

## Human Evolution

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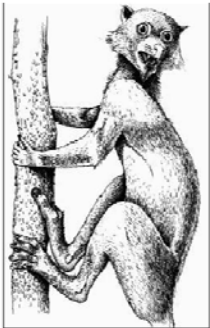
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Cantius, ca 55 mya



Cantius was an early Eocene primate. Note the flat nails and forward facing eyes.

The continent-hopping habits of early primates have long puzzled scientists, and several scenarios have been proposed to explain how the first true members of the group appeared virtually simultaneously on Asia, Europe and North America some 55 million years ago.

**Paleocene-Eocene thermal maximum (PETM)**, one of the most rapid and extreme global warming events recorded in geologic history.

- Originated in Africa and spread across Europe and Greenland to reach North America.
- Originated in North America and traveled across a temporary land bridge connecting Siberia and Alaska.
- Originated in Asia and fanned out eastward to North America and westward to Europe.




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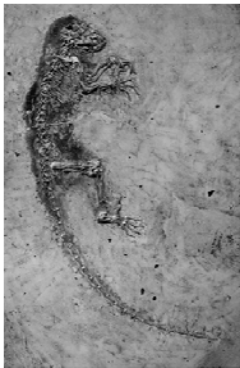
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## *Darwinius masillae*



- Ida
- Primate fossil from Messel pit in Germany
- Ca.47 M years old

Franzen et al., PloS One 2009

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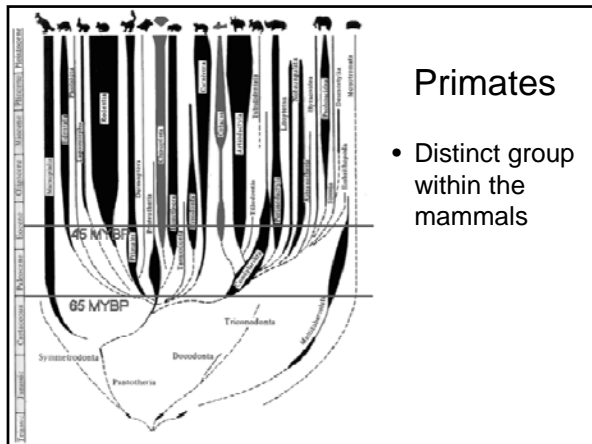
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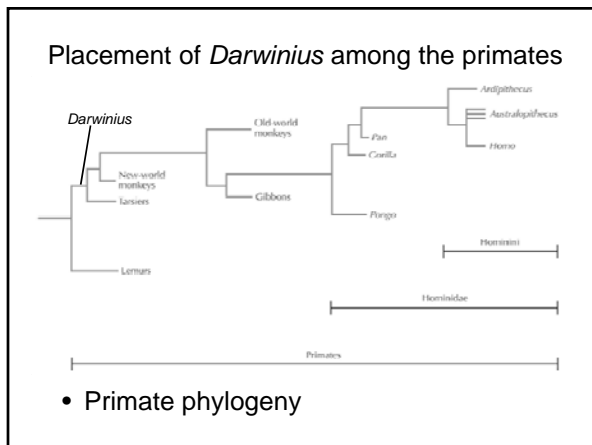
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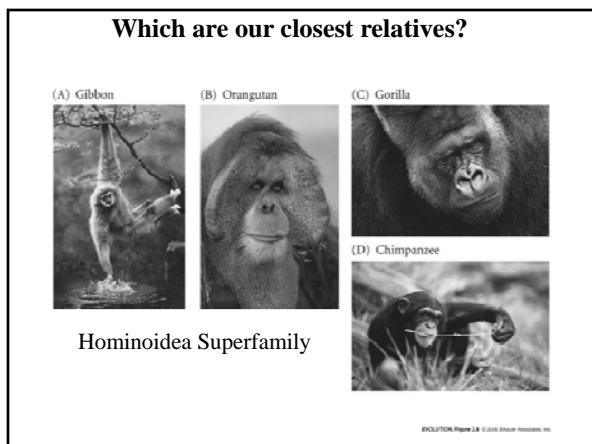
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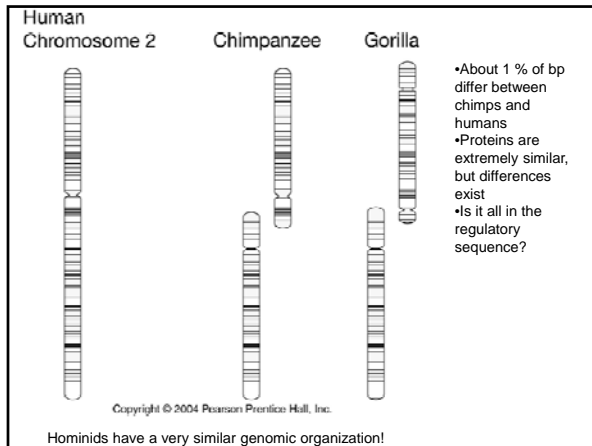
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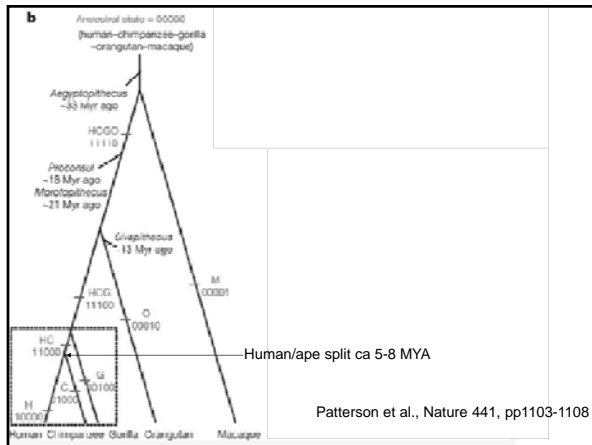
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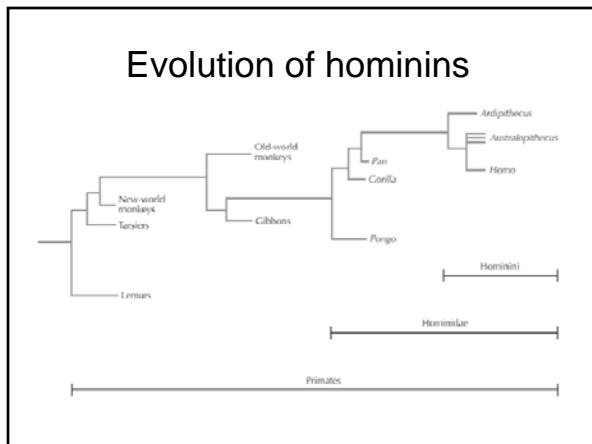
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## Species uncertainty within the hominins

