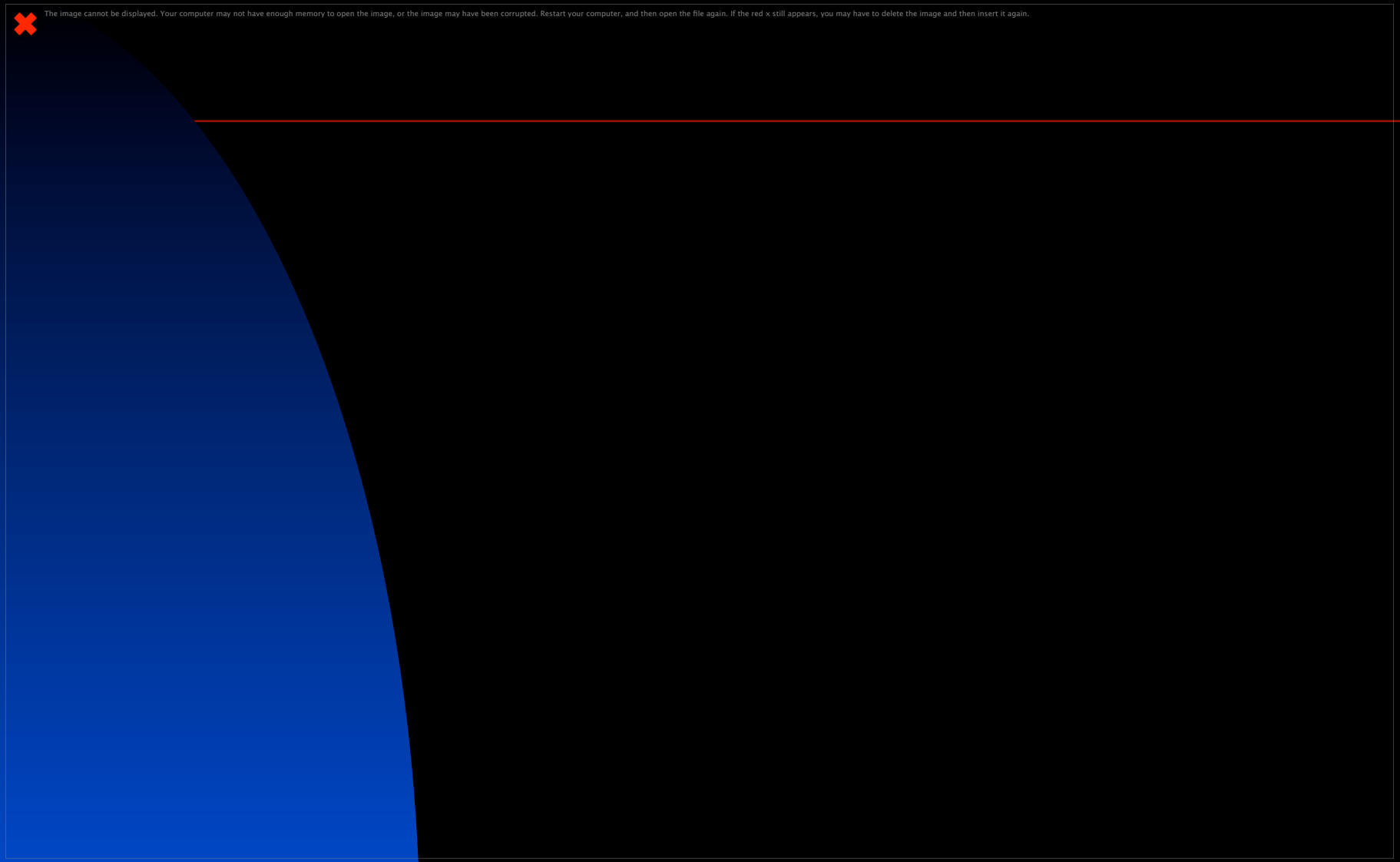
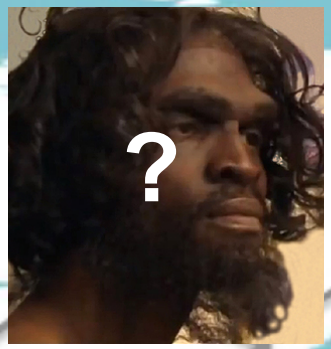
Human evolution in and out of Africa

Chris Stringer, The Natural History Museum London



Today *Homo sapiens* is the only human on Earth

Neanderthals



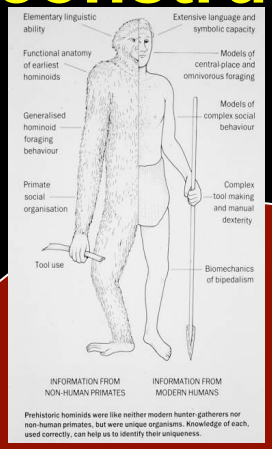
Denisovans

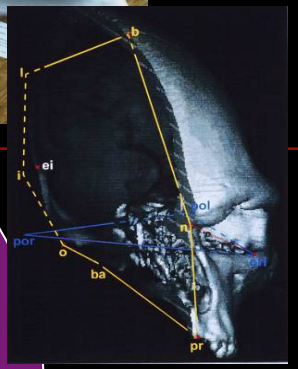
Homo sapiens

Homo floresiensis

There were at least *4* kinds of humans 60,000 years ago….

Evidence to reconstruct the past…





Behaviour

Tools

Archaeology

Palaeontology

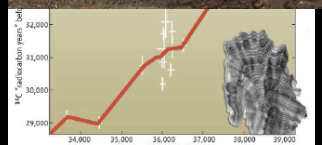
Fossils

History

Contextual and other data

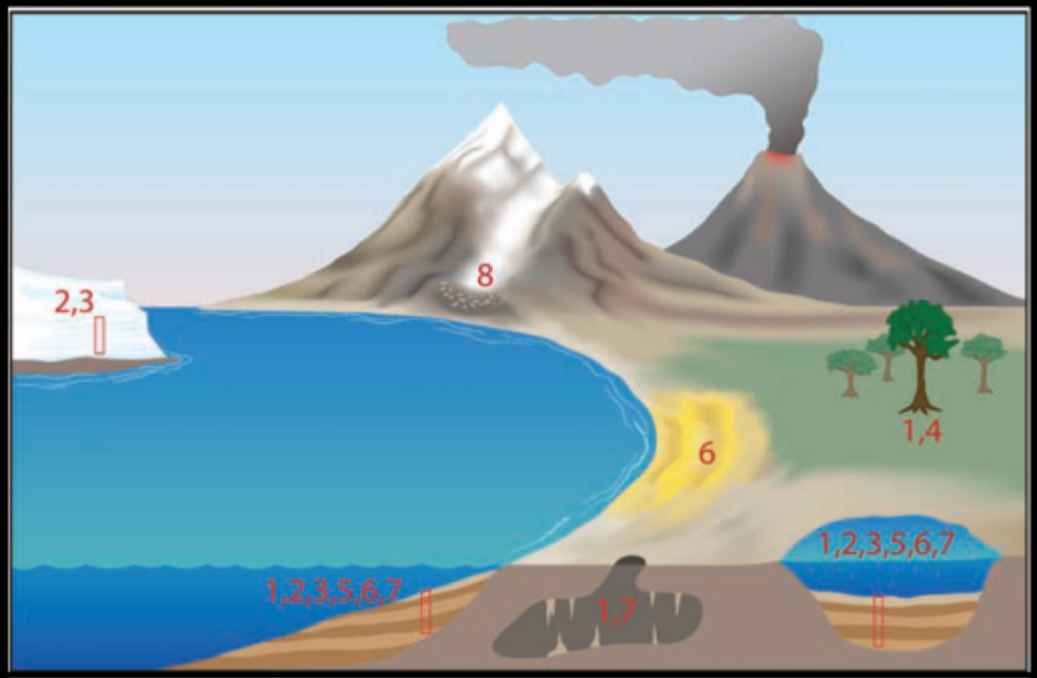
Evolution

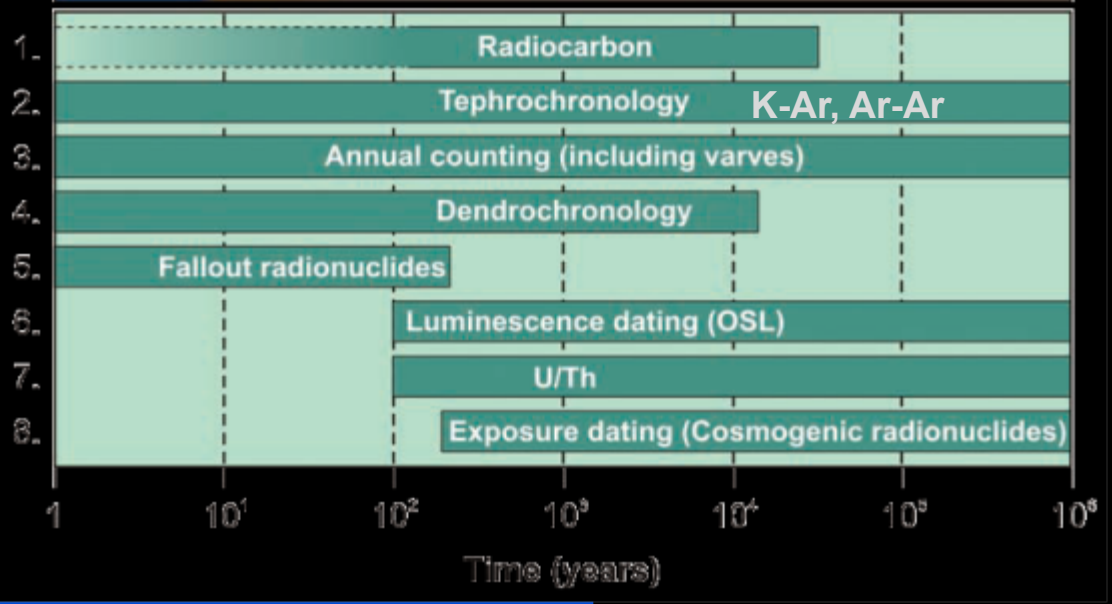
Stratigraphy + dating



Isotopes
Calculus
DNA

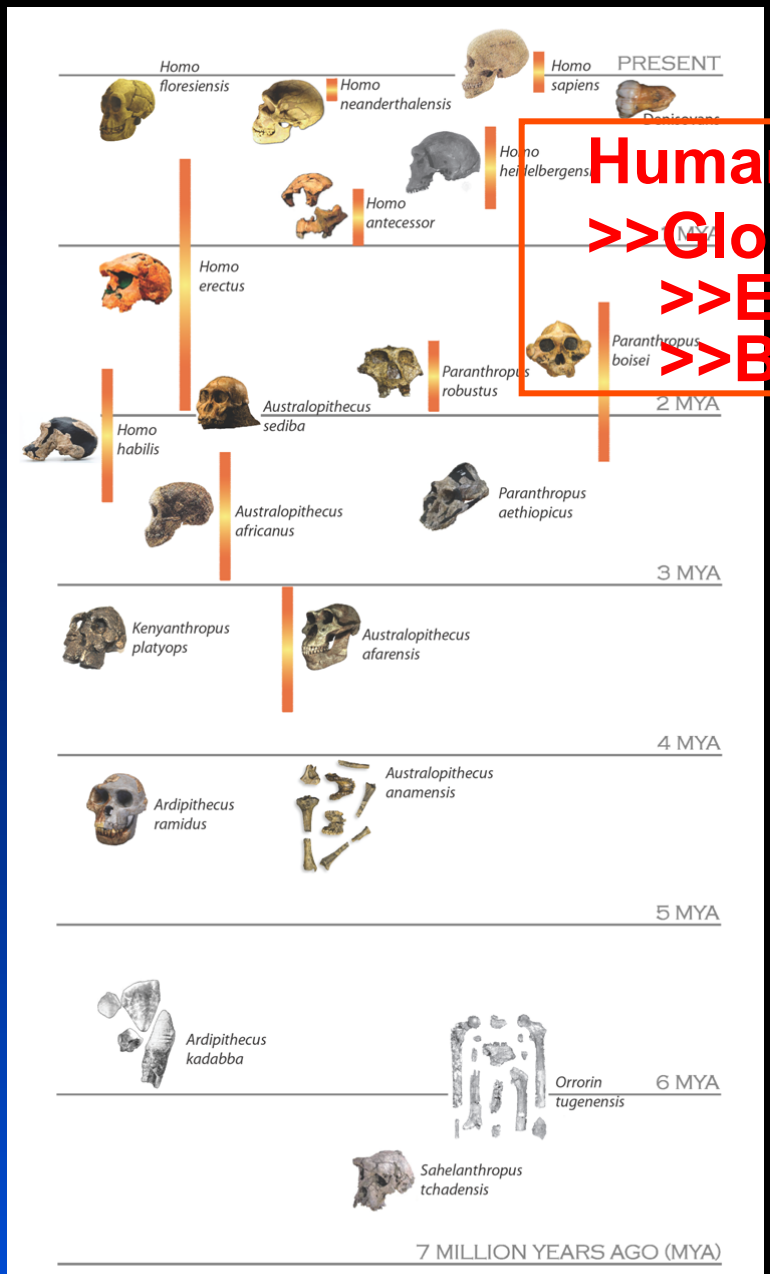
Some dating methods….





