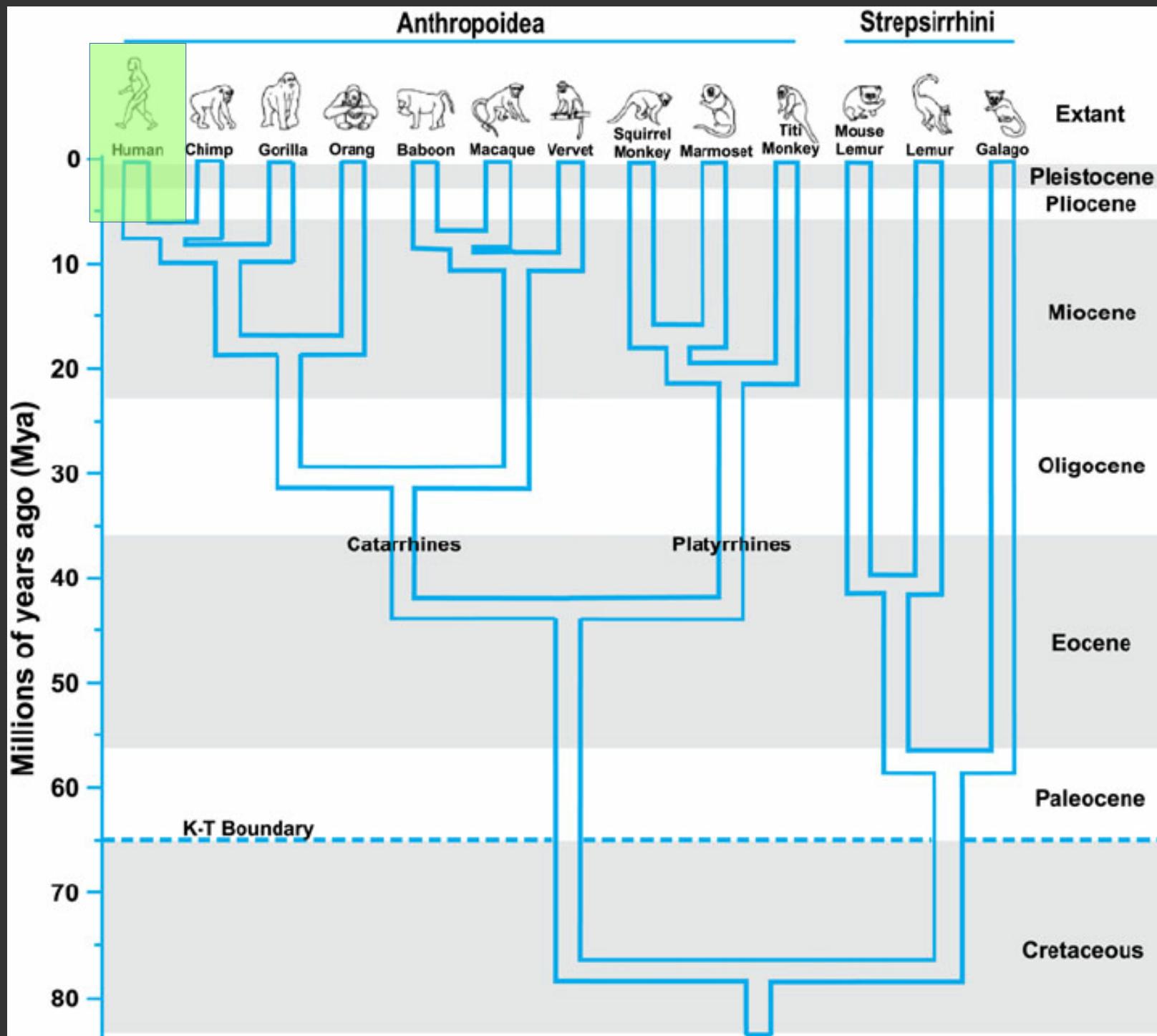


Bonobo (*Pan paniscus*)



Chimpanzee (*Pan troglodytes*)