- Drawing species limits between fossils is very tricky



Lucy (*Australopithecus afarensis*)

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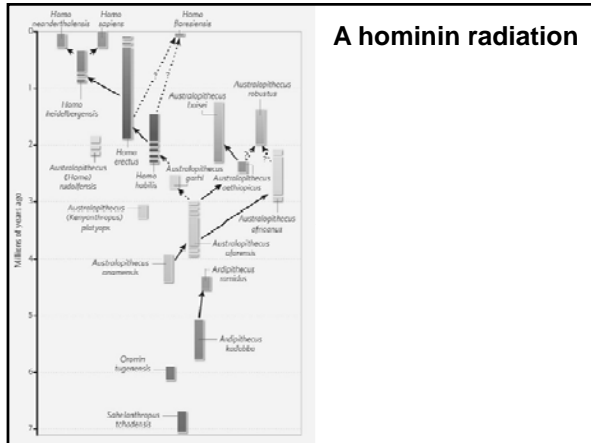
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A hominin radiation

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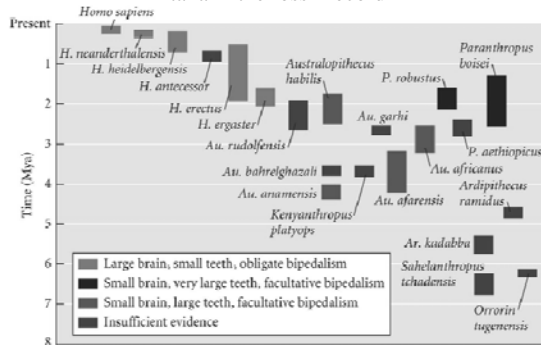
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## The approximate temporal extent of named hominin taxa in the fossil record