Ma = million yrs
Ka = thousand yrs

The last phase of human evolution



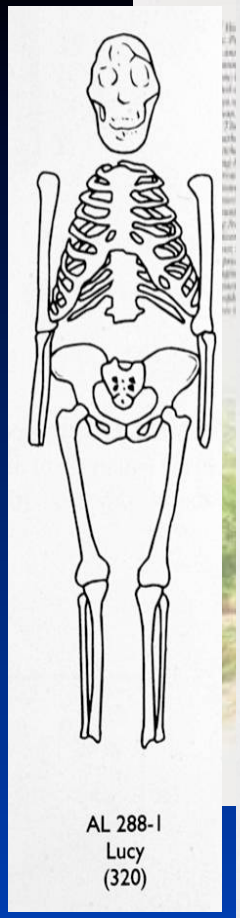
Human phase 2 – 0 Ma: several species

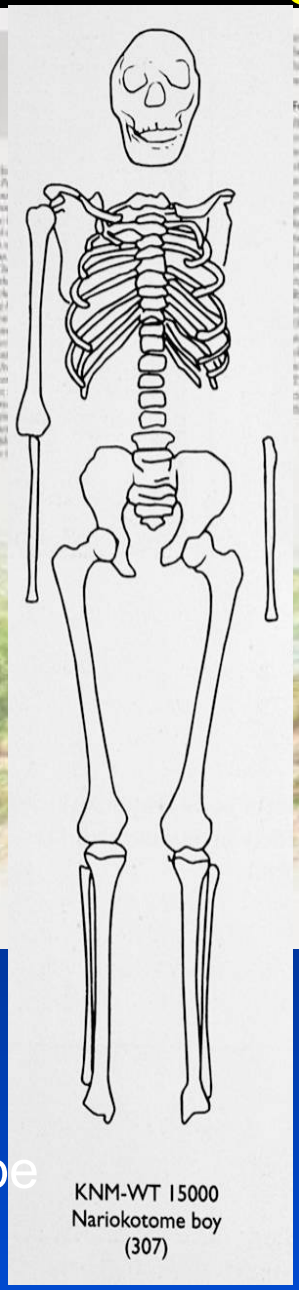
>>Global spread, "Human" anatomy

>>Encephalised >>Dietary range

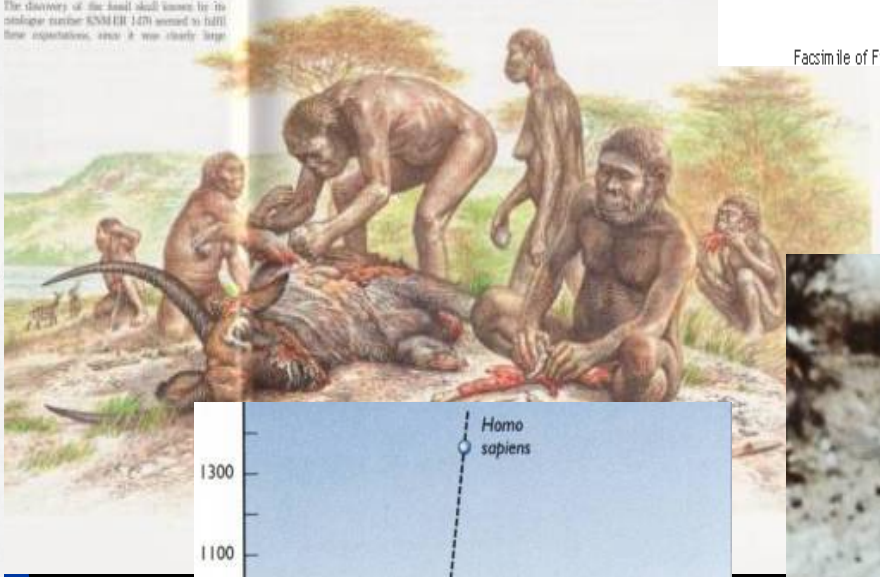
>>Behavioural complexity

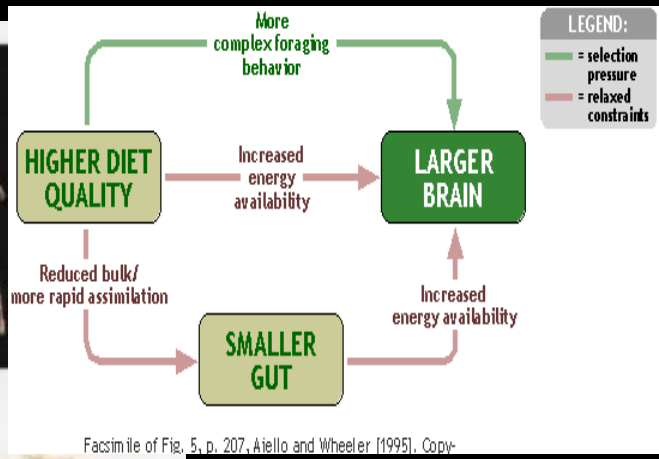
Becoming human





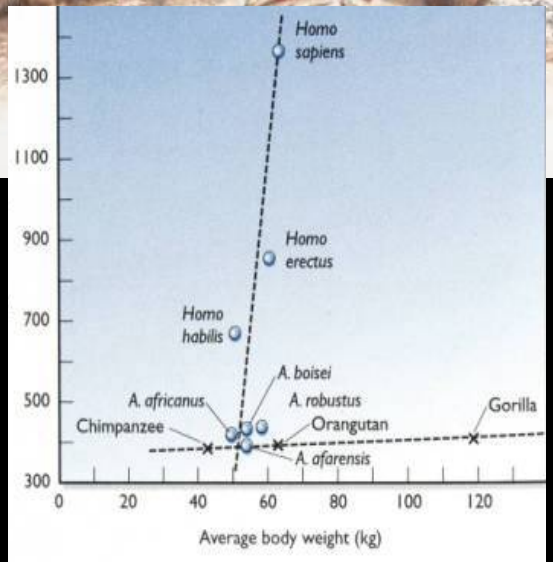
Body shape





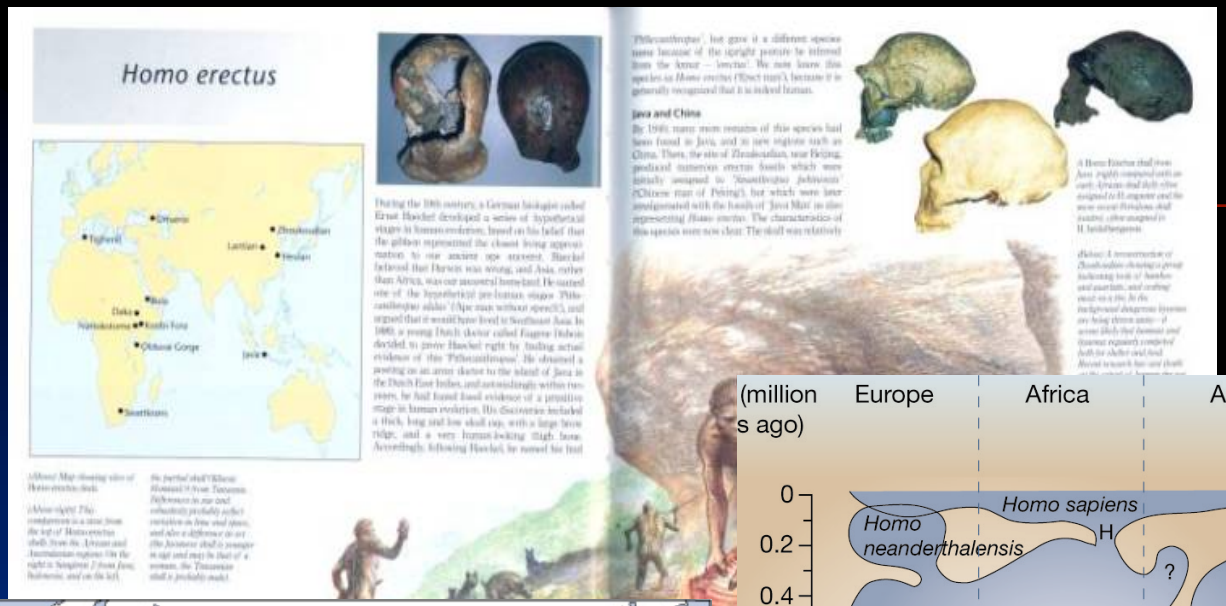
Facsimile of Fig. 5, p. 207, Aiello and Wheeler [1995]. Copy-

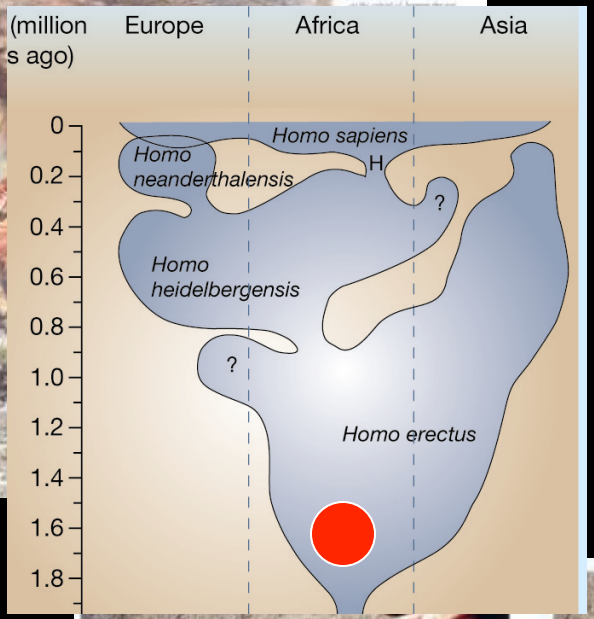
Meat, guts, and brains



Stone tools
~2.6 Ma

Early humans 1.5-1.8 Ma: 'Out of Africa 1'





Dmanisi, Georgia ~1.8 Ma

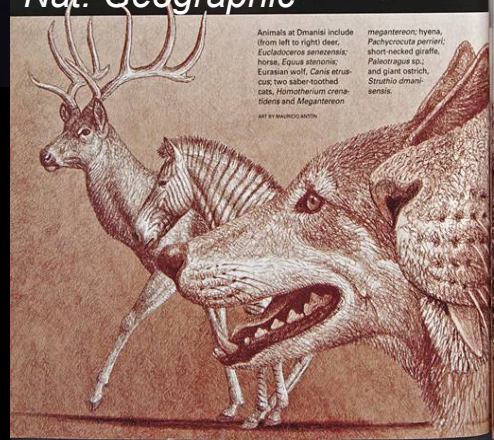
The first explorers?

Always a crossroads, the village of Dmanisi (above) once overlooked the old Silk Road through the Caucasus region. Nearly 1.8 million years ago the site lay on a peninsula between the Black and Caspian Seas (map, right), along one of several land corridors into Eurasia. Humans could have moved out of Africa—and back into it—in multiple waves, reaching Java by at least 1.6 million years ago. By one million years ago, *Homo* had spread across Eurasia, leaving bones and tools in its wake.

The emigrants

Humans weren't the only creatures leaving Africa 1.75 million years ago: Hundreds of animal bones have been unearthed at Dmanisi (select species shown below), and 10 percent of them are African species. The first wave of emigrants—including ostriches (leg bone, far left) and short-necked giraffes (foot bones, left)—was made up of species that scientists consider adaptable and opportunistic. They met Eurasians such as wolves (skull, top right), deer, and saber-toothed cats, whose fangs fit holes in one of the human skulls (left). Cats were a menace, but they may have benefited humans: Simple chopping and scraping tools found here may have been used for scavenging the animals that cats killed.

Nat. Geographic



Animals at Dmanisi include (from left to right) deer, *Eucladoceros senezensis*; horse, *Equus stenonis*; Eurasian wolf, *Canis etruscus*; two saber-toothed cats, *Homotherium crenatidens* and *Megantereon megantereon*; hyena, *Pachycrocuta perrieri*; short-necked giraffe, *Paleotragus* sp.; and giant ostrich, *Struthio dmanisensis*.

ART BY MAURICIO ANTÓN

of the world's great fossil hotbeds. In that decade the team unearthed several faceless skulls and mandibles—they seemed to be *Homo erectus*—along with thousands of simple stone tools in sediments the team dated at between 1.8 and 1.7 million years ago, the earliest undisputed evidence of humans outside Africa. Those dates at first surprised a skeptical scientific community. In the early 1990s most scientists thought *Homo erectus* hadn't departed Africa until around a million years ago.

Then last season, while visiting another dig in western Georgia, Dato got a call on his cell phone from Dmanisi: Another skull was coming out of the earth. Dato rushed back. The skull he saw half-buried in the dirt astonished him.

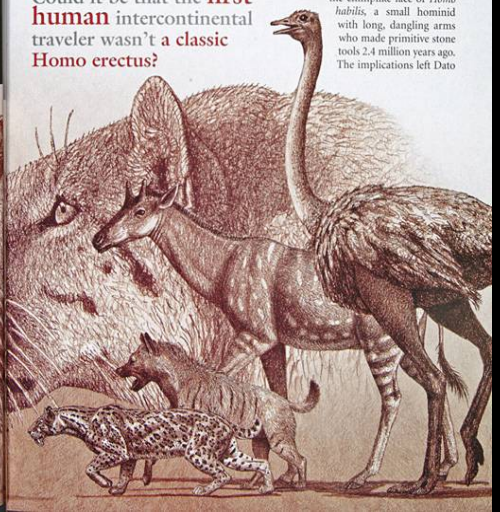
Usually fossil skulls are crushed almost beyond recognition, but this one looked almost as complete as a skull you'd find at a 21st-century crime scene. And it didn't look like *Homo erectus*. Its browridge seemed too thin. It didn't have much of a nose, and it had those werewolf canines, holdovers from our apelike ancestors. And its brain case was tiny—less than two-thirds the size of an average *Homo erectus*. If brain size is a measure of intelligence, as scientists have long believed, then this hominid from Georgia probably wasn't nearly as smart as a typical *Homo erectus*.

SOCIETY GRANT

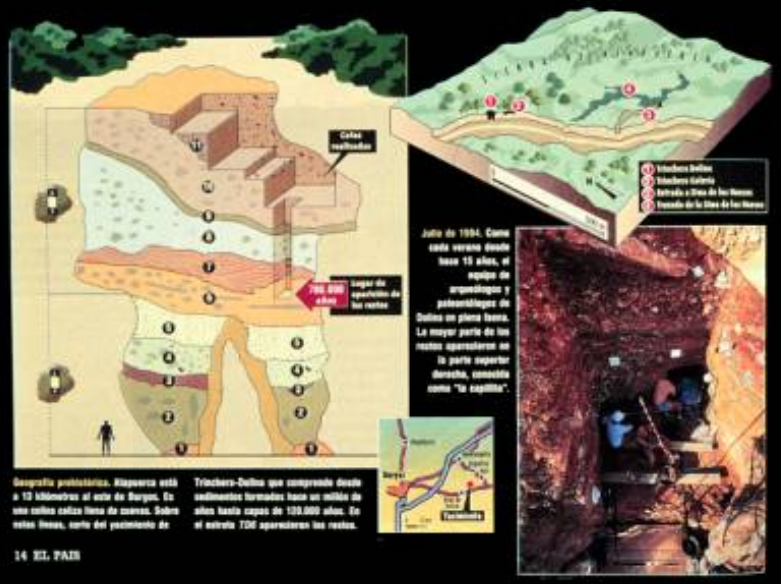
This Research Committee project is supported by your Society membership.

Could it be that the **first human** intercontinental traveler wasn't **a classic Homo erectus?**

To Dato the new skull had the chimplike face of *Homo habilis*, a small hominid with long, dangling arms who made primitive stone tools 2.4 million years ago. The implications left Dato