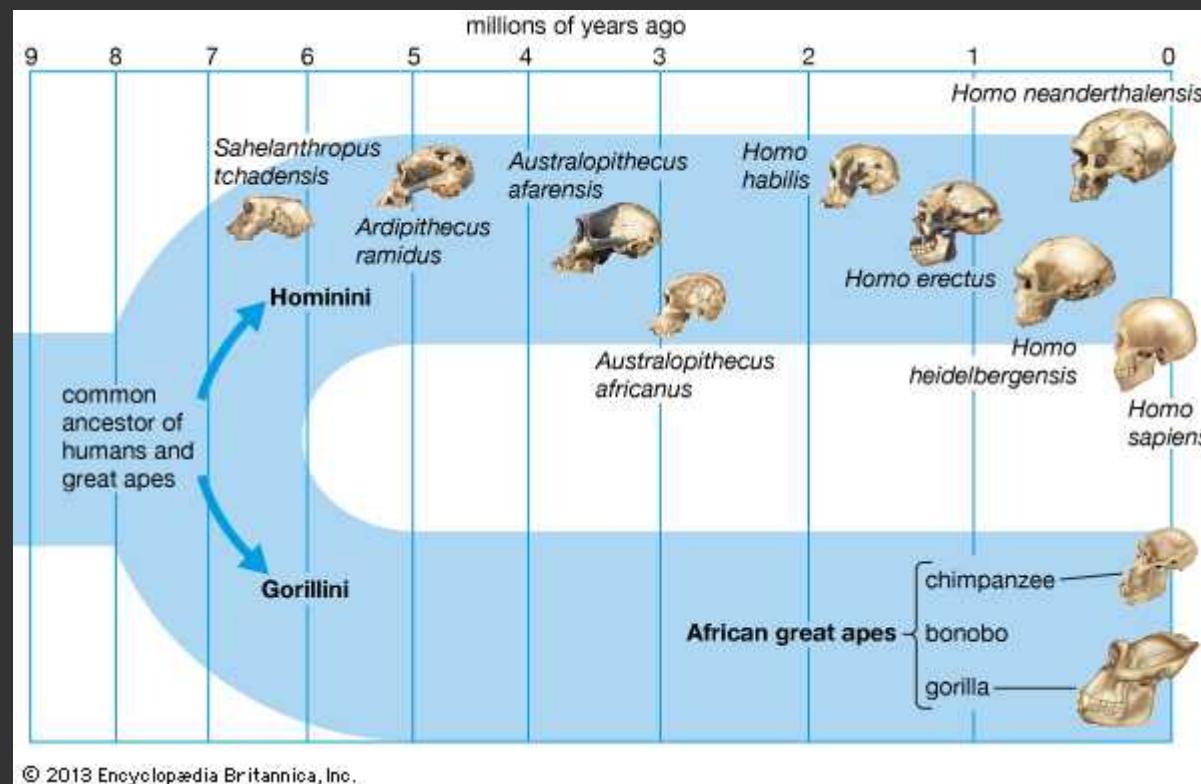




# Hominins

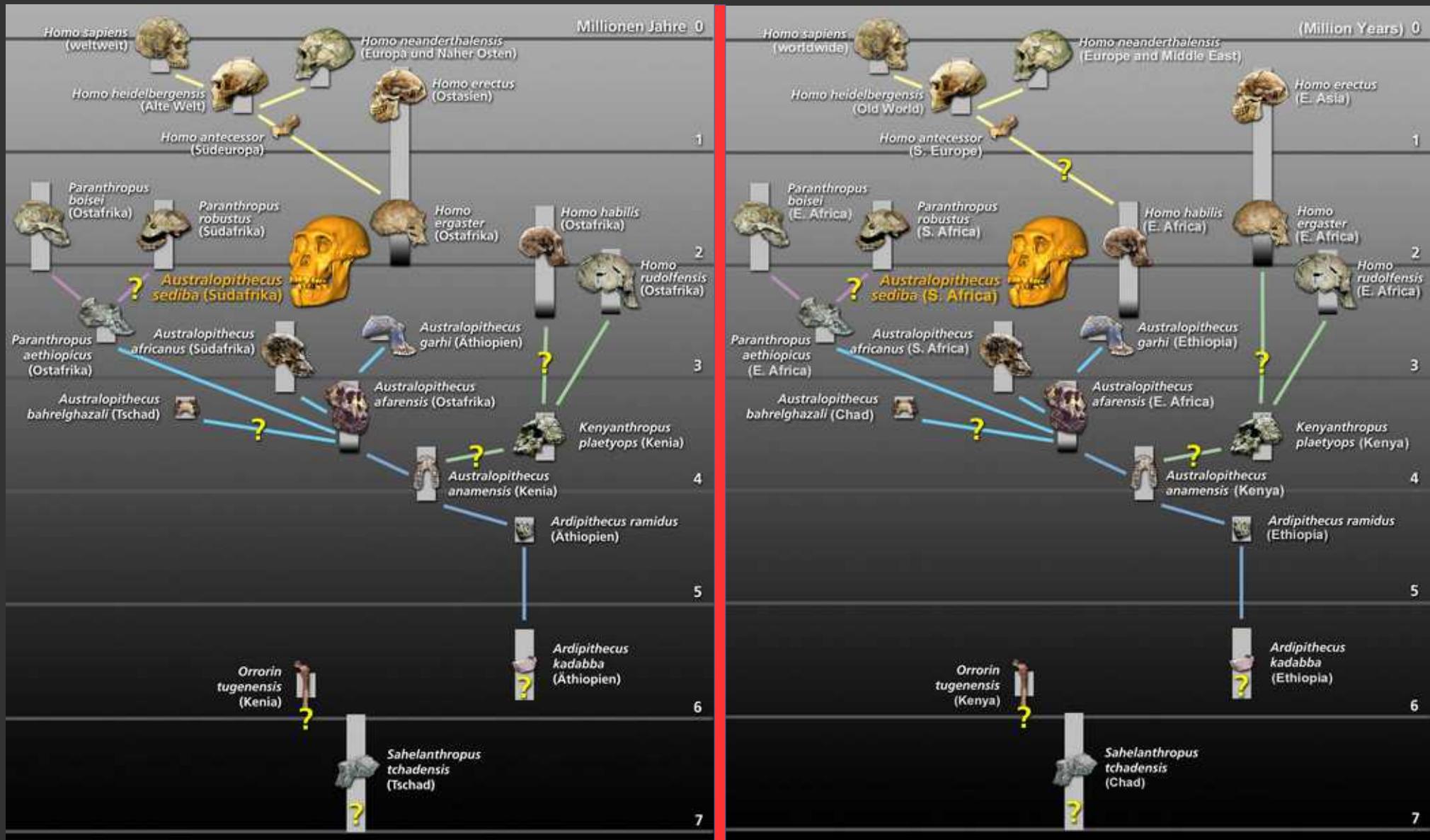
Apes that are more closely related to humans than they are to chimpanzees

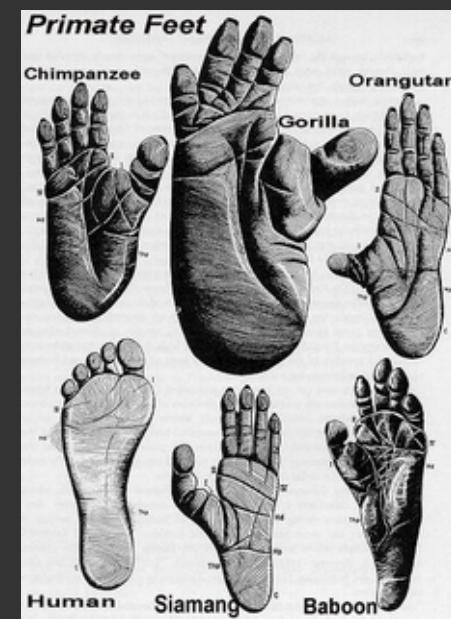
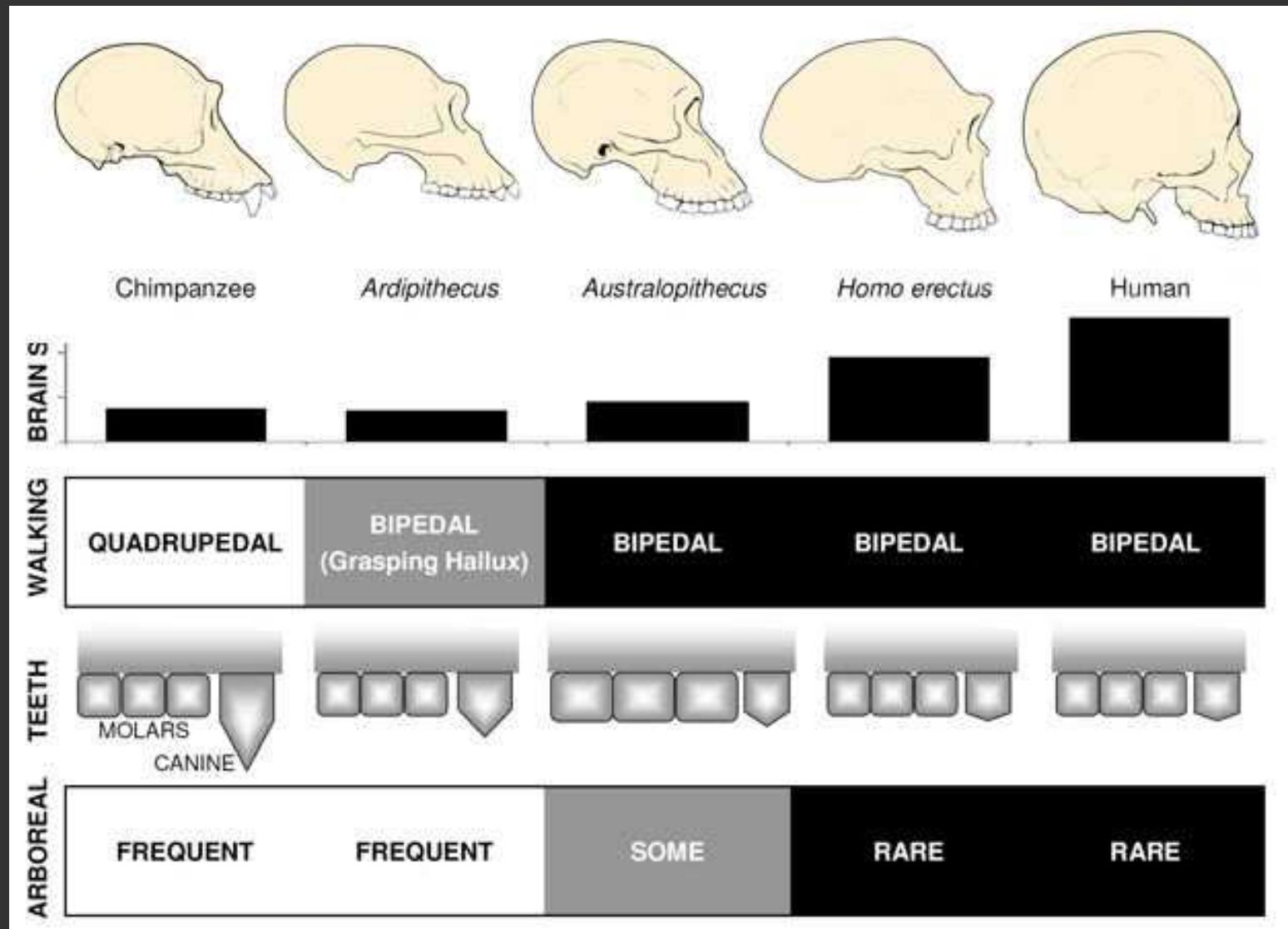
“Big brains and bipedal”