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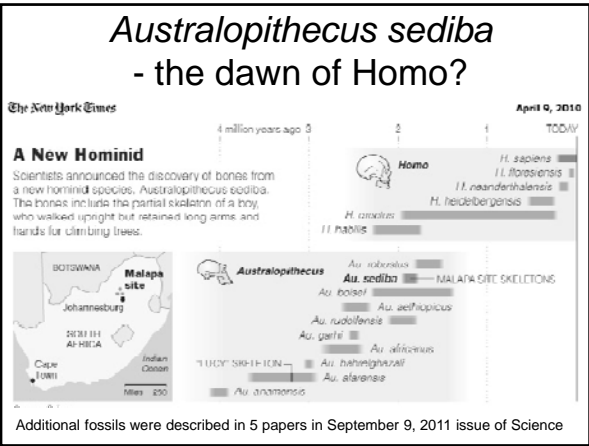
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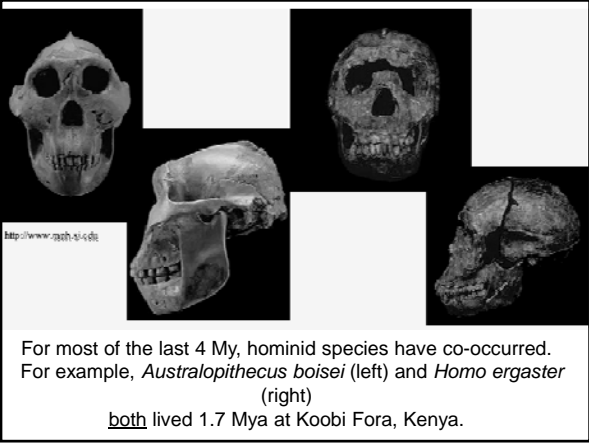
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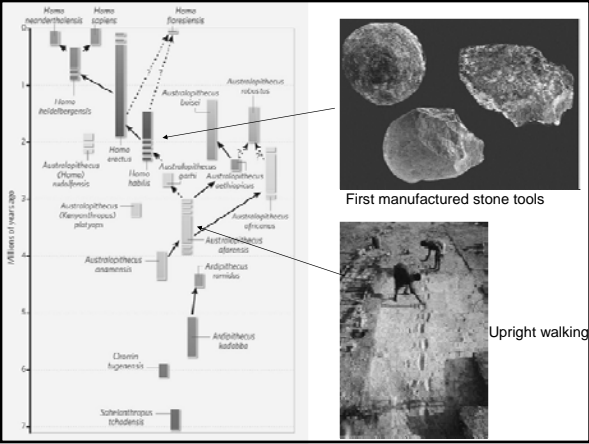
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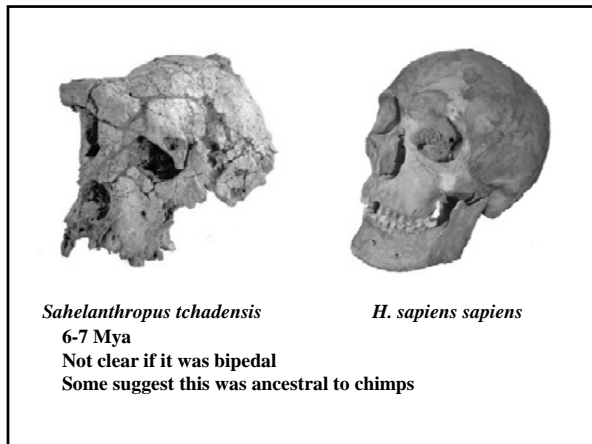
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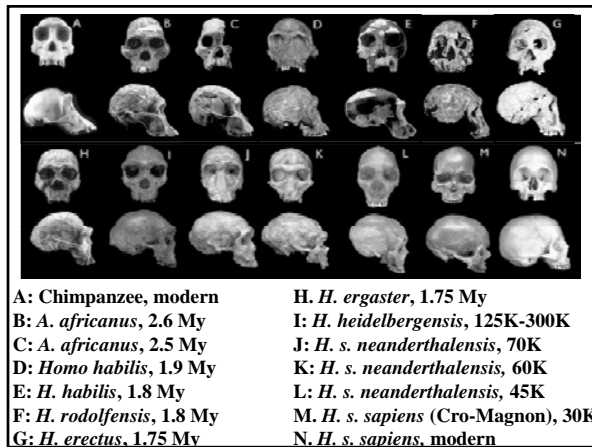
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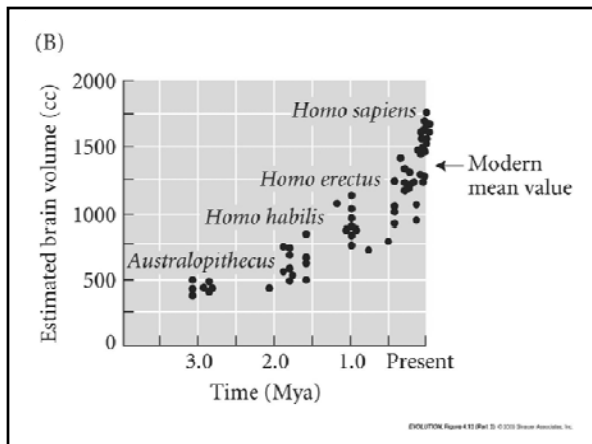
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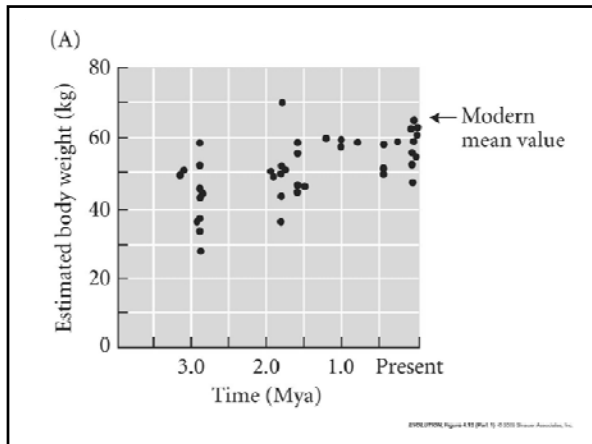
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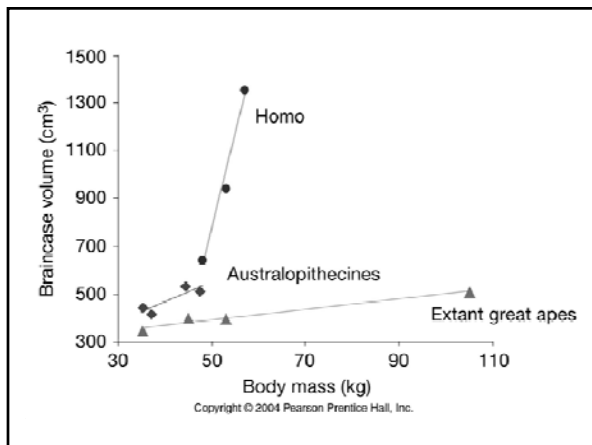
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What makes humans human?