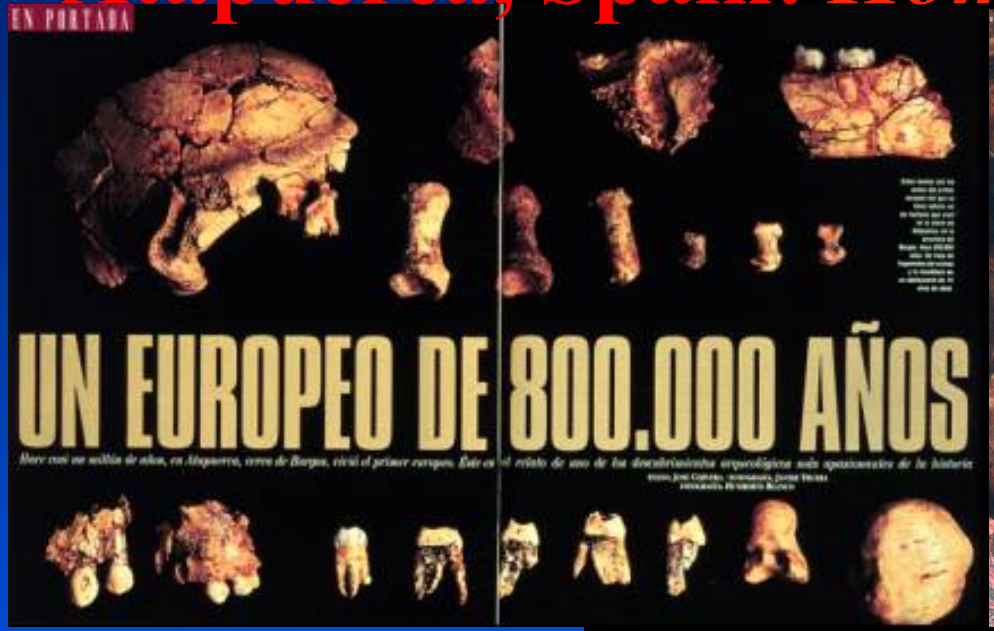


Sima del Elefante
1.2Ma



Gran Dolina
0.8Ma

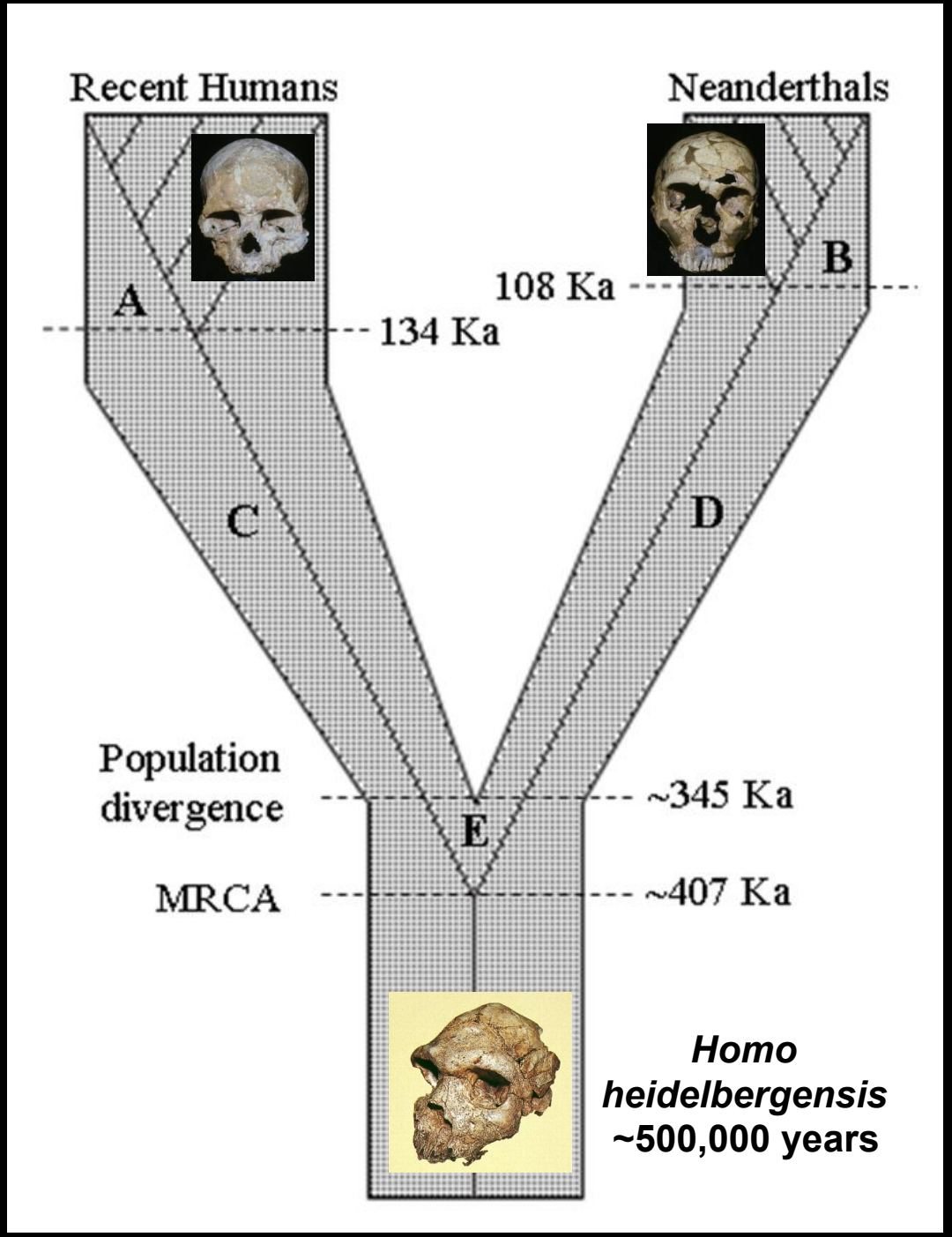
Atapuerca, Spain: *Homo antecessor* 0.8Ma



Homo heidelbergensis
Mauer ~600ka?

The evolution of Modern Humans and Neanderthals

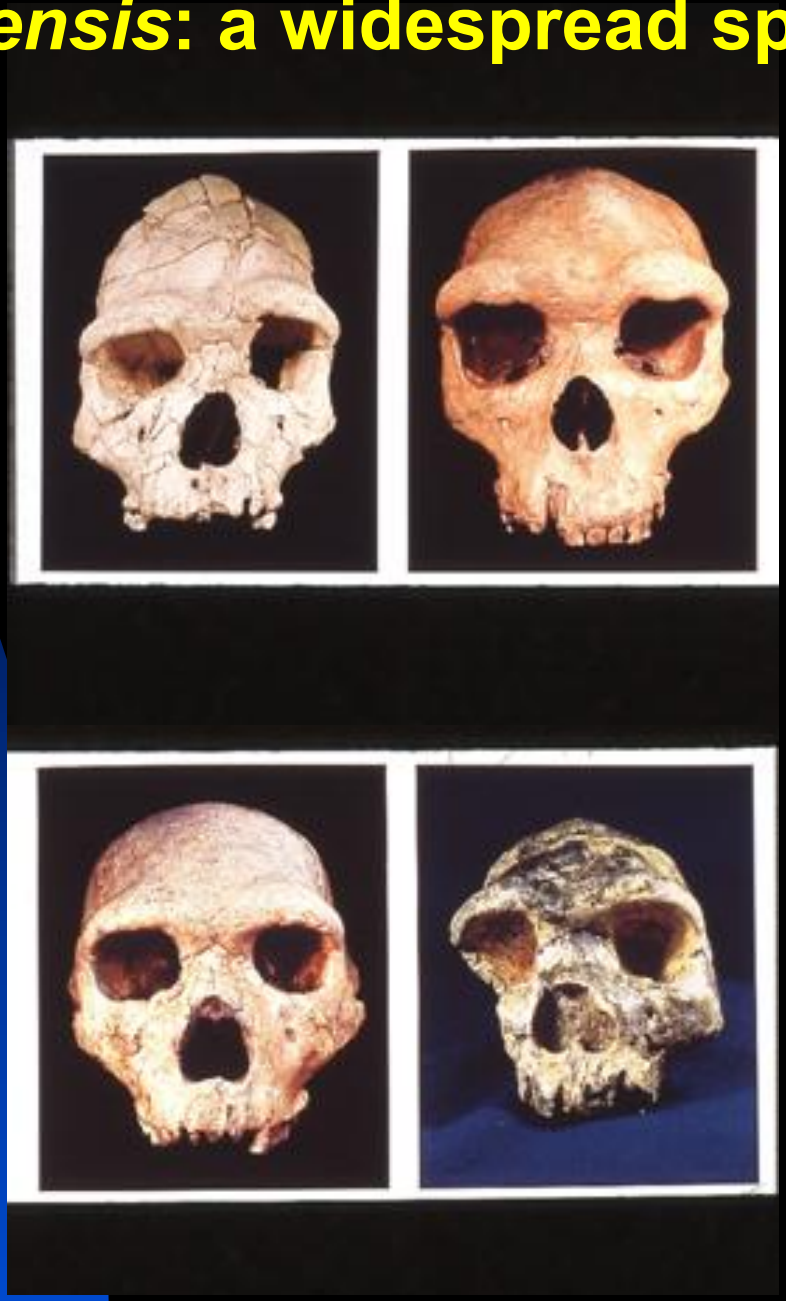
(based on fossil and genetic data)