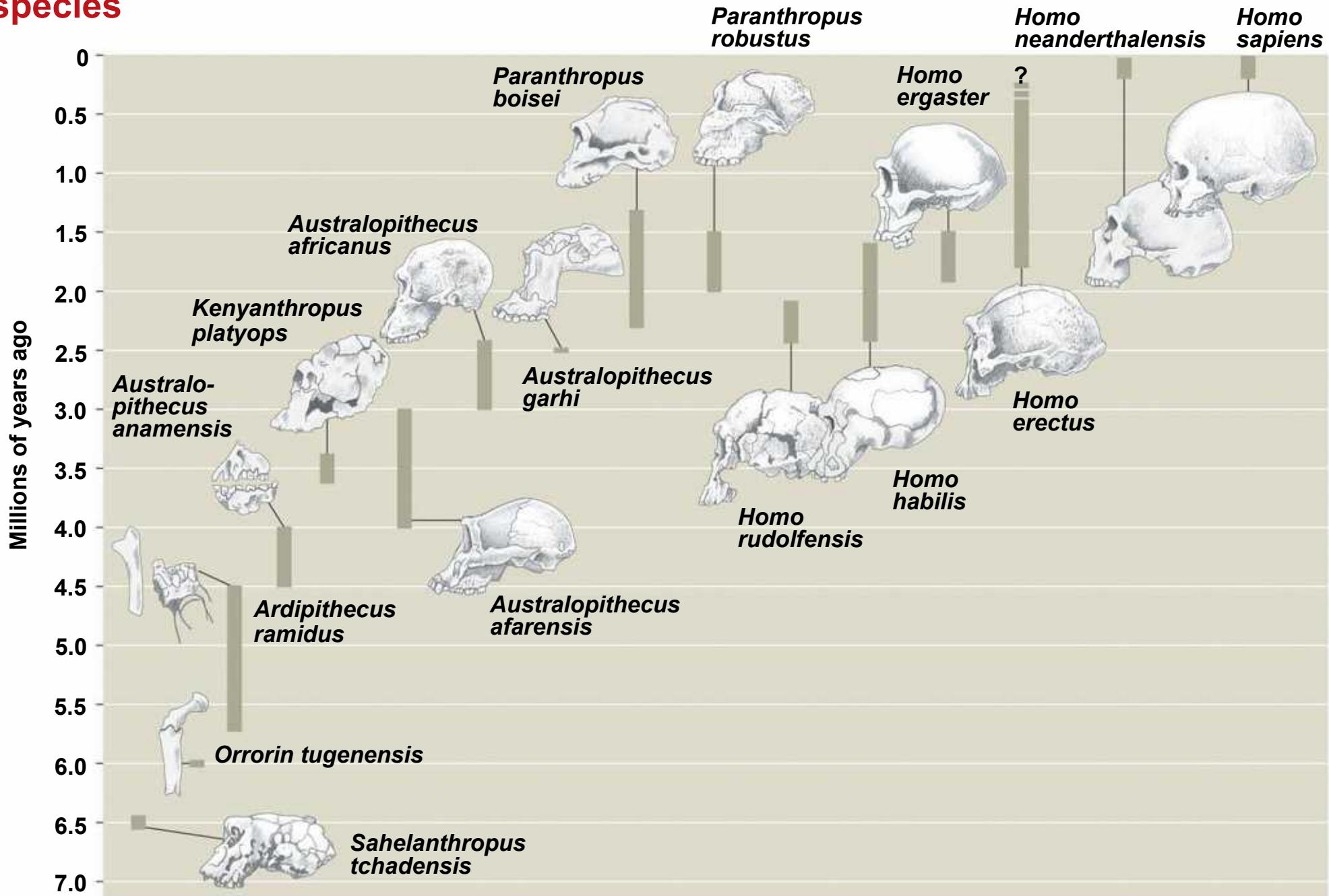
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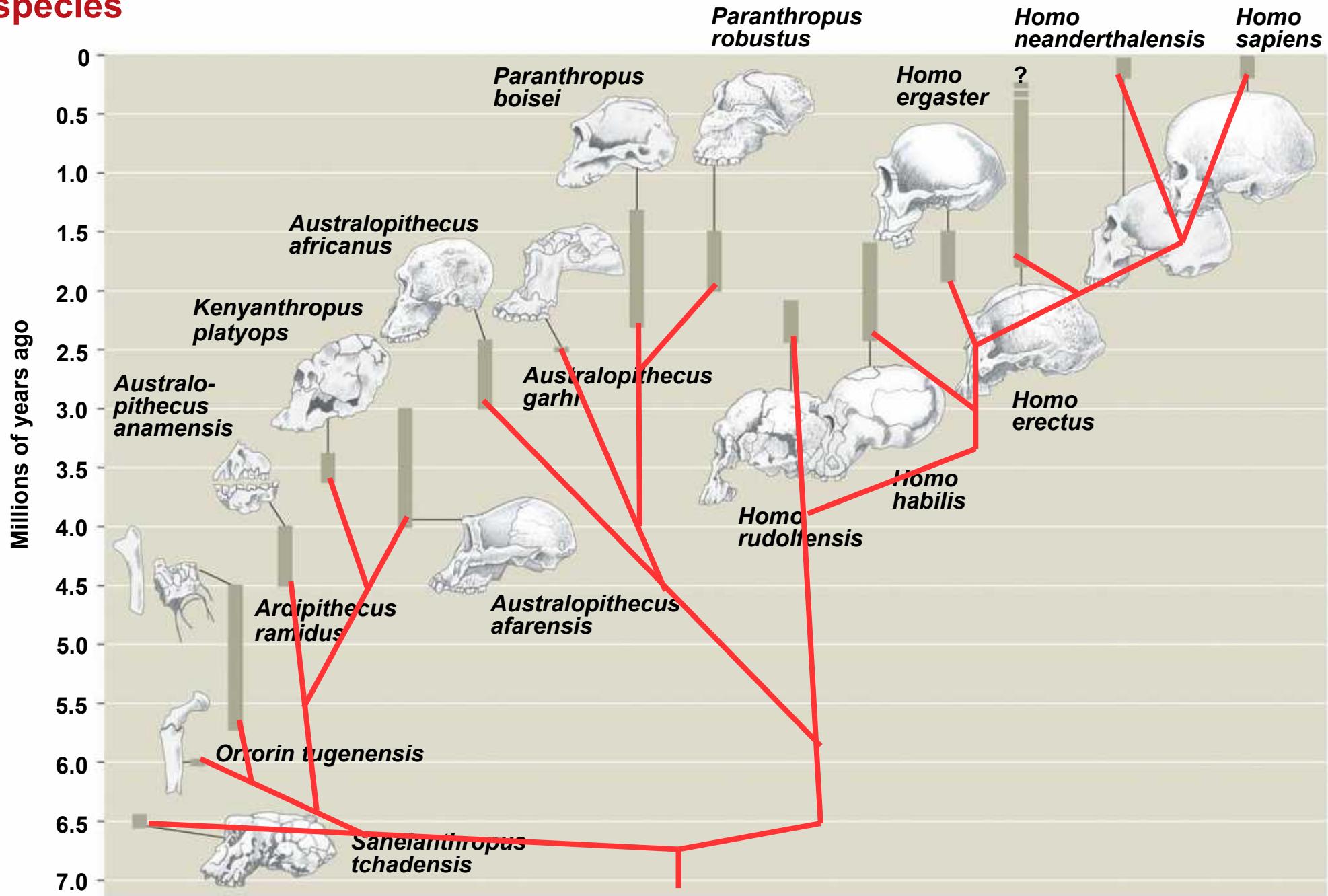