- Are there “quantitative” or just “qualitative” differences?

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**How did we people Earth?**



<http://cseigman.com>

**When?**

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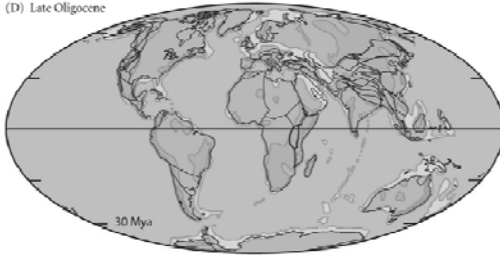
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**The distribution of land masses at several points in geological time**

- Mountainous highlands (>1500 m)
- Other land masses
- Shallow oceans (<200 m)
- Ocean basins (>200 m)

~25 Mya

(D) Late Oligocene



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***Homo erectus* spread (~1.8 Mya) from Africa to Europe and Asia and evolved into *H. neanderthalensis***



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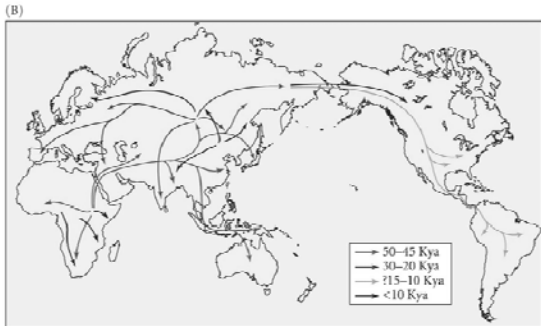
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The movement of human populations from about 50,000 to 10,000 years ago