heidelbergensis: a widespread species

Arago France

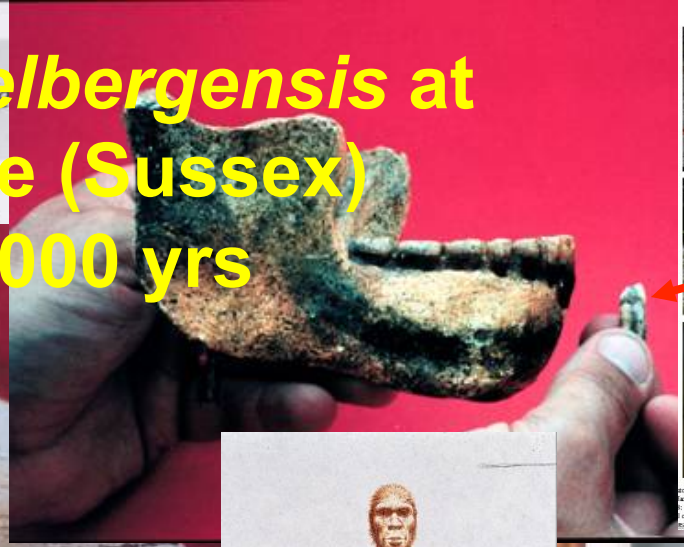
Broken Hill Zambia

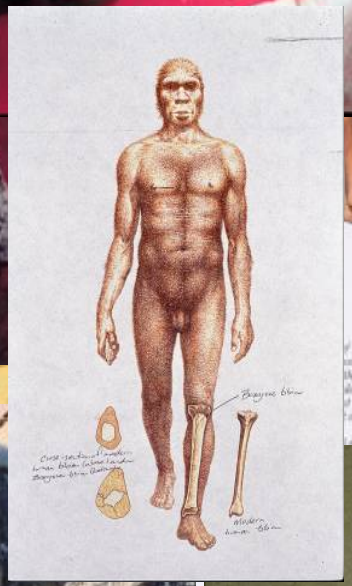


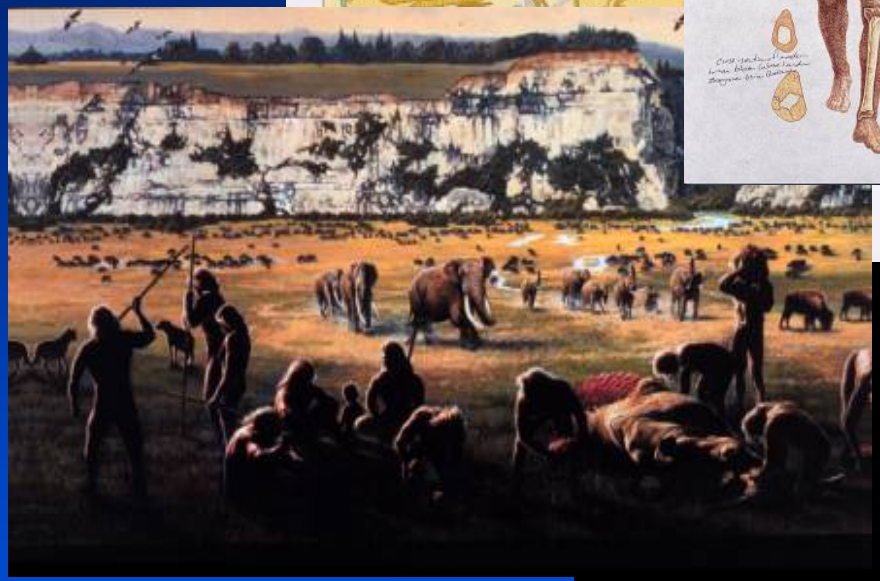
Petralona Greece

Bodo Ethiopia

Homo heidelbergensis at Boxgrove (Sussex) ~500,000 yrs



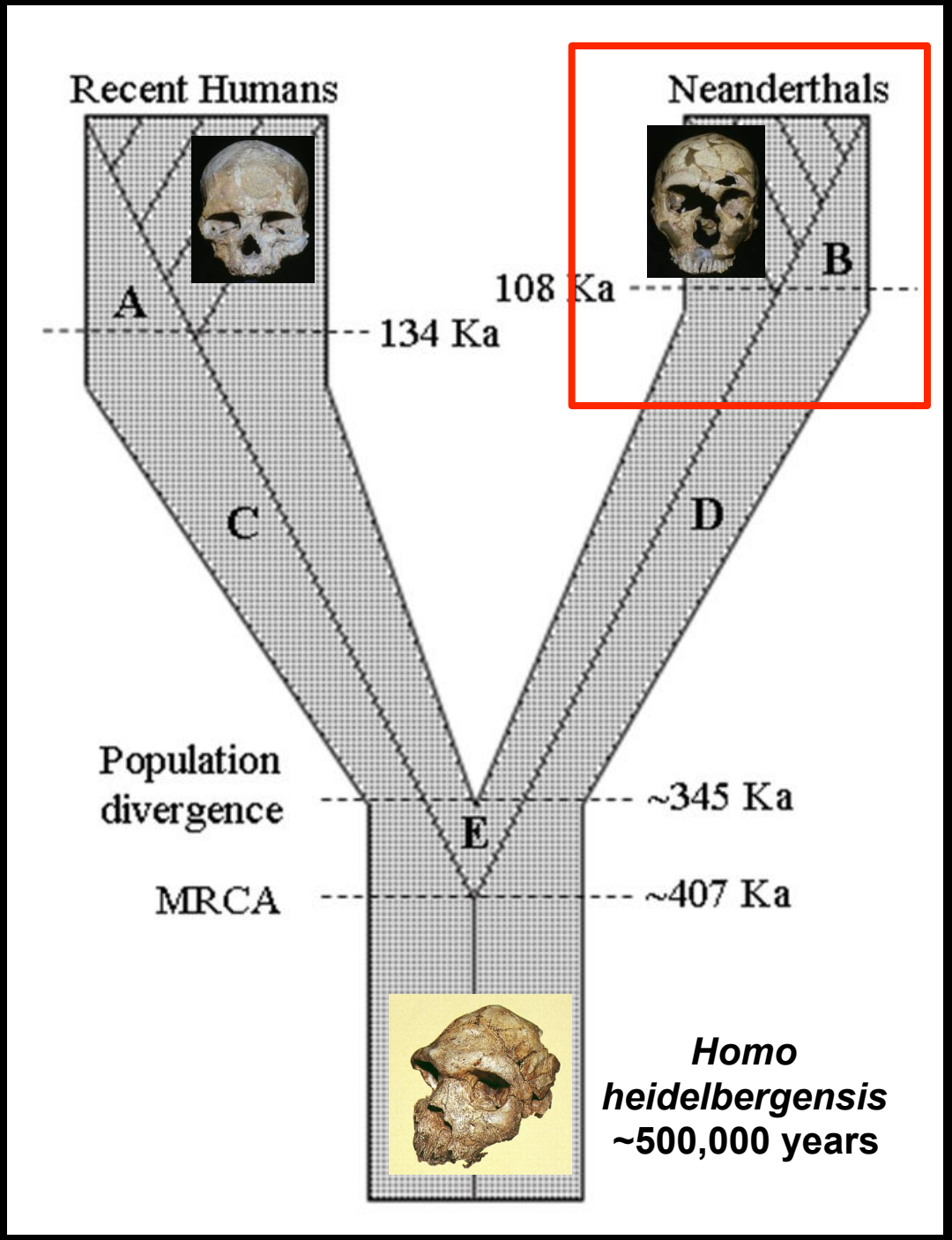




The Boxgrove Project

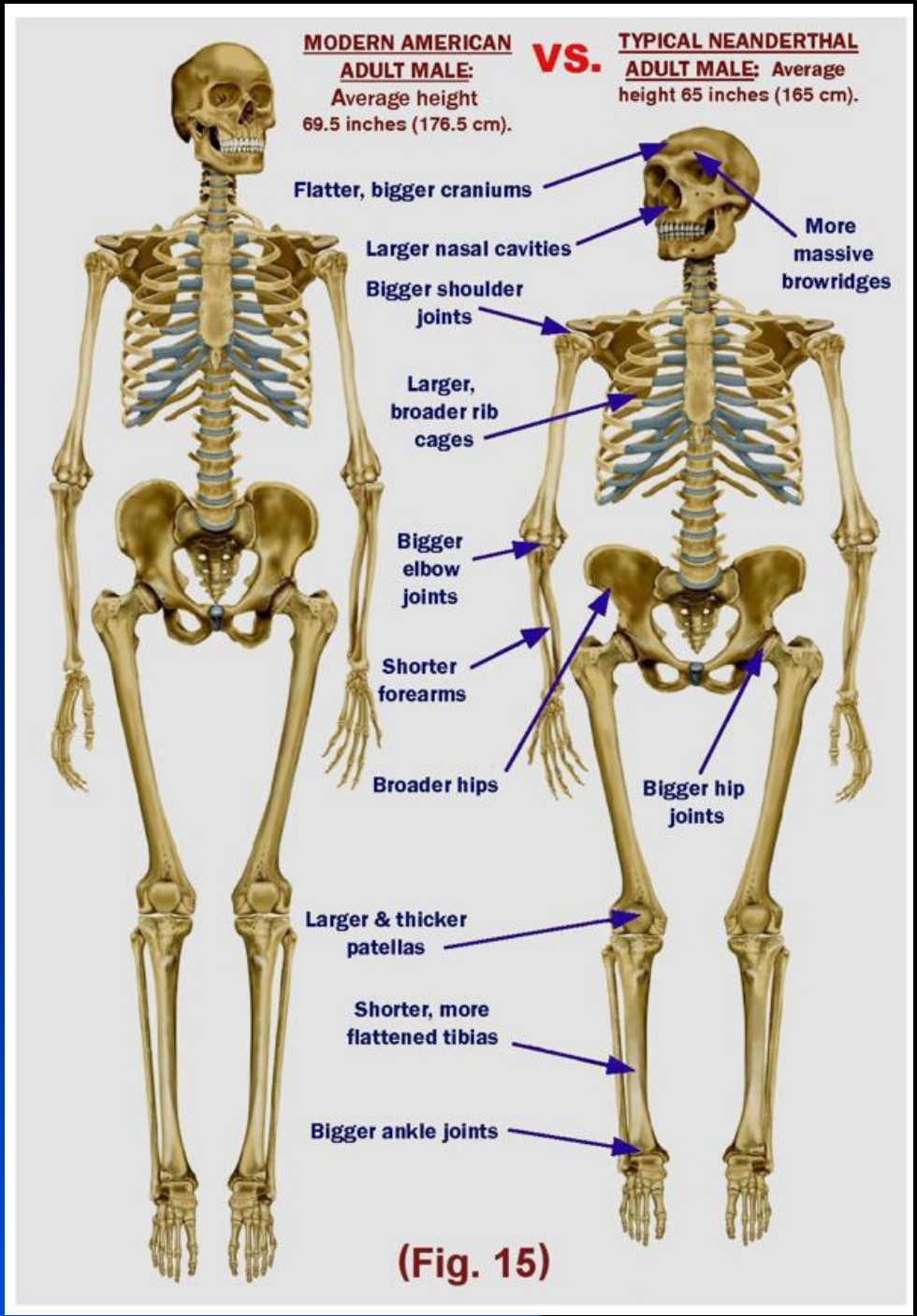
The evolution of Modern Humans and Neanderthals

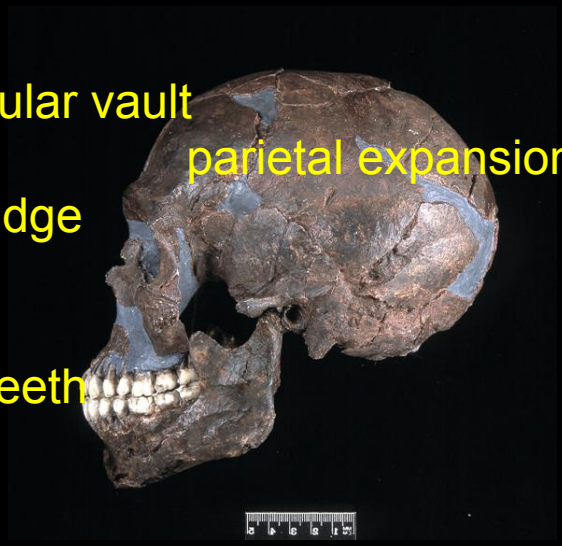
(based on fossil and genetic data)



The Neanderthals

Neander Valley 1856



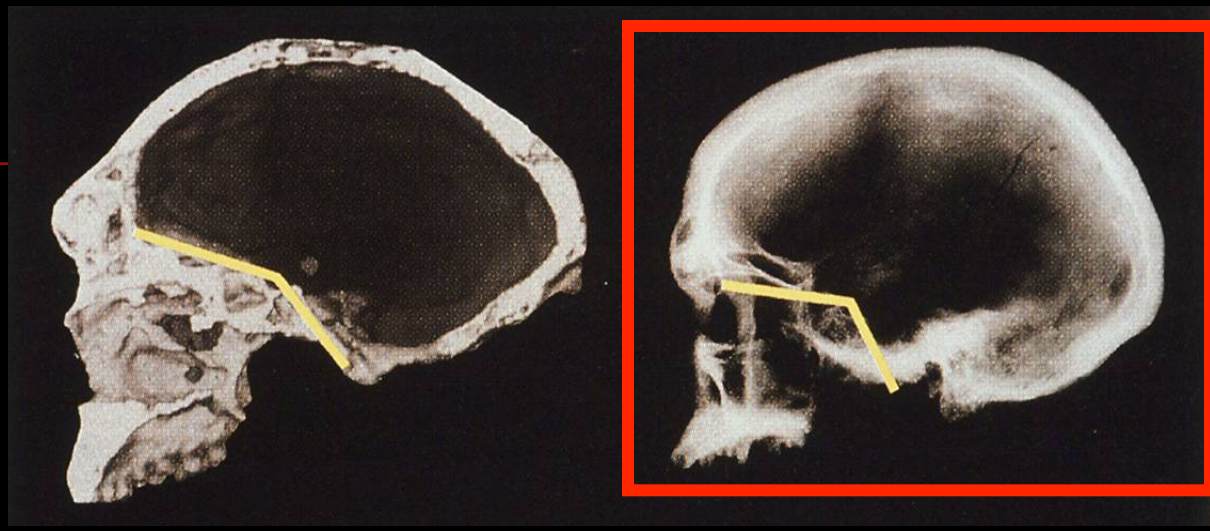


newworldeveryday.com

The origin of *our* species (*H. sapiens*)

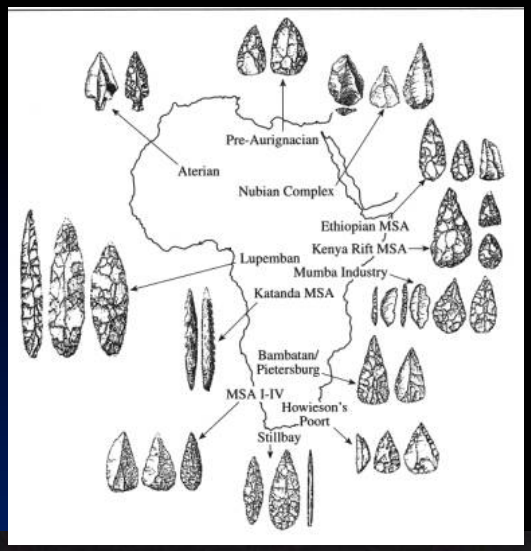
TWO origins to explain:

1.The shared (species) features

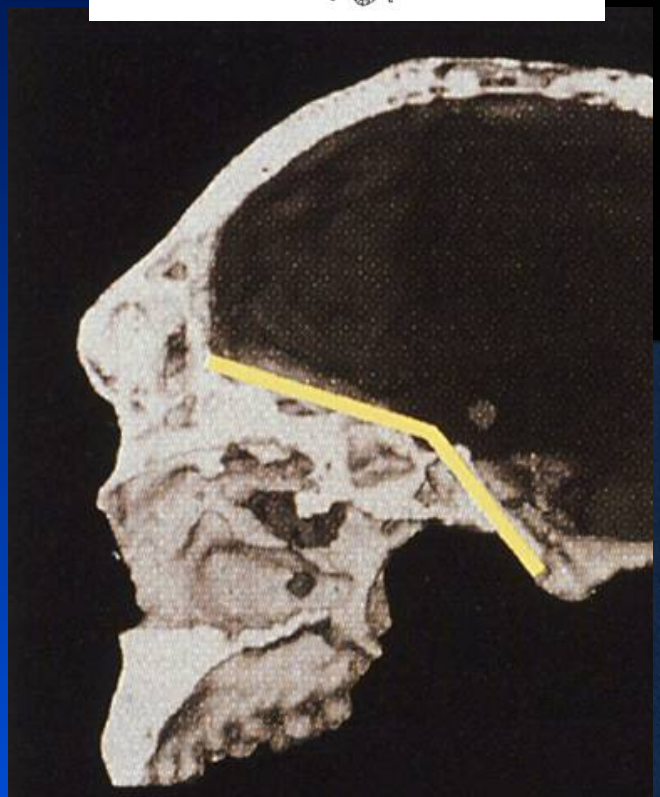


2. Non-shared (regional/racial) features

H. sapiens: fossils suggest an African origin for the modern pattern ~ 150-200ka?



Age ka ~260 ~150? ~160? ~195? >130

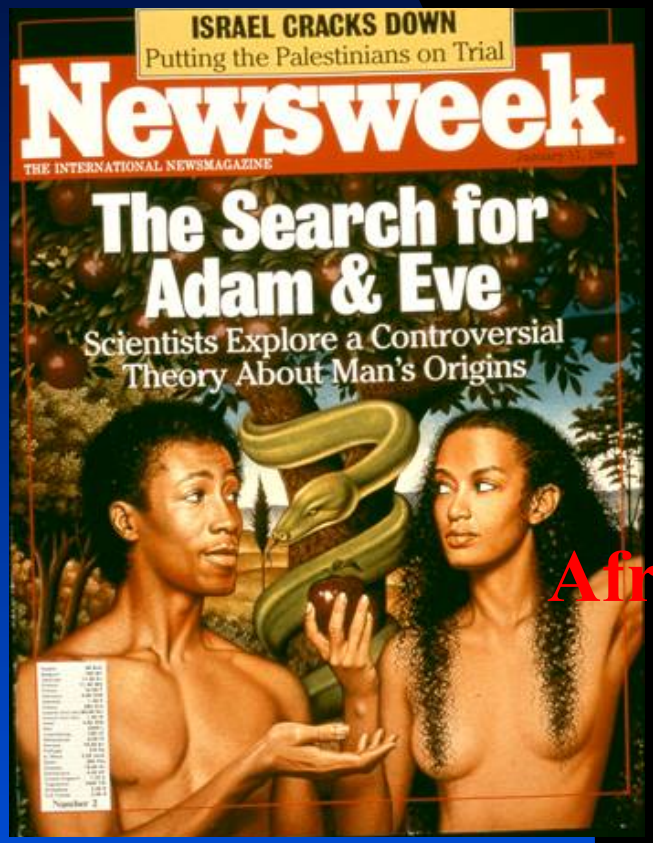


Tim White

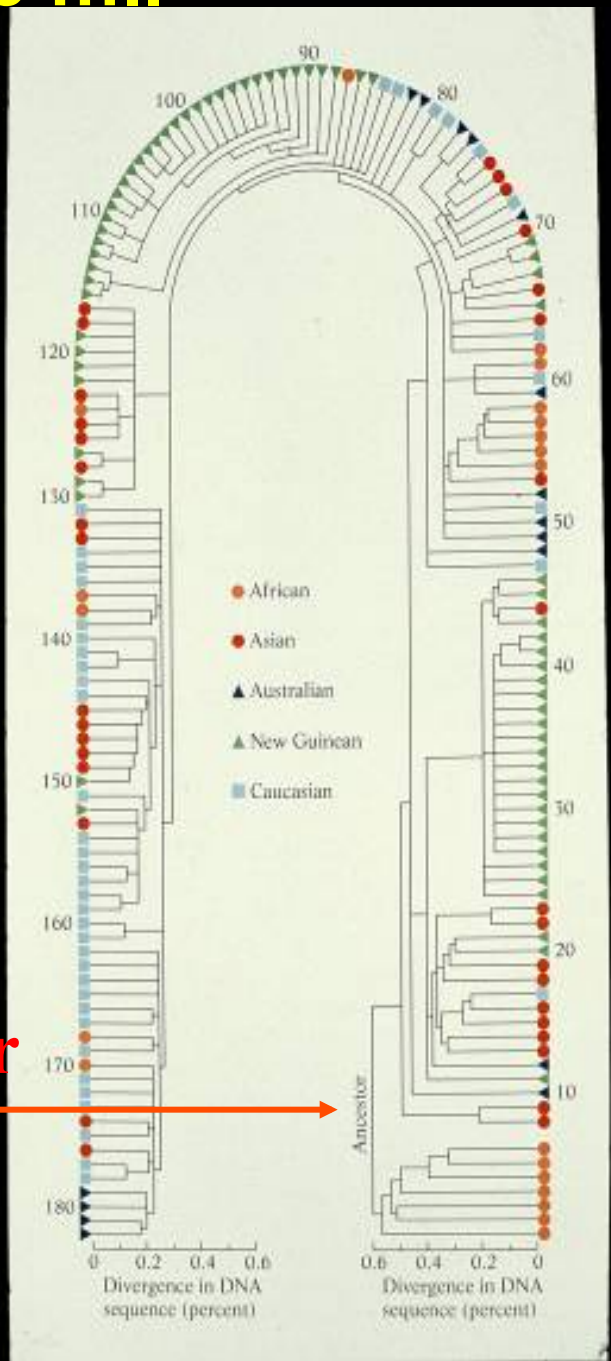
Lieberman

1987: ‘Mitochondrial Eve’…..

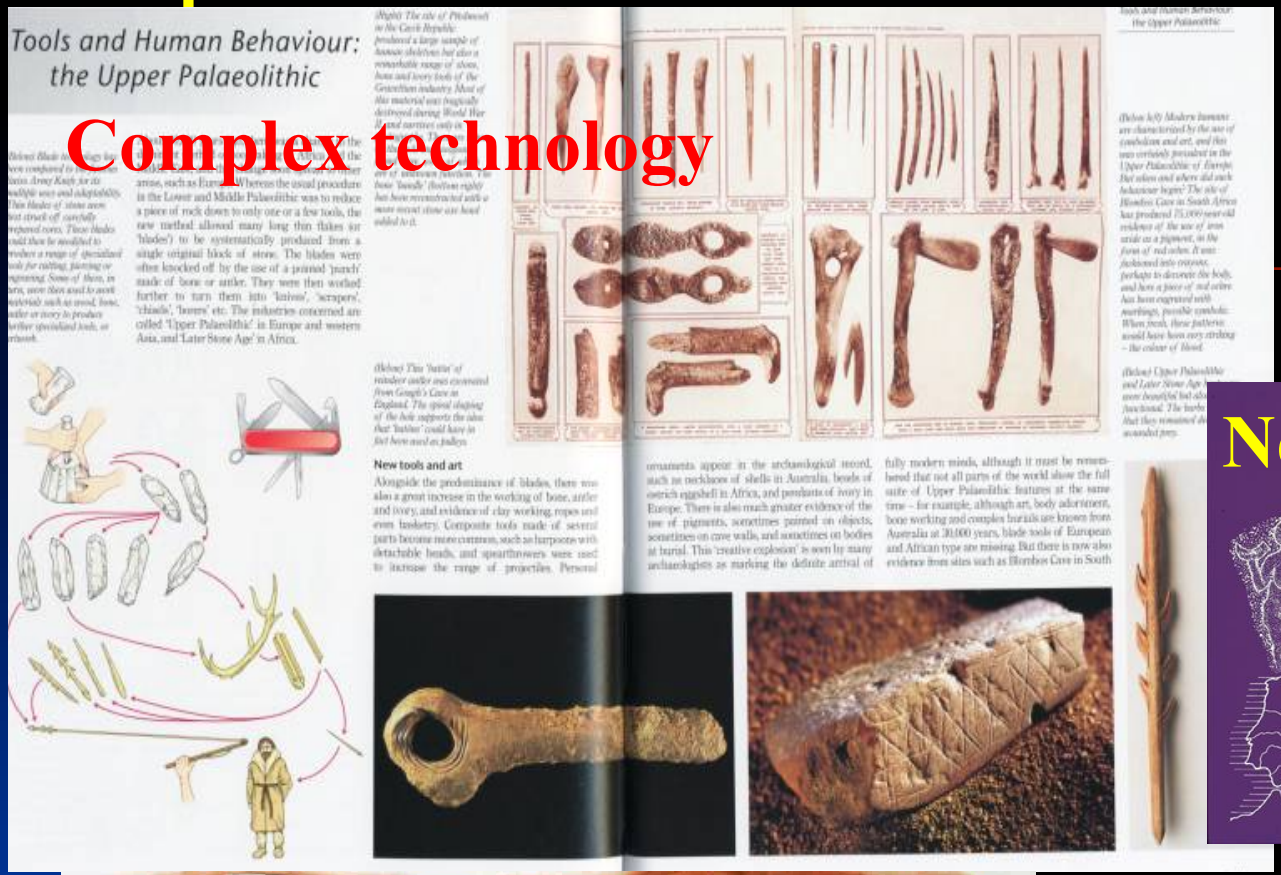
Mitochondrial DNA and human evolution *Nature* **325**, 31-36
Rebecca L. Cann, Mark Stoneking & Allan C. Wilson (1987)