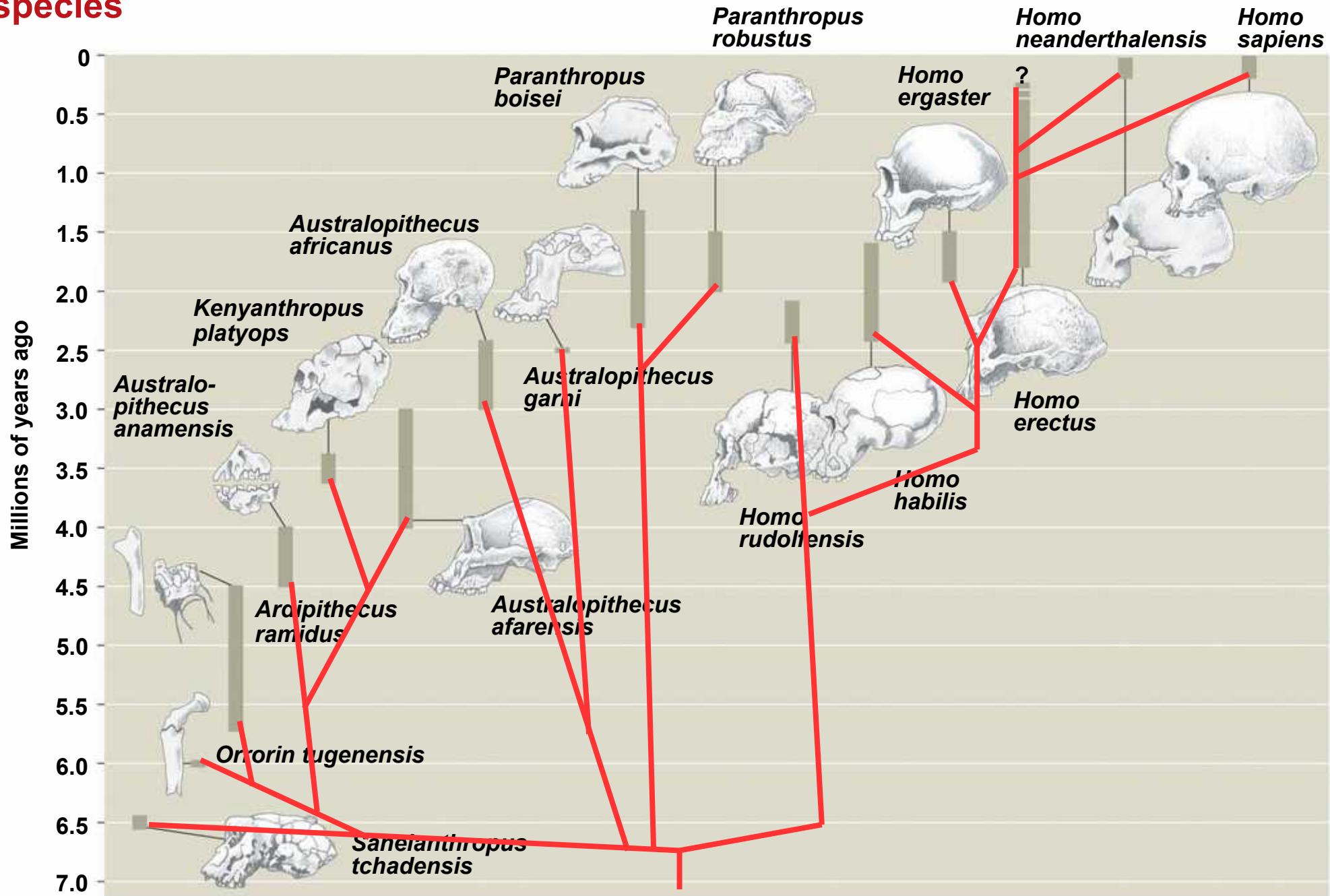
# A timeline for some selected hominin species