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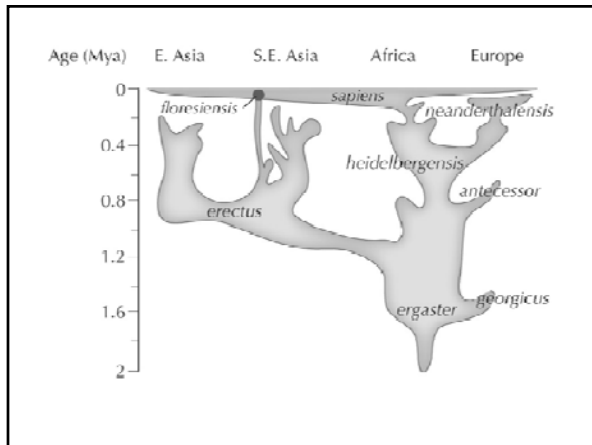
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### The "Hobbit"

- *Homo floresiensis* or diseased *H. sapiens*?



Flores



- Used most likely tools
- Two skeletons from ca. 80,000 and 17,000 years ago.

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Hypothesis: *H. floresiensis* is an island dwarf form that evolved from a hominin ancestor

- Problem: The “hobbit” brain is too small to be simply a scaled down *sapiens* or *erectus* brain
- But... dwarf species of hippos show a similar disproportionate reduction in brain size

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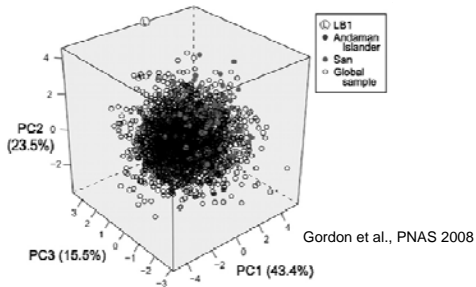
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Hobbit or modern human?



- Shape analysis of cranial morphology

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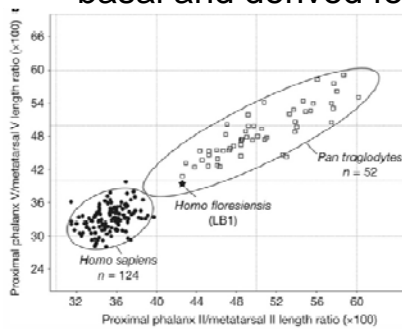
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Foot of *H. floresiensis* combines basal and derived features



- Good for walking but not for running?

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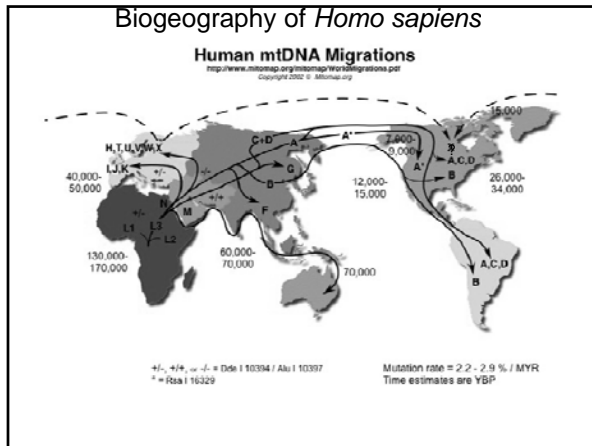
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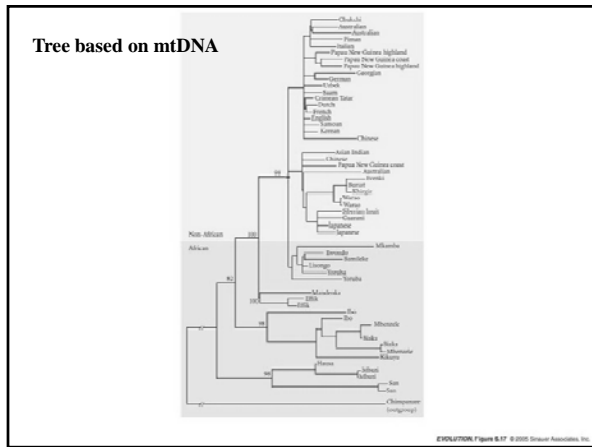
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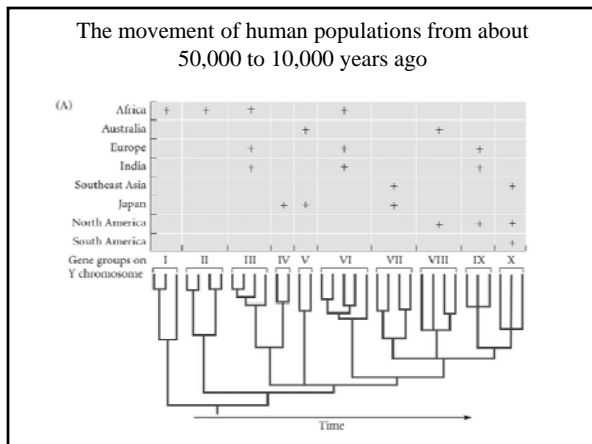
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## Can we really exclude *sapiens-neanderthalensis* interbreeding?