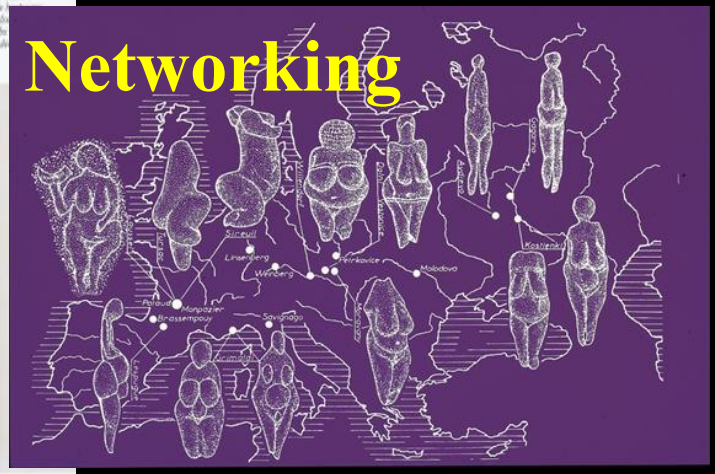


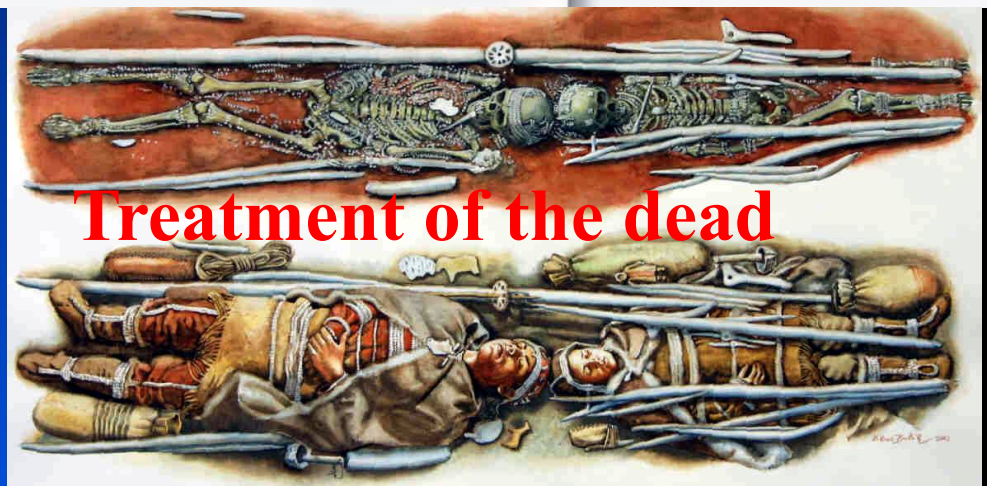
African female ancestor ~200ka



Complex human behaviour…







Microliths

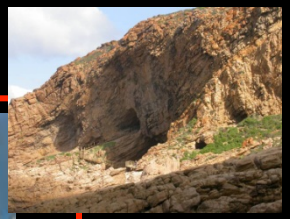
Shellfishing

Ochre

Shell beads

Early *H. sapiens* fossils

Pinnacle Point



Twin Rivers

Klasies

Howiesonspoort

Mumba

Enkapune ya Muto

Kapthurin

Twin Rivers

Klasies

Qafzeh

Blombos

300 ka 200 150 100 50 0

Taforalt

Skhul

Blombos

Enkapune ya Muto

Omo Kibish

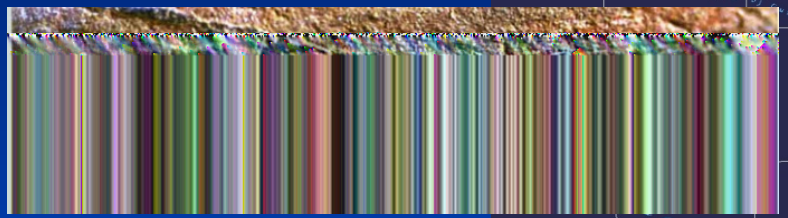
Herto

"Modern" anatomy *and* behaviour have deep roots in Africa…

Shell jewellery + red pigments ~70-100 ka

Middle Paleolithic Shell Beads in Israel and Algeria

Marian Vanhaeren,[1*] Francesco d'Errico,[2*] Chris Stringer,[3] Sarah L. James,[4] Jonathan A. Todd,[3] Henk K. Mienis[5]



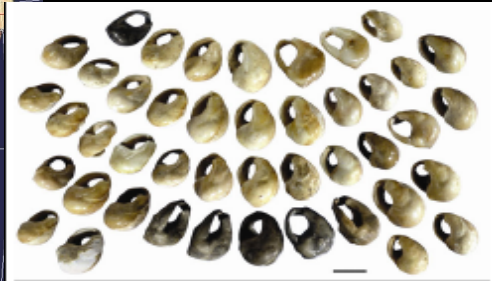
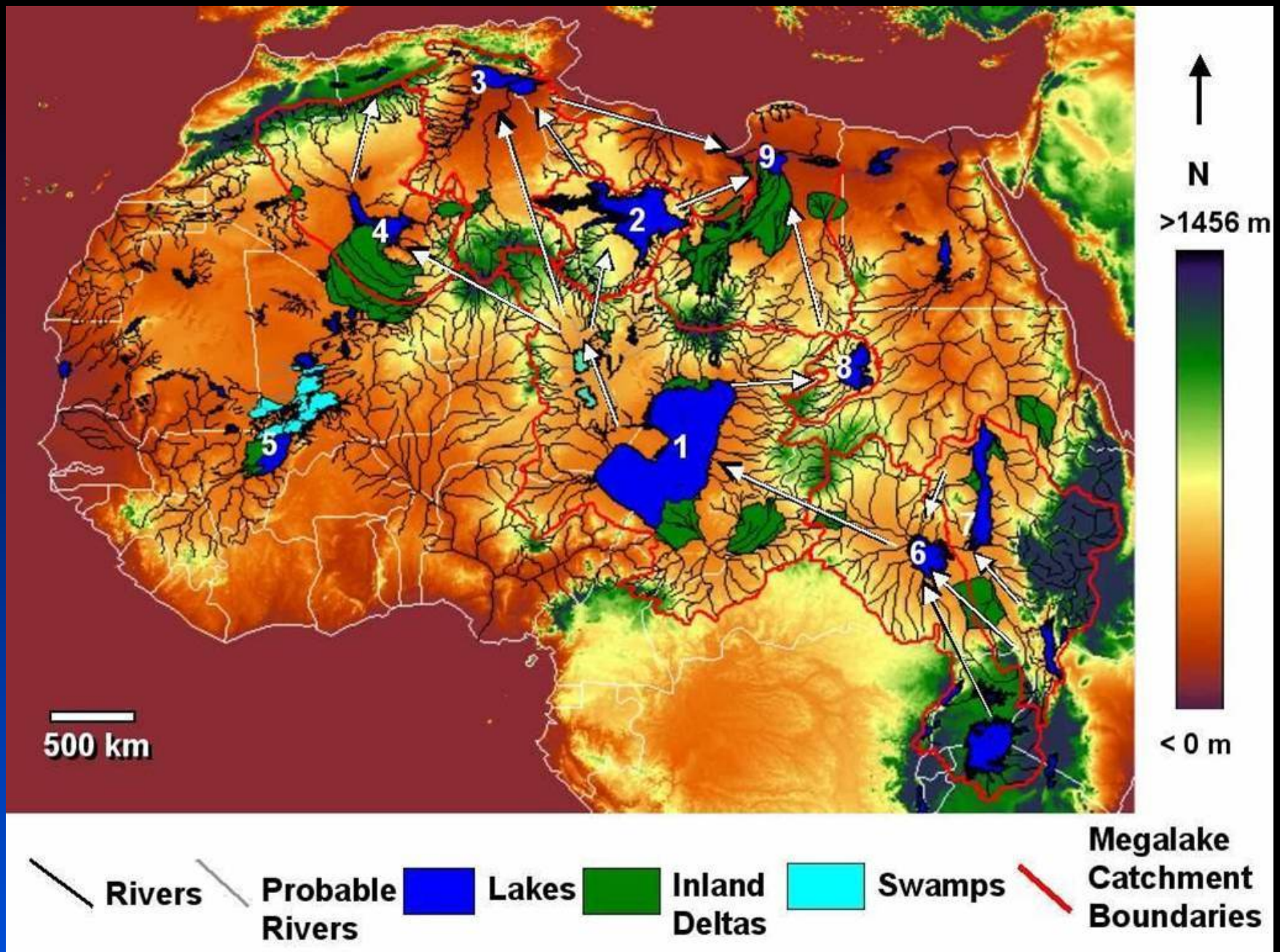


Fig. 1. Perforated *Nassarius kraussianus* beads from the Middle Stone Age of Blombos Cave. Scale bars = 5 mm.

100,000 yrs ago the Sahara was ‘green’ (Nick Drake *et al.*)



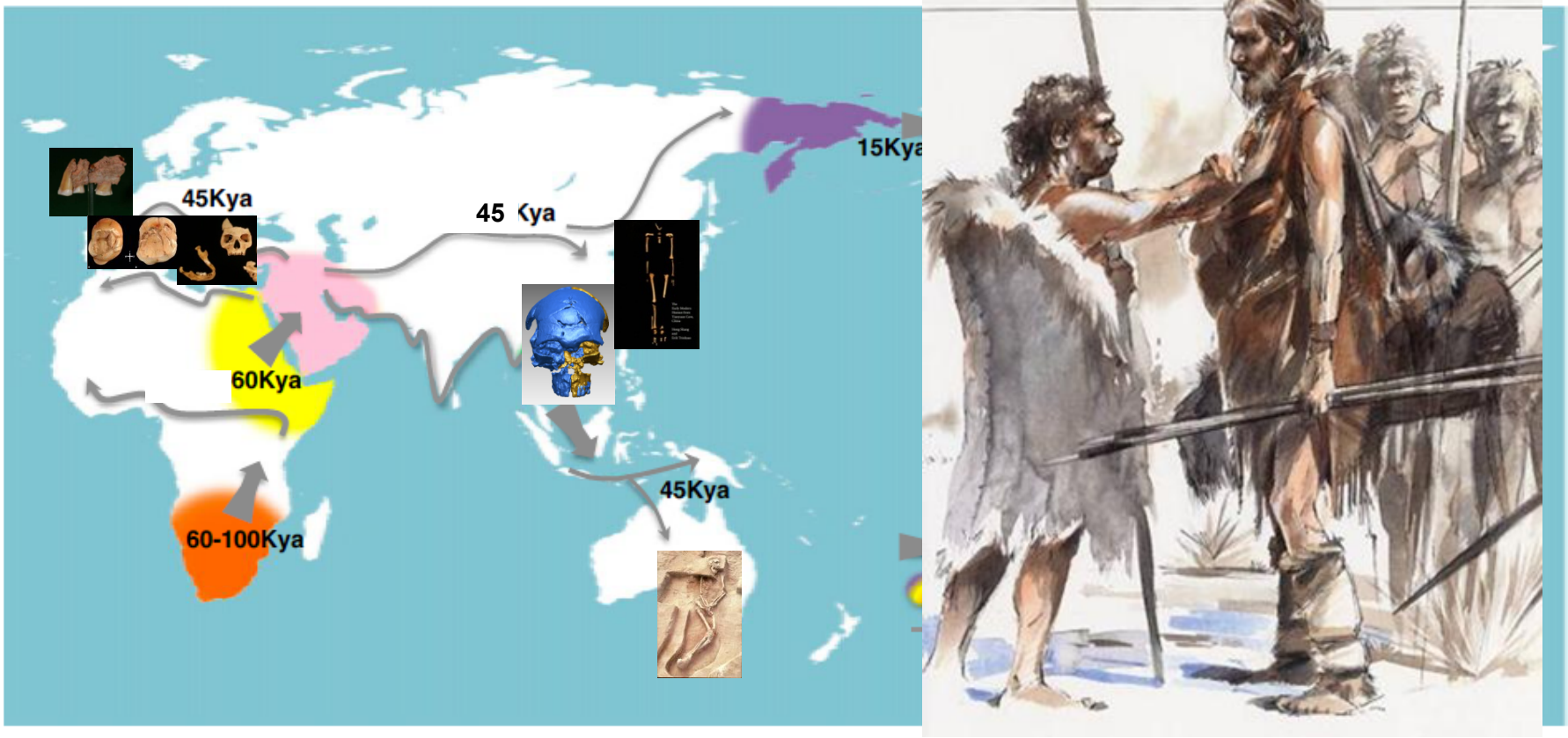


Fig. 1. Ancient dispersal patterns of modern humans during the past 100,000 y. This map highlights demic events that began with a source population in southern Africa 60 to 100 kya and conclude with the settlement of South America approximately 12 to 14 kya. Wide arrows indicate major founder events during the demographic expansion into different continental regions. Colored arcs indicate the putative source for each of these founder events. Thin arrows indicate potential migration paths. Many additional migrations occurred during the Holocene (11).