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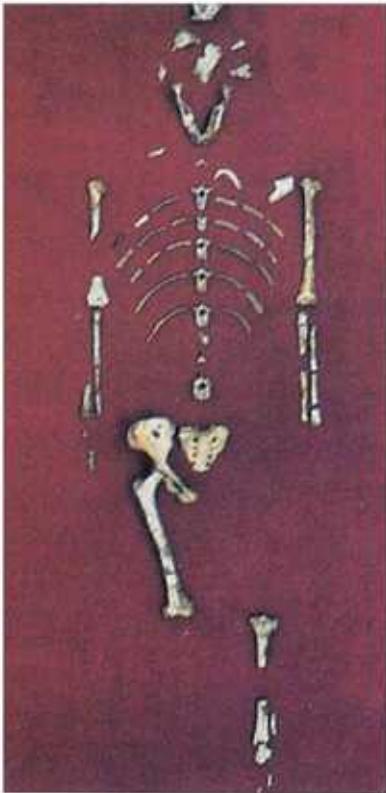


# A timeline for some selected hominin species



- Hominins originated in Africa about 6–7 million years ago
- Early hominins had a small brain but probably walked upright.
- Two common misconceptions about early hominins:
  - Thinking of them as chimpanzees
  - Imagining human evolution as a ladder leading directly to *Homo sapiens*.

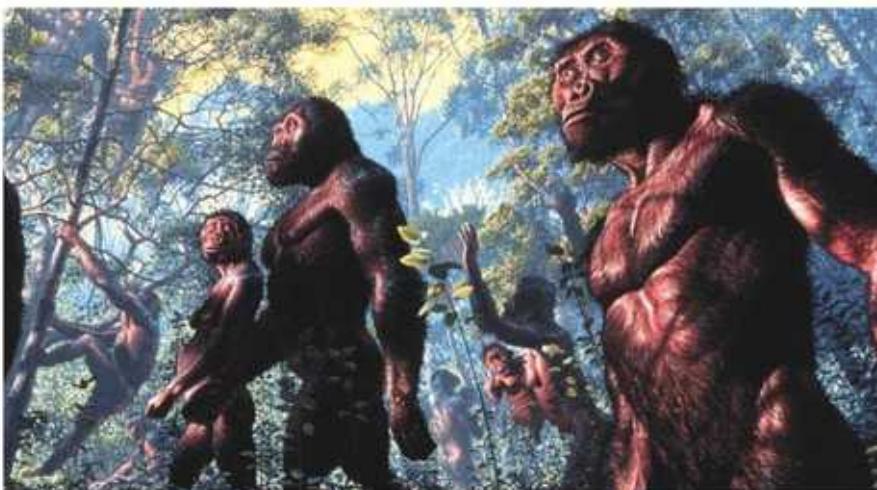
# Upright posture predates an enlarged brain in human evolution



(a) *Australopithecus afarensis* skeleton



(b) The Laetoli footprints



(c) An artist's reconstruction of what *A. afarensis* may have looked like

# Bipedalism & Tool Use

- Hominins began to walk long distances on two legs about 1.9 million years ago.
- The oldest evidence of tool use, cut marks on animal bones, is 2.5 million years old.
- The earliest fossils placed in our genus *Homo* are those of *Homo habilis*, ranging in age from about 2.4 to 1.6 million years.
- Stone tools have been found with *H. habilis*, giving this species its name, which means “handy man.”

- ***Homo erectus*** originated in Africa by 1.8 million years ago
- It was the first hominin to leave Africa.
- ***Neanderthals***, *Homo neanderthalensis*, lived in Europe and the Near East from 200,000 to 28,000 years ago.
  - They were thick-boned with a larger brain

# *Homo Sapiens*

- *Homo sapiens* appeared in Africa by 195,000(??) years ago.
- All living humans are descended from these African ancestors.
- The oldest fossils of *Homo sapiens* outside Africa date back about 115,000 years and are from the Middle East.
- Humans first arrived in the Western Hemisphere sometime before 15,000 years ago.

160,000-year-old fossil of *Homo sapiens*



- Rapid expansion of our species may have been preceded by changes to the brain that made cognitive innovations possible.
  - For example, the ***FOXP2 gene is essential for human language***, and underwent intense natural selection during the last 200,000 years.
- *Homo sapiens* and *H. neanderthalis* were the only hominin groups to show evidence of symbolic and sophisticated thought (so far).

# 40,000 - 30,000 years ago



*Homo sapiens* - "The man who knows"