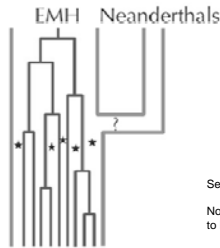


Figure from textbook!

Serre et al., 2004 PLoS Biology  
No Evidence of Neanderthal mtDNA Contribution to Early Modern Humans

Contemporary humans

- Just a matter of mtDNA sampling error?

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## A scientific revolution!

### RESEARCH ARTICLE

### A Draft Sequence of the Neandertal Genome

Richard E. Green,<sup>1,2,3,4</sup> Johannes Krause,<sup>1,5</sup> Adrian W. Briggs,<sup>1,6</sup> Tomislav Maricic,<sup>1,5</sup> Udo Stenzel,<sup>1,5</sup> Martin Kircher,<sup>1,5</sup> Nick Patterson,<sup>1,5</sup> Heng Li,<sup>1</sup> Weiwei Zhang,<sup>1,7</sup> Markus Hi-Yang Fritze,<sup>1</sup> Nancy F. Hansen,<sup>1</sup> Eric V. Durand,<sup>1</sup> Ana-Sapfo Malaspinas,<sup>1</sup> Jeffrey D. Jensen,<sup>1</sup> Tomas Marques-Bonet,<sup>2,12</sup> Can Alkan,<sup>1</sup> Kay Prüfer,<sup>1</sup> Matthias Meyer,<sup>1</sup> Hernán A. Burbano,<sup>1</sup> Jeffrey M. Good,<sup>1,8</sup> Rigo Schultz,<sup>2</sup> Aytaner Asim-Petri,<sup>1</sup> Anne Butthof,<sup>1</sup> Barbara Höber,<sup>1</sup> Barbara Höffner,<sup>1</sup> Madlen Stegemund,<sup>1</sup> Antje Weltmann,<sup>1</sup> Chad Nusbaum,<sup>2</sup> Eric S. Lander,<sup>2</sup> Carsten Russ,<sup>2</sup> Nathaniel Navod,<sup>2</sup> Jacan Affourtit,<sup>2</sup> Michael Egholm,<sup>2</sup> Christine Verha,<sup>2</sup> Pavlo Rudan,<sup>10</sup> Dejana Brajkovic,<sup>11</sup> Zeljko Kucan,<sup>10</sup> Ivan Gušić,<sup>10</sup> Vladimir B. Doronichev,<sup>12</sup> Liubov V. Golovanova,<sup>12</sup> Carlos Lalueza Fox,<sup>12</sup> Marco de la Rasilla,<sup>12</sup> Javier Fortes,<sup>12</sup> Antonio Rosas,<sup>12</sup> Ralf W. Schwitzgebel,<sup>12</sup> Phillip L. F. Johnson,<sup>12</sup> Ewan K. Eichler,<sup>1</sup> Daniel Falush,<sup>1,3</sup> Ewan Birney,<sup>1</sup> James C. Mullikin,<sup>1</sup> Montgomery Slatkin,<sup>1</sup> Rasmus Nielsen,<sup>1</sup> Janet Kelso,<sup>1</sup> Michael Lachmann,<sup>1</sup> David Reich,<sup>1,9,11</sup> Svante Pääbo<sup>1,11</sup>