The great human expansion

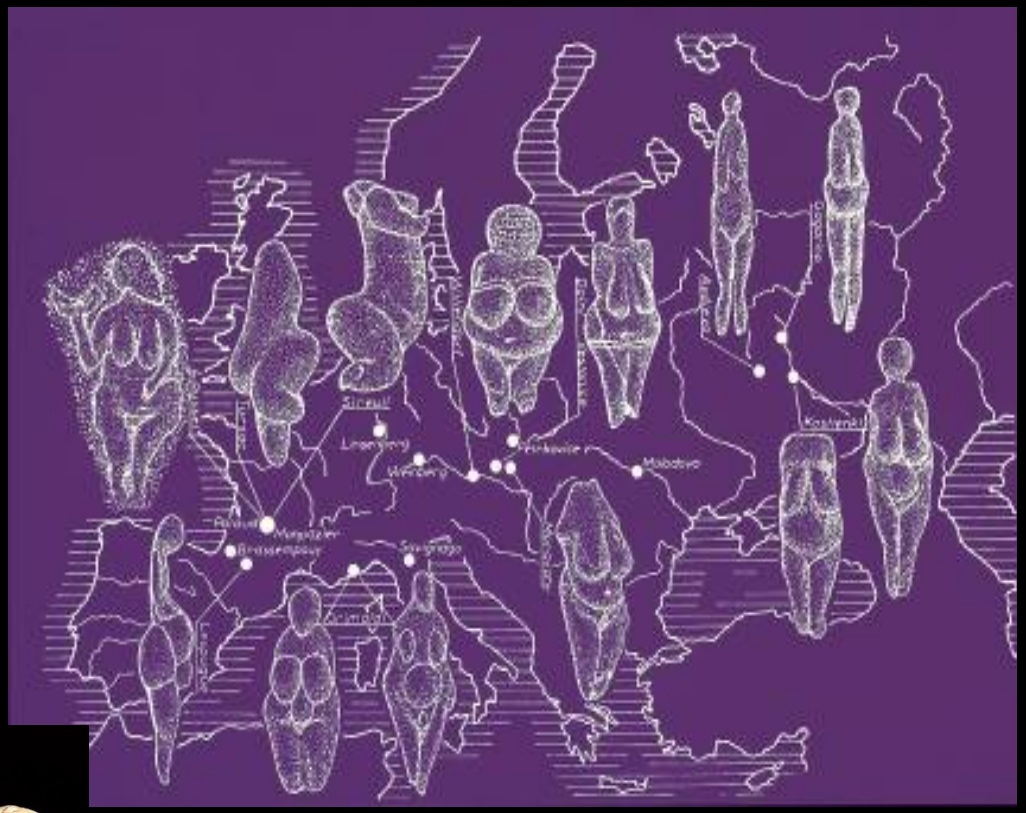
Brenna M. Henn[a], L. L. Cavalli-Sforza[a,1], and Marcus W. Feldman[b,2]

PNAS 2012

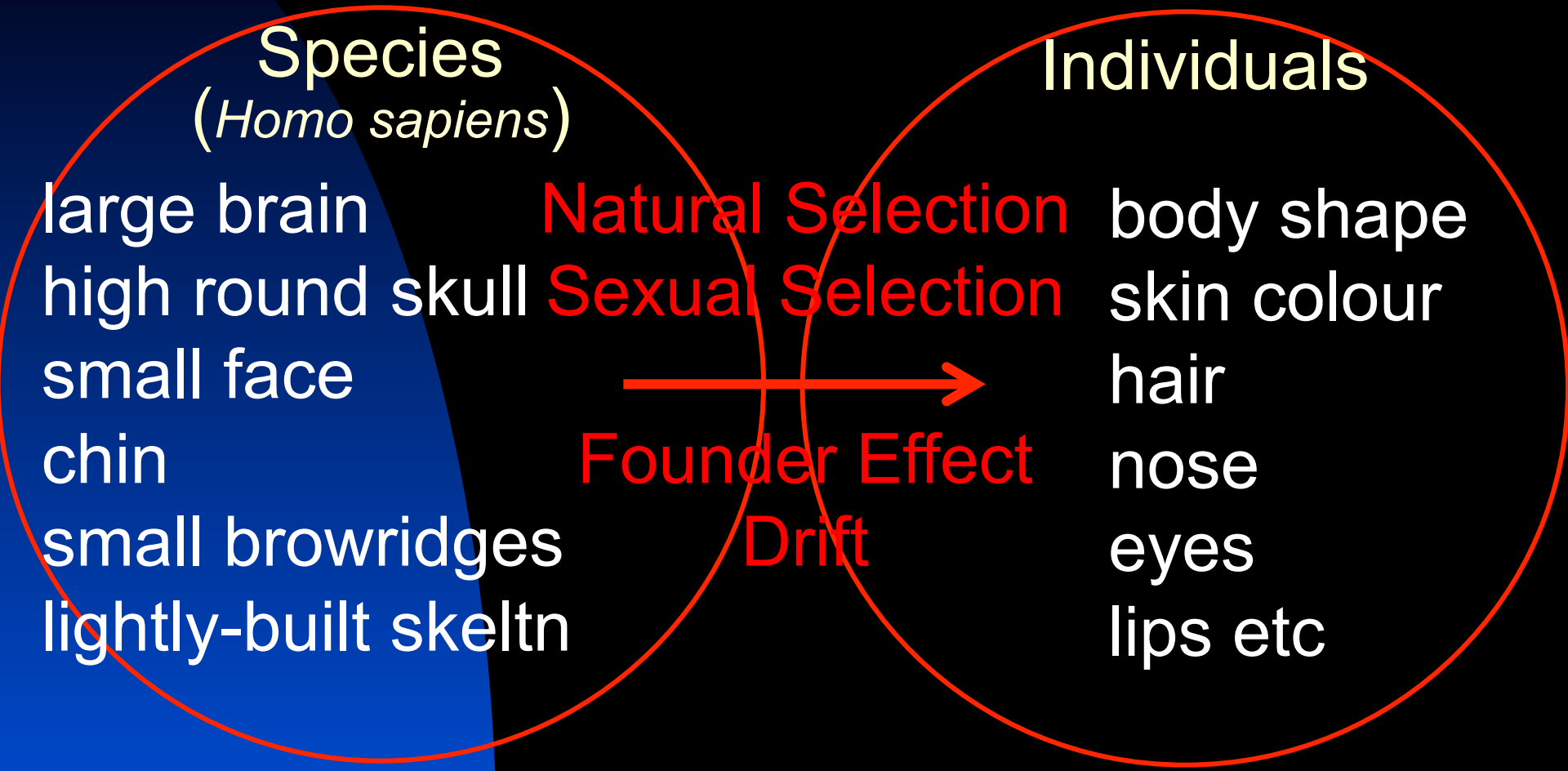
Art and music 30-40 ka

Female figurines Europe and Asia

Statuettes and flutes: Hohle Fels & Vogelherd ~ 40ka



We are all the same (species), but we all look different (individuals, ♀/♂, regions, "races").



doi:10.1038/nature12886

The complete genome sequence of a Neanderthal from the Altai Mountains

Kay Prüfer[1], Fernando Racimo[2], Nick Patterson[3], Flora Jay[2], Sriram Sankararaman[3,4], Susanna Sawyer[1], Anja Heinze[1],

doi:10.1038/nature12961

The genomic landscape of Neanderthal ancestry in present-day humans

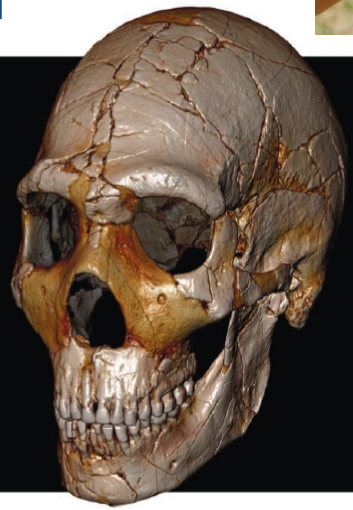
Sriram Sankararaman[1,2], Swapan Mallick[1,2], Michael Dannemann[3], Kay Prüfer[3], Janet Kelso[3], Svante Pääbo[3], Nick Patterson[1,2] & David Reich[1,2,4]

Patterns of coding variation in the complete exomes of three Neandertals

Sergi Castellano[a,1], Genís Parra[a,2], Federico A. Sánchez-Quinto[b,2], Fernando Racimo[a,c,2], Martin Kuhlwilm[a,2],

Close Encounters Of the Prehistoric Kind

The long-awaited sequence of the Neandertal genome suggests that modern humans and Neandertals interbred tens of thousands of years ago, perhaps in the Middle East



SEPARATING THEM FROM US

Some genes that differ between modern humans and Neandertals

Gene	Significance
RPTN	Encodes the protein repetin, expressed in skin, sweat glands, hair roots, and tongue papilli
TRPM1	Encodes melastatin, a protein that helps maintain skin pigmentation
THADA	Associated with type 2 diabetes in humans; evolutionary changes may have affected energy metabolism
DYRK1A	Found in an area critical for causing Down syndrome
NRG3	Mutations associated with schizophrenia
CADPS2,AUTS2	Mutations implicated in autism
RUNX2 (CBRA1)	Causes cleidocranial dysplasia, characterized by delayed closure of cranial sutures, malformed clavicles, bell-shaped rib cage, and dental abnormalities
SPAG17	Protein important for the beating of the sperm flagellum

As a result, many people living outside Africa have inherited a small but significant amount of DNA from these extinct humans.

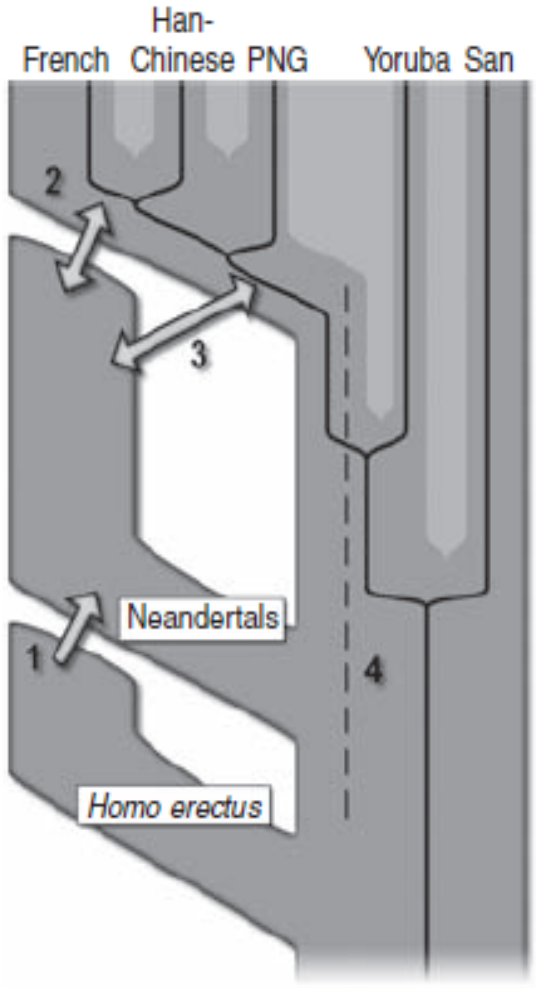
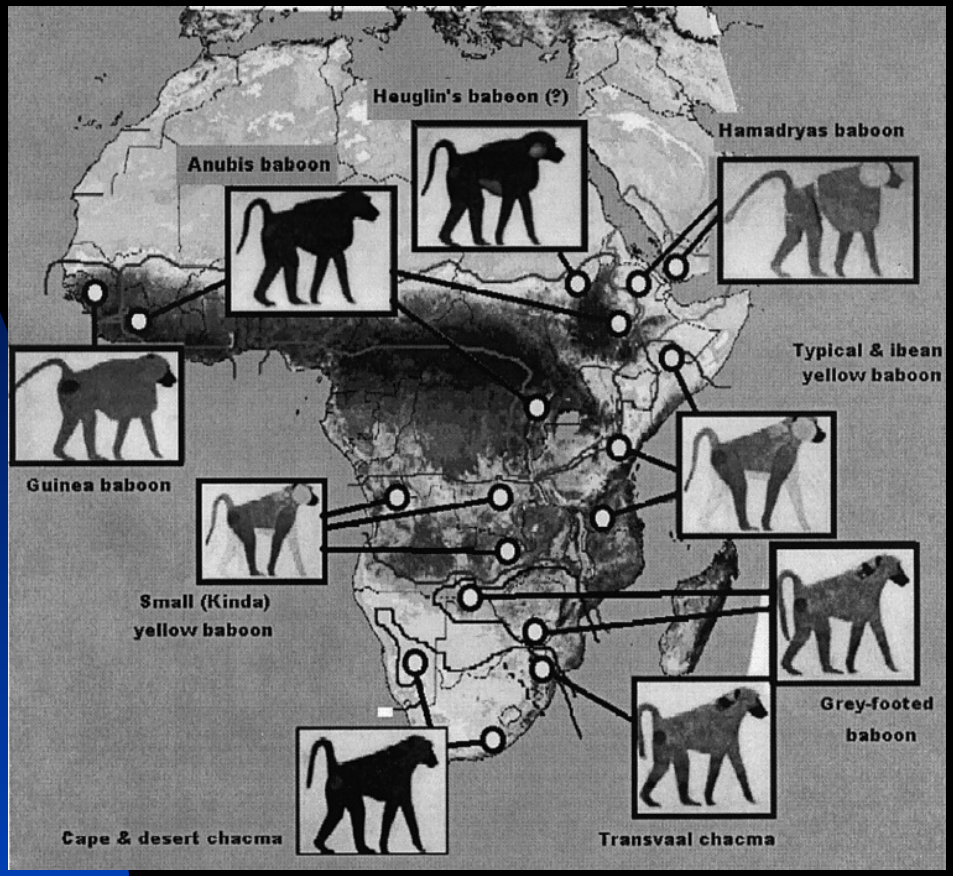


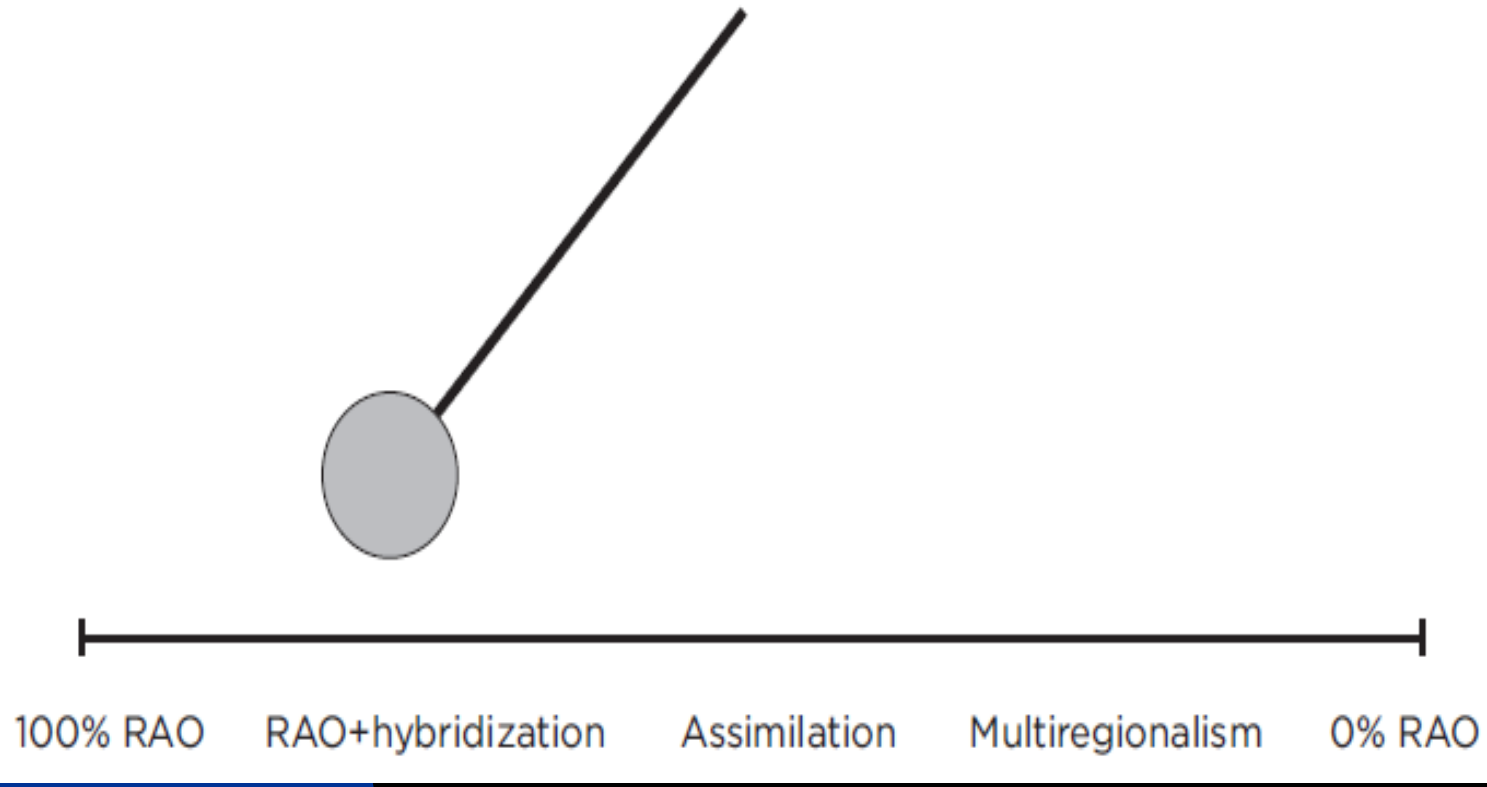
Fig. 6. Four possible scenarios of genetic mixtu

Baboon-like monkeys in Africa constitute good ‘species’ but also interbreed (Clifford Jolly)



The message is to concentrate on biology, avoid semantic traps, and realize that any species-level taxonomy based on fossil material is going to be only an approximate reflection of real-world complexities.