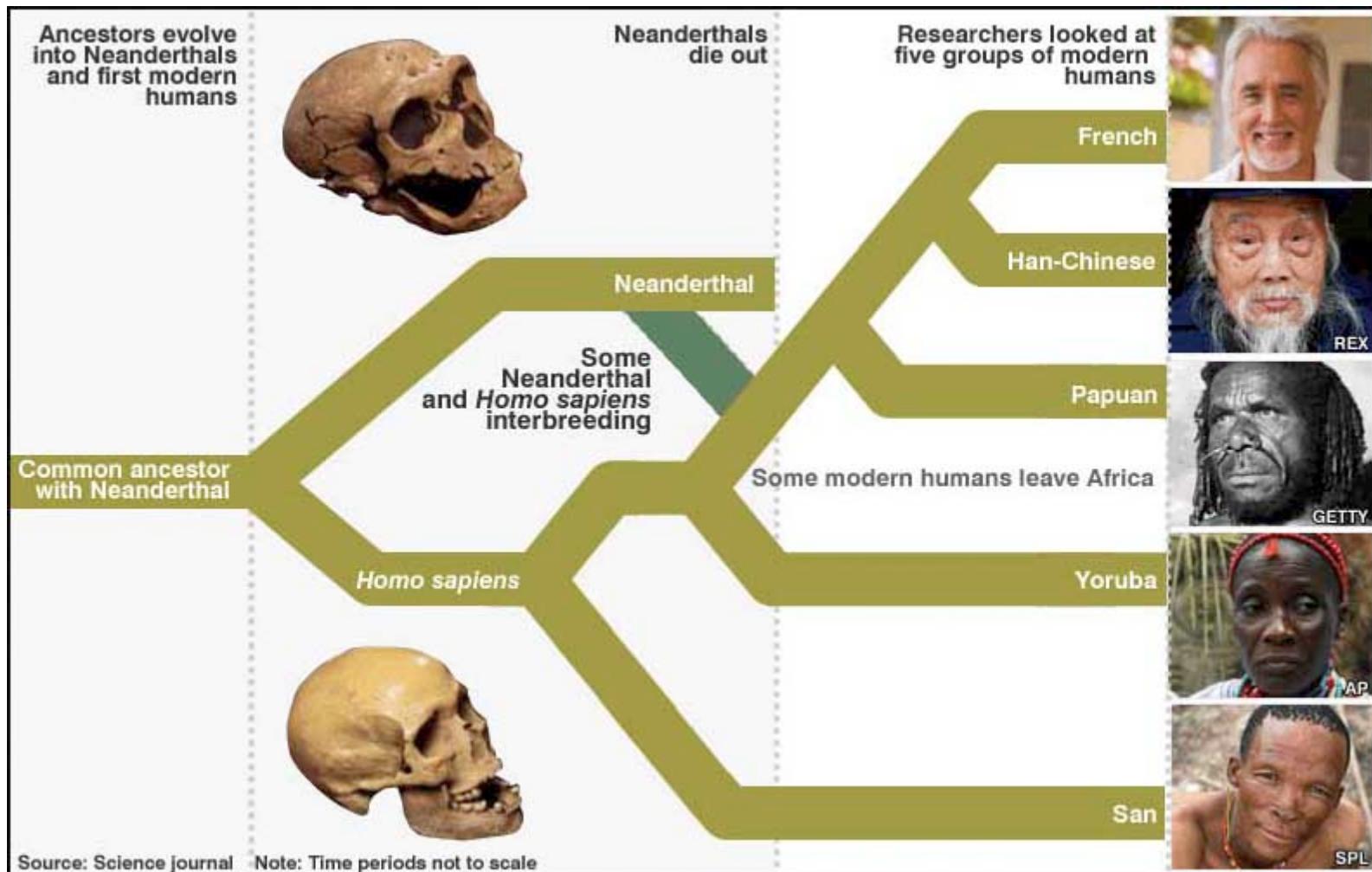


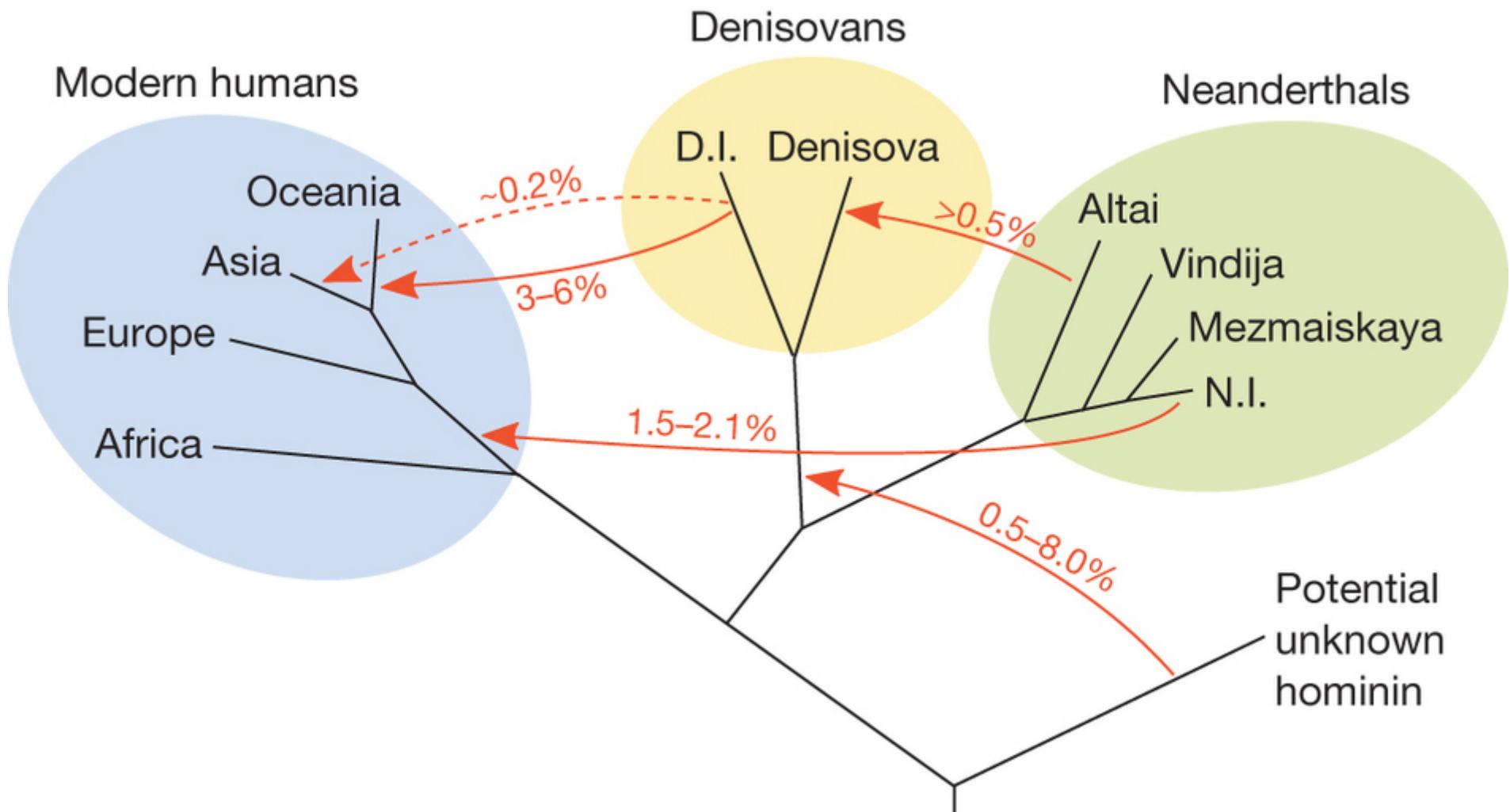
Ancient burial dated at 50,000 years ago.

Individual had chronic hip problems that he had lived with for at least ten years.

Thorn branches placed on top of body to keep out scavengers

Pollen from many flowers found in grave





Cool. But what genes do some of us have that came from Neanderthals?



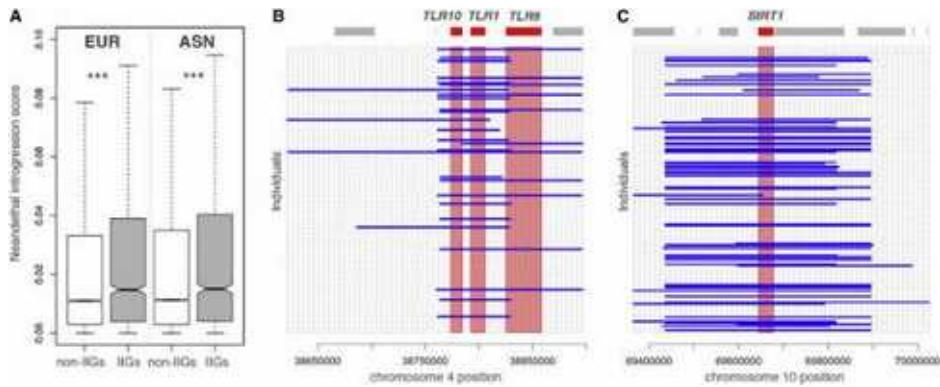


Belly button showing

Killer jacket

Ginger kid

Neanderthal-free sister



Neanderthal DNA is found in  
some humans' nuclear DNA

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ARTICLE

Introgression of Neandertal- and Denisovan-like Haplotypes Contributes to Adaptive Variation in Human Toll-like Receptors

Michael Dannemann, Alba M. Andrés, Janet Kelso

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Certain keratin and immune system alleles are neanderthal in origin.