- Science 2010

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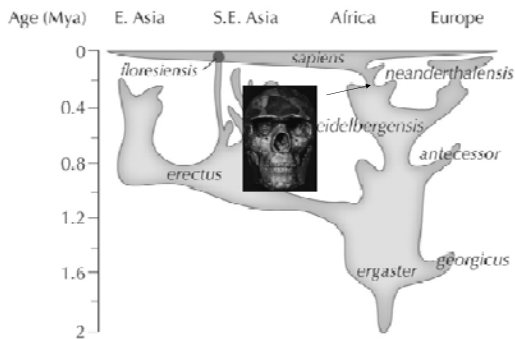
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- Oldest modern humans ca. 200,000 yrs old (Omo valley in ethiopia)

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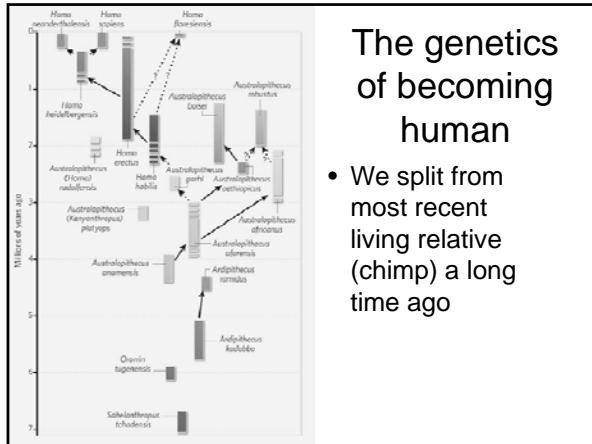
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### The genetics of becoming human

- We split from most recent living relative (chimp) a long time ago

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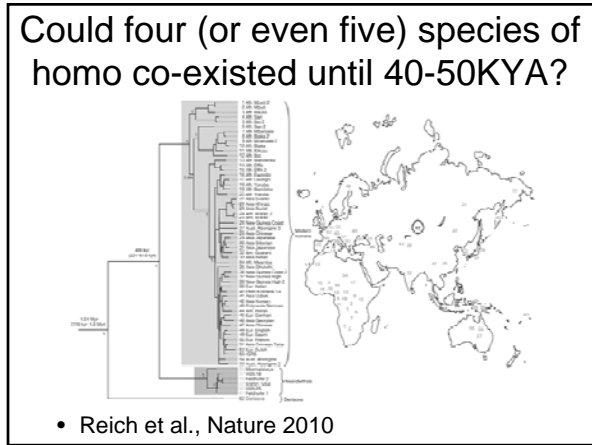
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- Reich et al., Nature 2010

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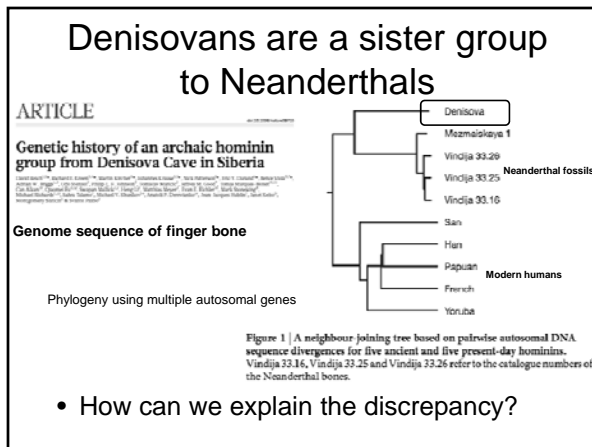
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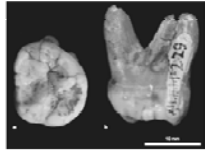
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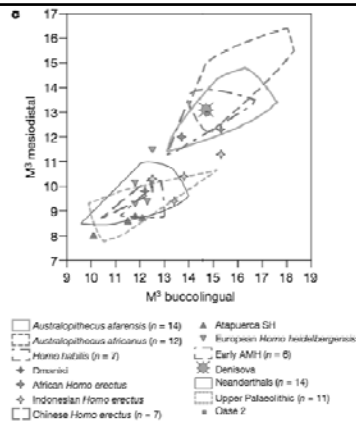
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Are the Denisovans separate from the Neanderthals?