The pendulum of our species origin



2014

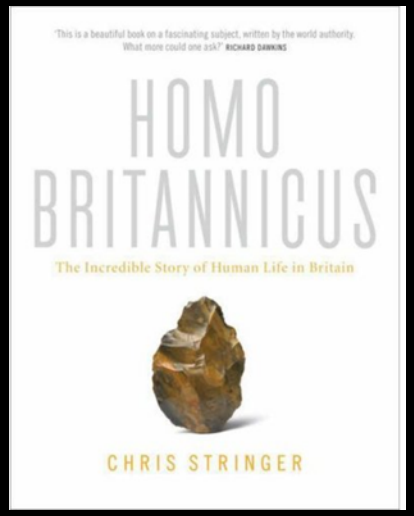
"Mostly Out of Africa"

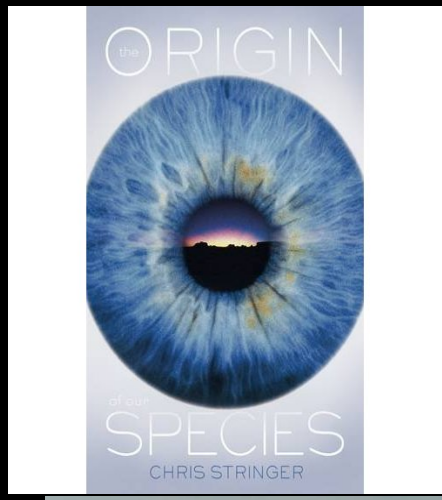
Thanks to you all for listening, and to…
The Natural History Museum London
Hum Origins Res Fund & The Calleva Foundation
and all my sources of data and illustrations..

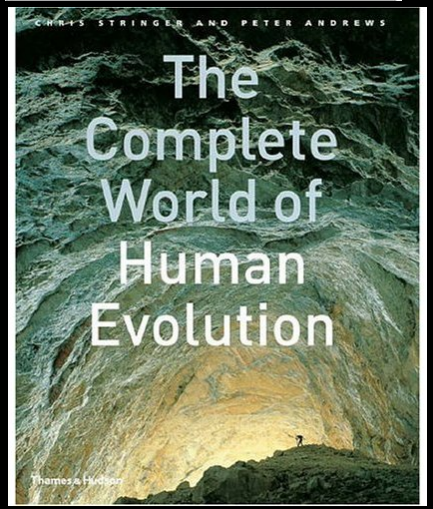
NATURAL HISTORY MUSEUM

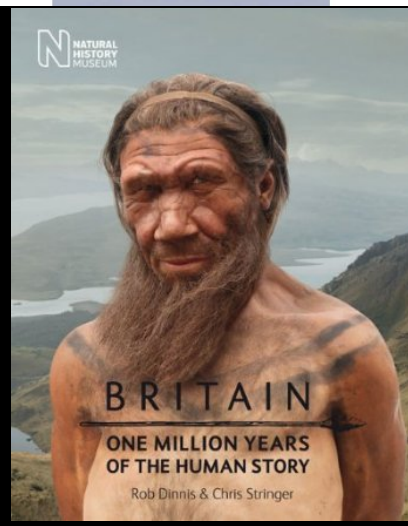
HUMAN ORIGINS RESEARCH GROUP

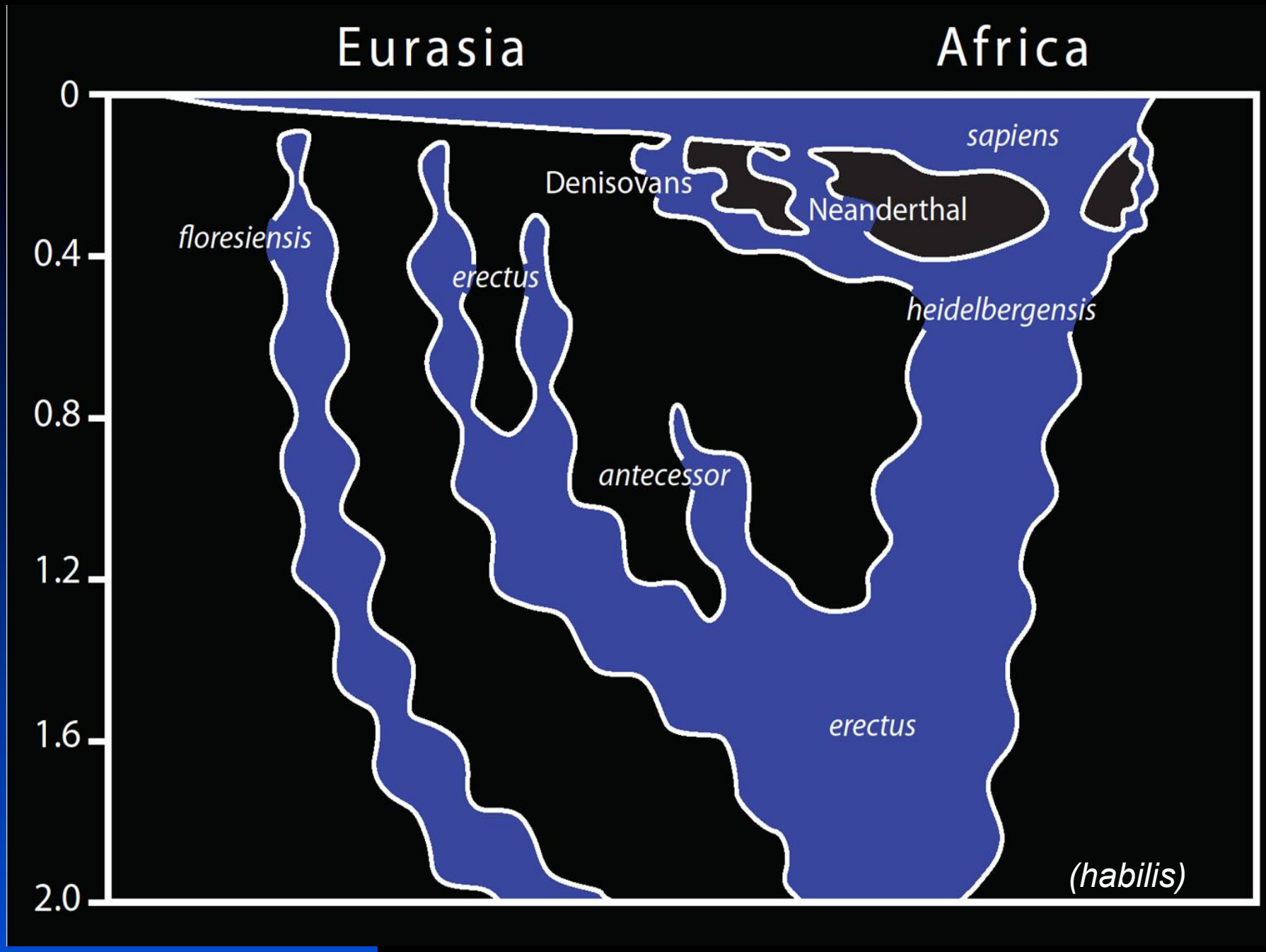
PAB
PATHWAYS TO ANCIENT BRITAIN










Eurasia
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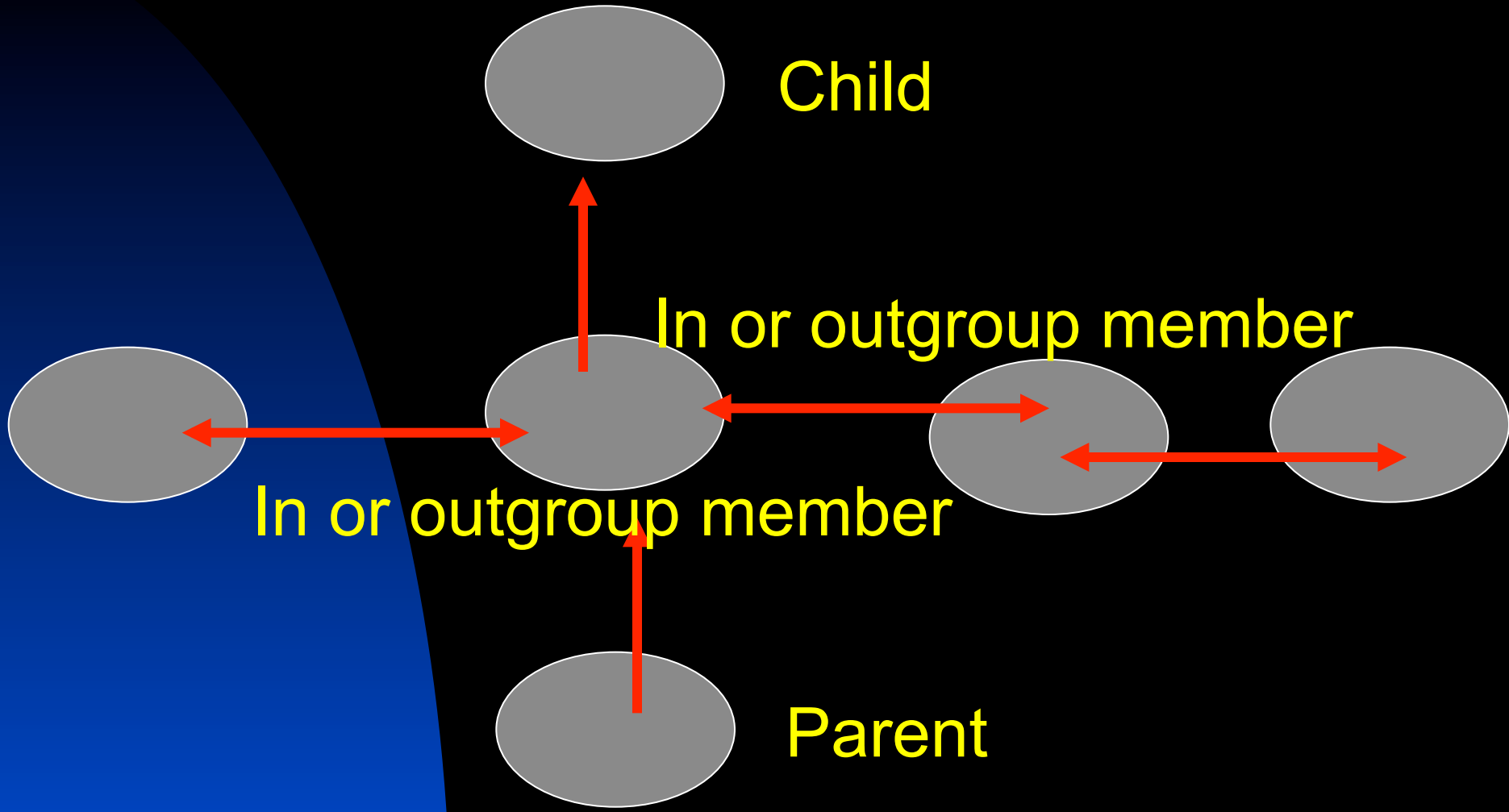
floresiensis
erectus
Denisovans
Neanderthal
sapiens
heidelbergensis
antecessor
erectus
(habilis)

Transmission in archaic humans?



vis-à-vis: Explorations in Anthropology, Vol. 10: 102–125.
Style, Symboling, and Interaction in Middle Stone Age Societies
JAYNE WILKINS

Modern humans grow more slowly, live longer, and network more widely…

Current Anthropology
Volume 41, Number 4, 2000
The "Venus" Figurines: Textiles, Basketry, Gender, and Status in the Upper Paleolithic
by O. Soffer, J. M. Adovasio & D. C. Hyland

Dental evidence for ontogenetic differences between modern humans and Neanderthals

Tanya M. Smith[a,b,1], Paul Tafforeau[c,1], Donald J. Reid[d], Joane Pouech[b,c], Vincent Lazzari[b,c,e], John P. Zermeno[a], Debbie Guatelli-Steinberg[f], Anthony J. Olejniczak[b], Almut Hoffman[g], Jakov Radovčić[h], Masrour Makaremi[i], Michel Toussaint[j], Chris Stringer[k], and Jean-Jacques Hublin[b]

[a]Department of Human Evolutionary Biology, Harvard University, Cambridge, MA 02138; [b]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, 04103 Leipzig, Germany; [c]European Synchrotron Radiation Facility, BP 220, 38046 Grenoble Cedex, France; [d]Department of Oral Biology, School of Dental Sciences, Newcastle University, Newcastle upon Tyne NE2 4BW, United Kingdom; [e]International Institute of Paleoprimatology and Human Paleontology: Evolution and Paleoenvironments, Unité Mixte de Recherche Centre National de la Recherche Scientifique 6046, Université de Poitiers, 86022 Poitiers cedex, France; [f]Department of Anthropology, Ohio State Universit… Charlottenburg–Langhansbau, D-14059 Berlin, Germany; [h]Croatian Natural Histor… of Bordeaux II, 33000 Bordeaux, France; [j]Direction de l'Archeologie, Service Publi… Natural History Museum, London SW7 5BD, United Kingdom

Edited* by Richard G. Klein, Stanford University, Stanford, CA, and approved Oct

Humans have an unusual life history, with an early weaning age, long childhood, late first reproduction, short interbirth intervals, and long lifespan. In contrast, great apes wean later, reproduce

Older age becomes common late in human evolution

Rachel Caspari*† and Sang-Hee Lee‡

*Department of Anthropology, University of Michigan, Ann Arbor, MI 48109-1092; and ‡Department of Anthropology, University of California, Riverside, CA 92521-0418

Communicated by Ward H. Goodenough, University of Pennsylvania, Philadelphia, PA, May 27, 2004 (received for review October 28, 2003)

Increased longevity, expressed as number of individuals surviving to older adulthood, represents one of the ways the human life history pattern differs from other primates. We believe it is a critical demographic factor in the development of human culture. Here, we examine when changes in longevity occurred by assessing the ratio of older to younger adults in four hominid dental samples from successive time periods, and by determining the significance of differences in these ratios. Younger and older adult status is assessed by wear seriation of each sample. Whereas there is significant increased longevity between all groups, indicating a trend of increased adult survivorship over the course of human evolution, there is a dramatic increase in longevity in the modern humans of the Early Upper Paleolithic. We believe that this great increase contributed to population expansions and cultural innovations associated with modernity.