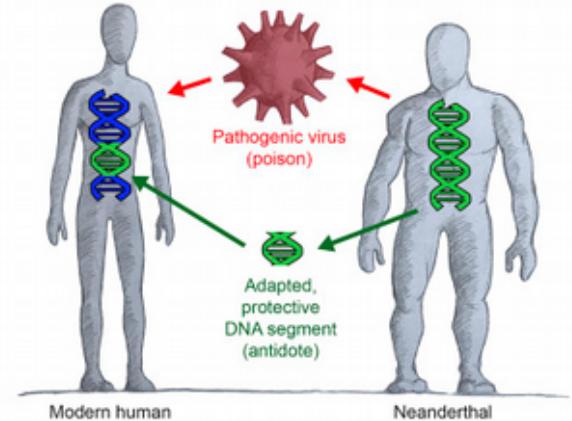
Two separate scientific teams, not allowed to communicate with each other, found the exact same results.

# Evidence that RNA Viruses Drove Adaptive Introgression between Neanderthals and Modern Humans

David Enard    • Dmitri A. Petrov • Show footnotes

DOI: <https://doi.org/10.1016/j.cell.2018.08.034> •  Check for updates

The poison-antidote model of adaptive introgression



Highlights

Summary

Graphical Abstract

Keywords

Introduction

Results

Discussion

STAR★Method

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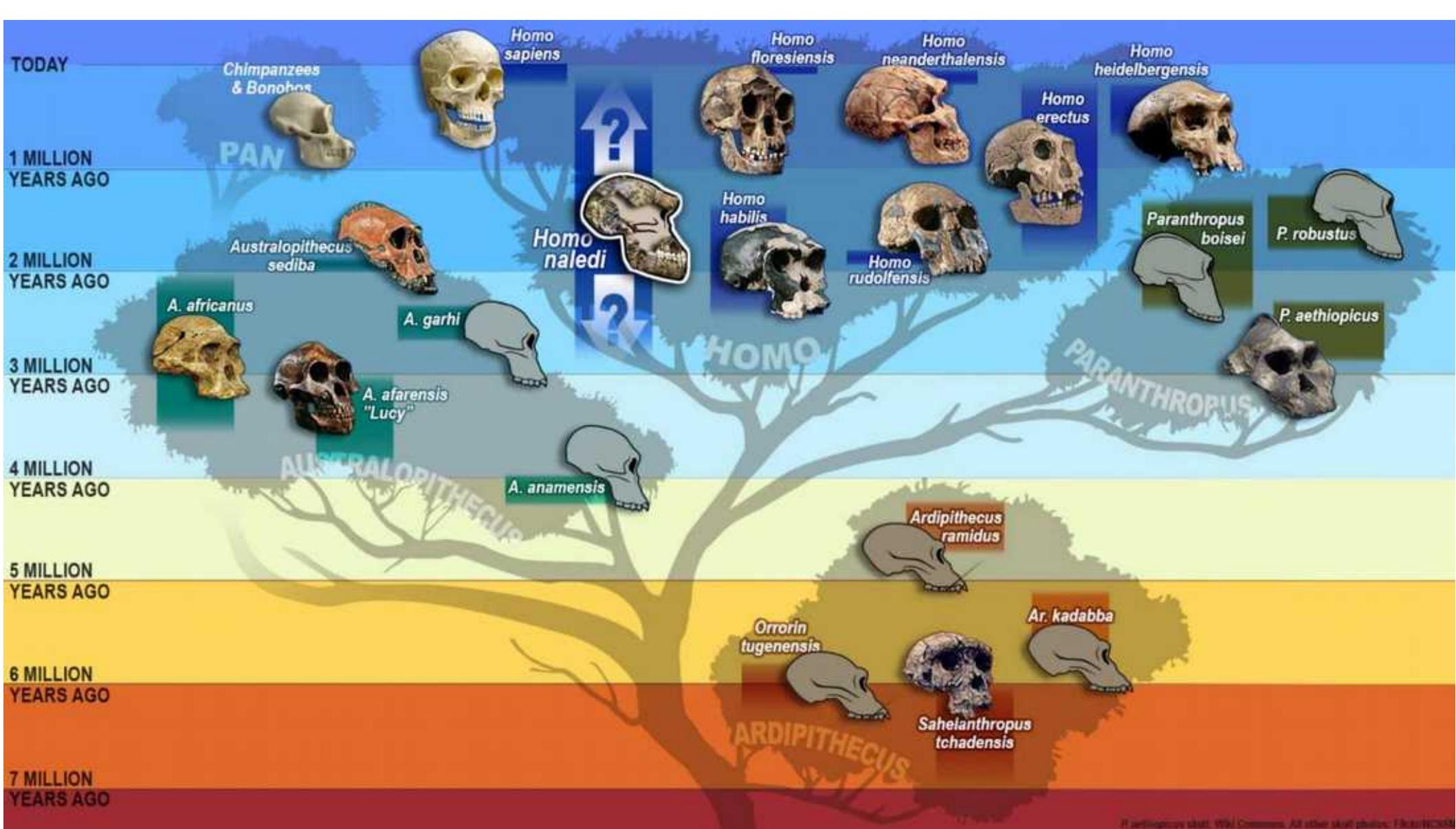
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## Highlights