- Population history
- Tooth morphology




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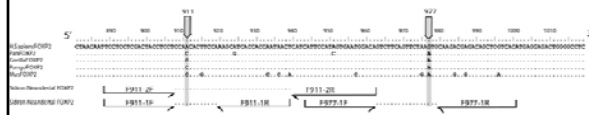
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### Homo neanderthalensis and speech



- FOXP2 is the only gene that is known (to date) to be implicated in human speech
  - Inactive copy leads to difficulties in speech (Broca's aphasia)
- Neanderthals share unique human nonsynonymous mutations in this gene

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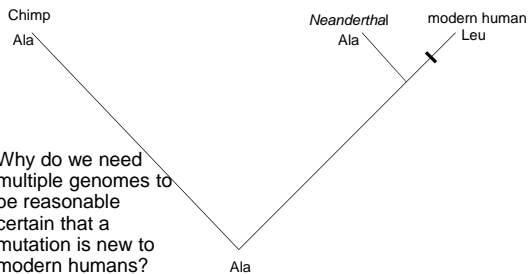
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### How the Neanderthal genome helps to find sapiens specific mutations



- Why do we need multiple genomes to be reasonable certain that a mutation is new to modern humans?

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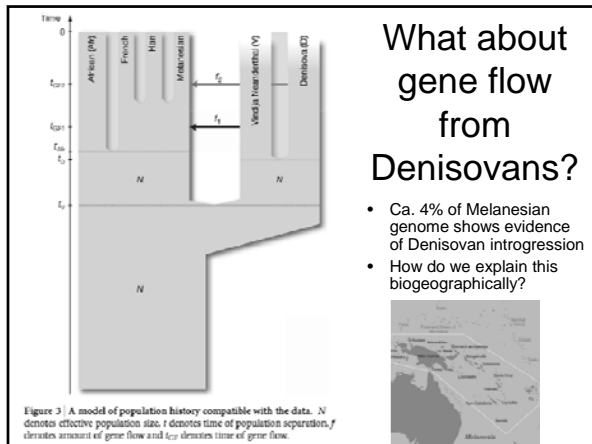
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**Take Home Message**

- Mitochondria good from tracking phylogeography.
- Genomics necessary to catch a glimpse of gene flow.
- More diversity (of late) that we thought possible.
- Many humans fossils are now submerged (last ice age; 80K to 11K ago).

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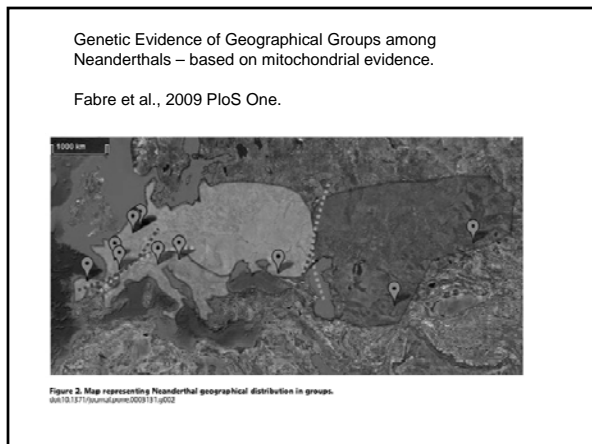
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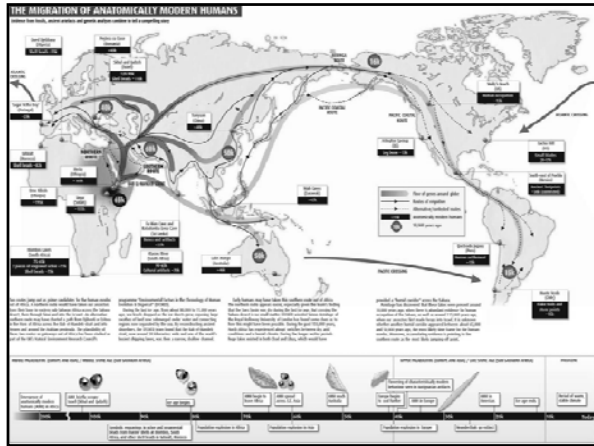
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