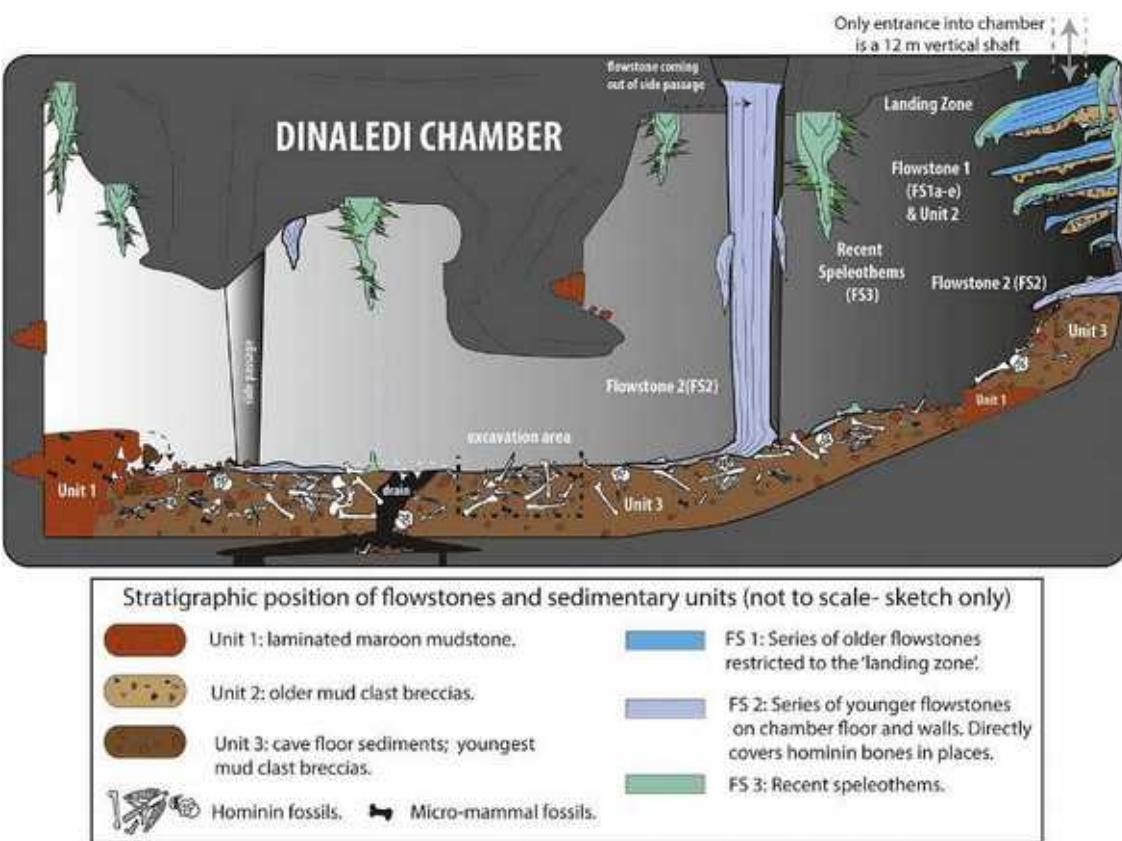
- Neanderthals and modern humans interbred and exchanged viruses
- Neanderthal DNA introgressed in modern humans helped them adapt against viruses
- Neanderthal DNA-based adaptation was particularly strong against RNA viruses in Europeans
- Ancient epidemics can be detected through the lens of abundant host genomic adaptation

## Summary

Neanderthals and modern humans interbred at least twice in the past 100,000 years. While there is evidence that most introgressed DNA segments from Neanderthals to modern humans were removed by purifying selection, less is known about the adaptive nature of introgressed sequences that were retained. We hypothesized that interbreeding between Neanderthals and modern humans led to (1) the exposure of each species to novel viruses and (2) the exchange of

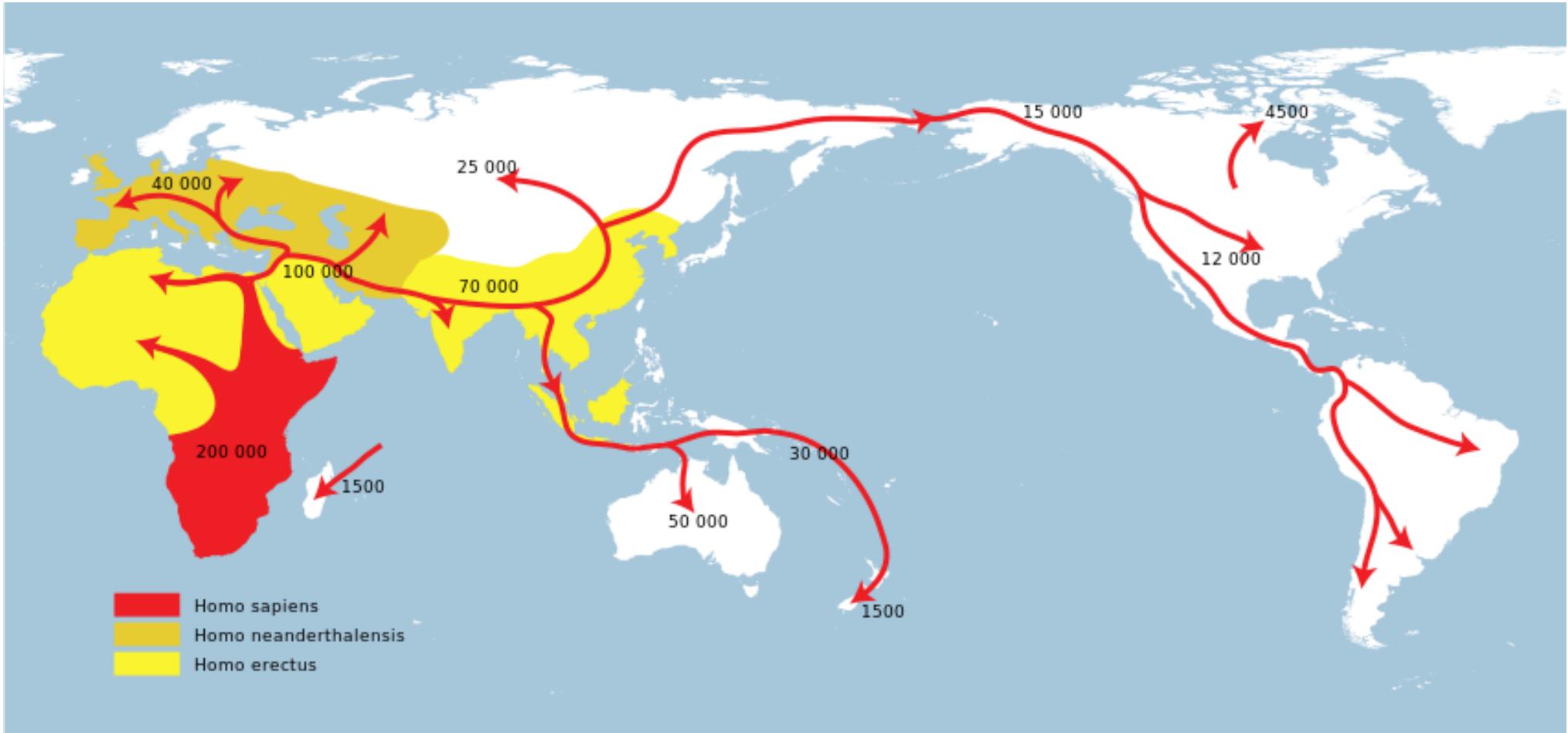


The pleistocene was awash with many different *Homo* species on divergent evolutionary paths, but gene flow was occurring.



*Homo naledi* - discovered in 2015





<https://www.ncbi.nlm.nih.gov/Traces/study/?acc=ERX204465>