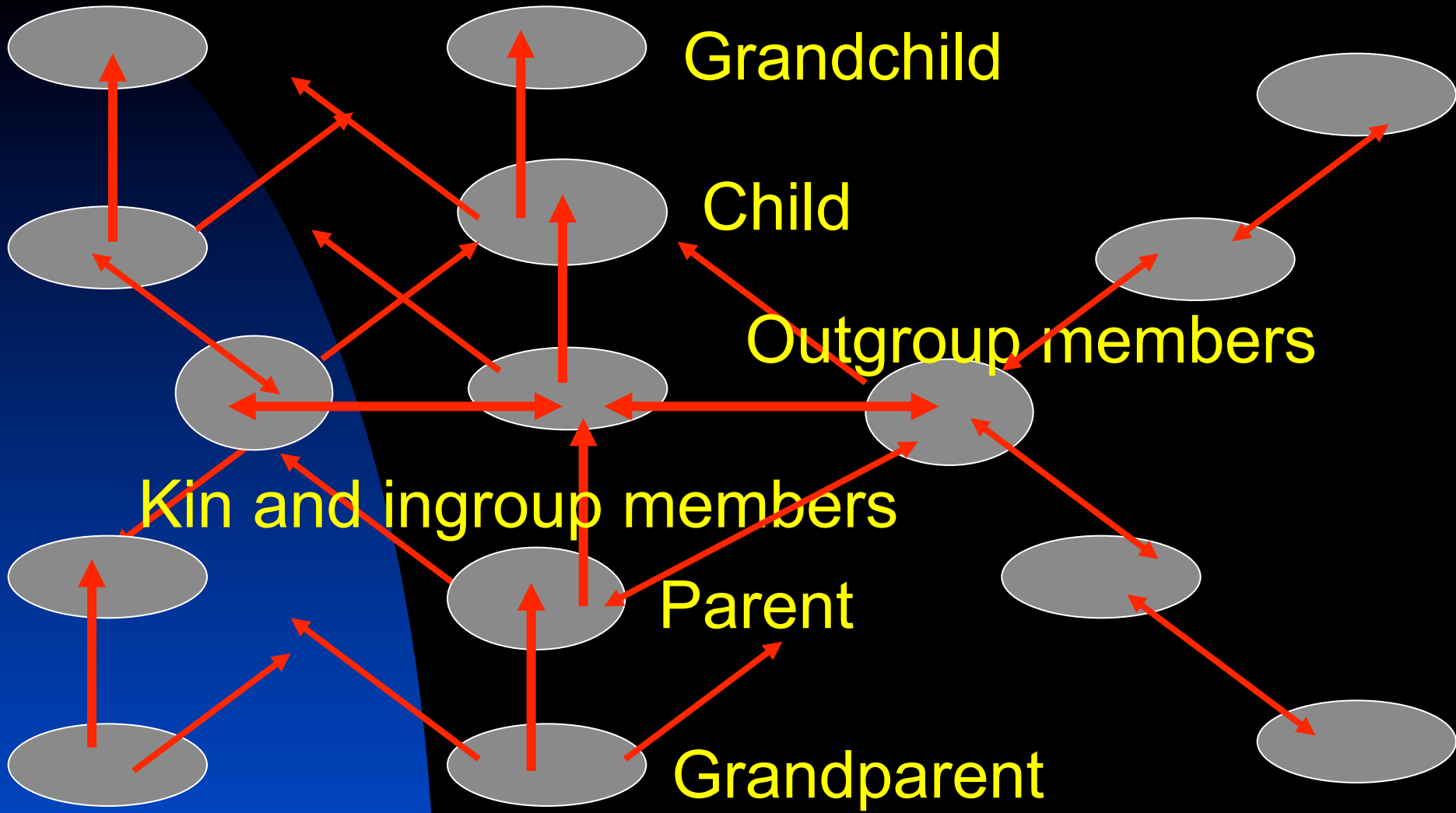
brain size and … supports the … By longevit… span attainabl… adults who li… individuals liv… selection favo… tant for many … longevity. To … involved with … study to adu… younger adult… Although this … living popula… insight into th… record.

…ssil record …ly *Homo*. …ximum life …number of …number of …vidence of …d is impor… …changes in …c problems …he present …f older to …over time. …cted in the …ges provide …man fossil

***Science** 11 September 2009:*
***Vol. 325 no. 5946** p. 1359*
DOI: 10.1126/science.1175404

30,000-Year-Old Wild Flax Fibers

Transmission in modern humans?



Variation in the Neanderthal genome appears to have been lower than in present-day humans and is among the lowest measured for any organism.

Signs of low genetic diversity in the Neanderthal woman's DNA indicate that her parents were closely related, possibly half siblings. Small population sizes encouraged inbreeding among Neandertals, the researchers suggest.

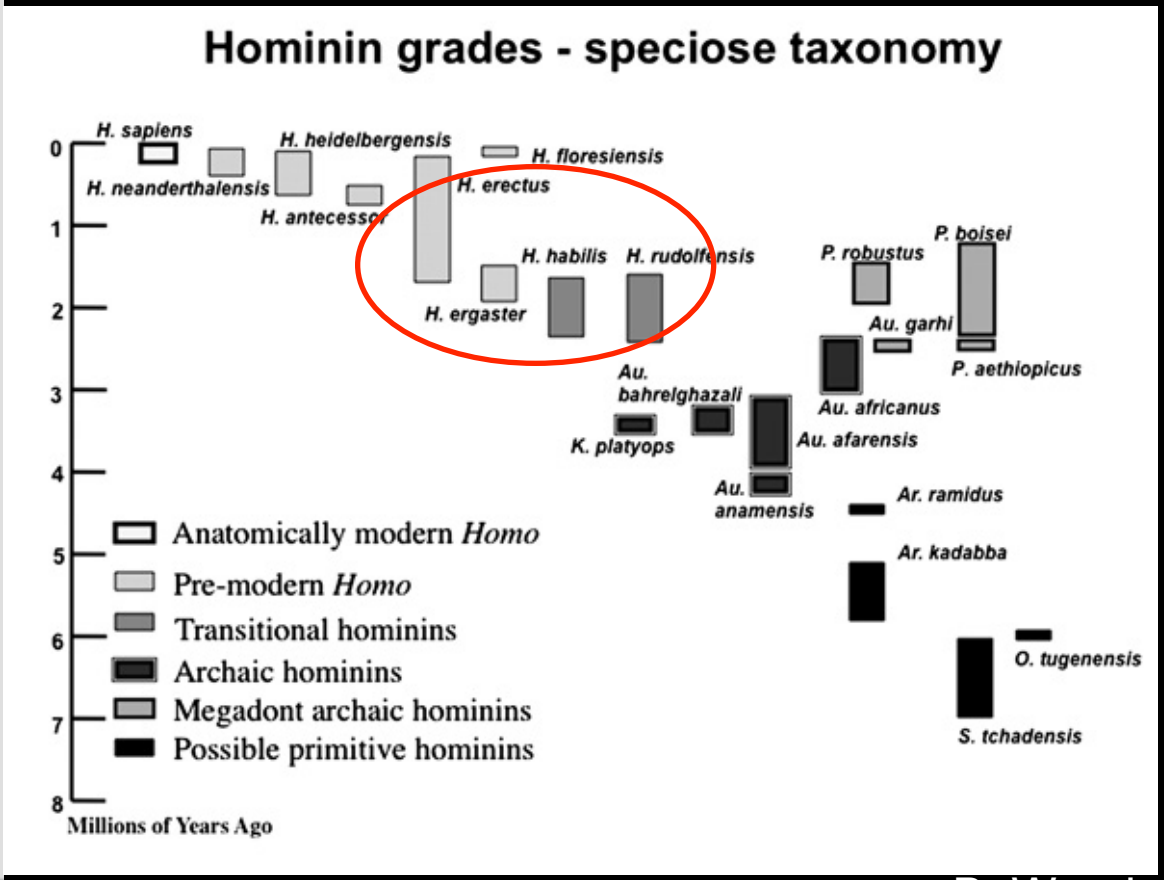
Mating in small and isolated populations may have caused Neandertal populations to be more differentiated from one another than what is typical for present-day humans.

The first explorers?

Always a crossroads, the village of Dmanisi (above) once overlooked the old Silk Road through the Caucasus region. Nearly 1.8 million years ago the site lay on a peninsula between the Black and Caspian Seas (map, right), along one of several land corridors into Eurasia. Humans could have moved out of Africa—and back into it—in multiple waves, reaching Java by at least 1.6 million years ago. By one million years ago, *Homo* had spread across Eurasia, leaving bones and tools in its wake.

Dmanisi: humans at the gates of Europe 1.8Ma


Science
18 October 2013 | $10
AAAS


Hominin grades - speciose taxonomy
H. sapiens
H. neanderthalensis
H. heidelbergensis
H. antecessor
H. floresiensis
H. erectus
H. ergaster
H. habilis
H. rudolfensis
P. robustus
P. boisei
Au. garhi
P. aethiopicus
Au. africanus
Au. bahrelghazali
K. platyops
Au. afarensis
Au. anamensis
Ar. ramidus
Ar. kadabba
O. tugenensis
S. tchadensis
Anatomically modern Homo
Pre-modern Homo
Transitional hominins
Archaic hominins
Megadont archaic hominins
Possible primitive hominins
0
1
2
3
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5
6
7
8
Millions of Years Ago

B. Wood

Naturwissenschaften. 2007 Feb: 94(2):107-112.

Evidence of earliest human occurrence in Europe: the site of Pirro Nord (Southern Italy).

Arzarello M, Marcolini F, Pavia G, Pavia M, Petronio C, Petrucci M, Rook L, Sardella R.

1.5 Ma?

ARTICLE IN PRESS

ELSEVIER

Quaternary Science Reviews ▮ (▮▮▮▮) ▮▮▮–▮▮▮

QSR

Evaluation of the Olduvai subchron in the Orce ravine (SE Spain). Implications for Plio-Pleistocene mammal biostratigraphy and the age of Orce archeological sites

L. Gibert[a,*], G. Scott[b], C. Ferràndez-Cañadell[c]

1.4 Ma?

1.2 Million year old jawbone found in Sima del Elefante Atapuerca, Spain

1.2 Ma?

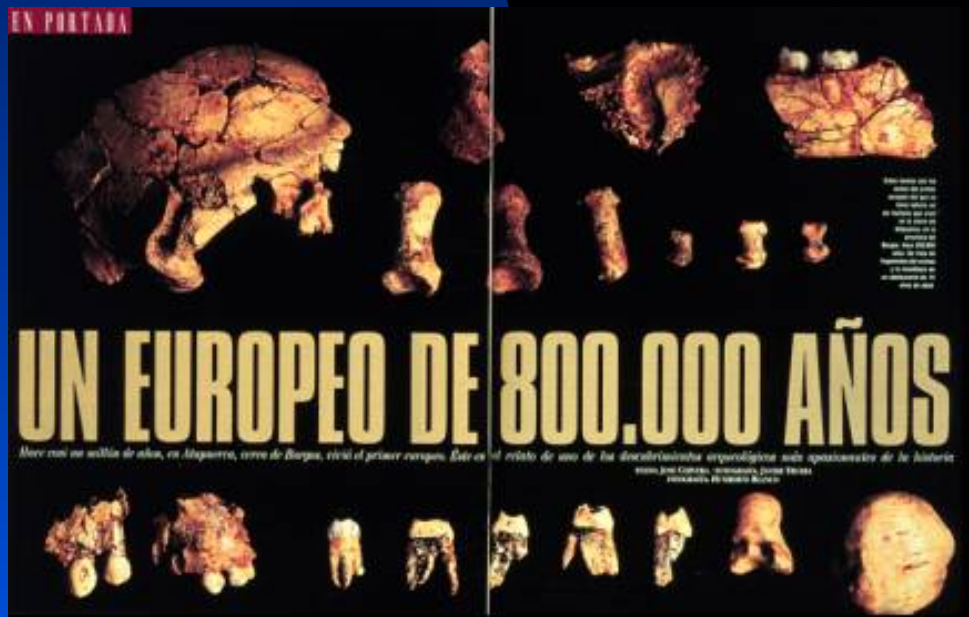
Atapuerca

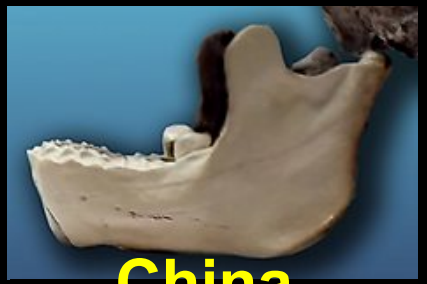

El mapa de los yacimientos
REGISTRO CRONOLÓGICO
PRINCIPALES HALLAZGOS
VISTA AÉREA
GRAN DOLINA
ENTRE 1.000.000 Y 200.000 AÑOS
Principales restos de 'Homo antecessor'. Huesos de grandes carnívoros
GALERÍA
ENTRE 400.000 Y 200.000 AÑOS
'Homo heidelbergensis' y herramientas de Modo 2 (Achelense).
TRINCHERA DEL FERROCARRIL
Los yacimientos afloraron durante la construcción de una línea de ferrocarril (1896-1901) hoy abandonada
HALLAZGO DE LA MANDÍBULA
SIMA DEL ELEFANTE
ENTRE 1,3 MILLONES Y 150.000 AÑOS
Lascas de Modo 1 (Olduvayense)
SIMA DE LOS HUESOS
400.000 AÑOS
'Homo heidelbergensis'. Es el yacimiento más rico en fósiles humanos
PORTALÓN
3.000 AÑOS (EDAD DEL BRONCE)
Adornos de hueso y marfil
0 50M

Ceprano Italy

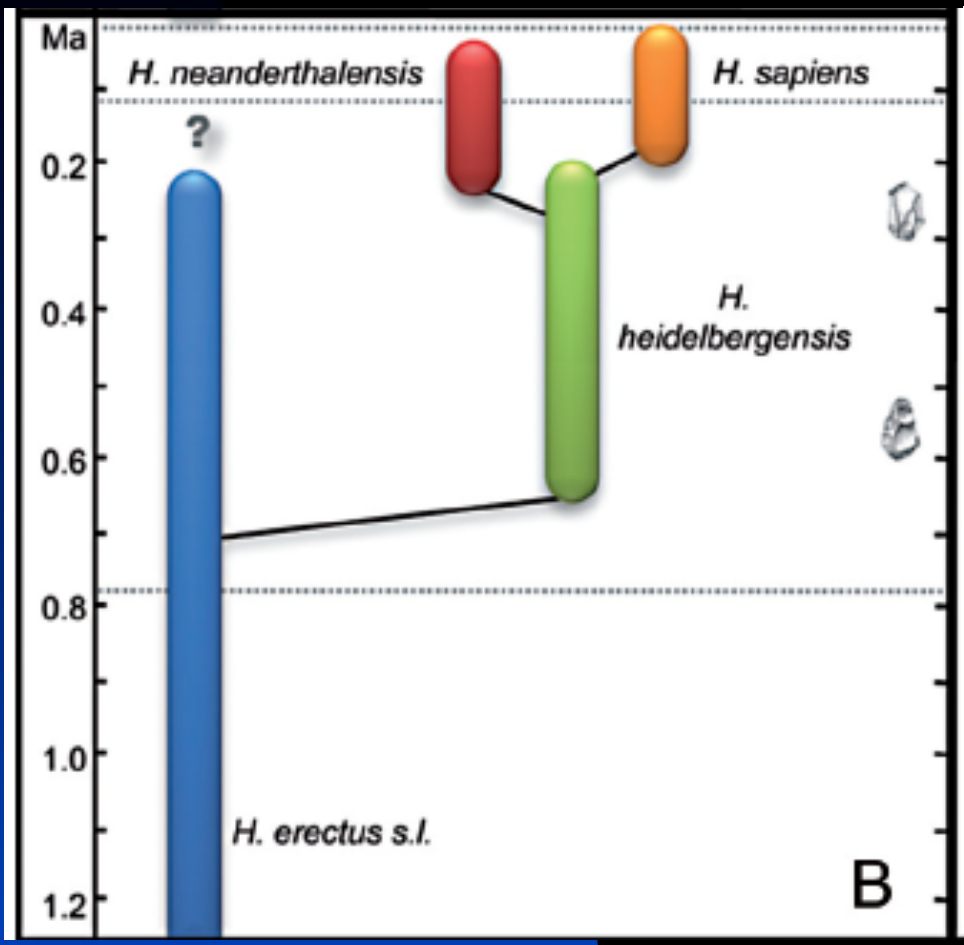
Homo antecessor 0.8Ma

Atapuerca Spain: Gran Dolina





China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H. sapiens
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H.
heidelbergensis
H. erectus s.l.
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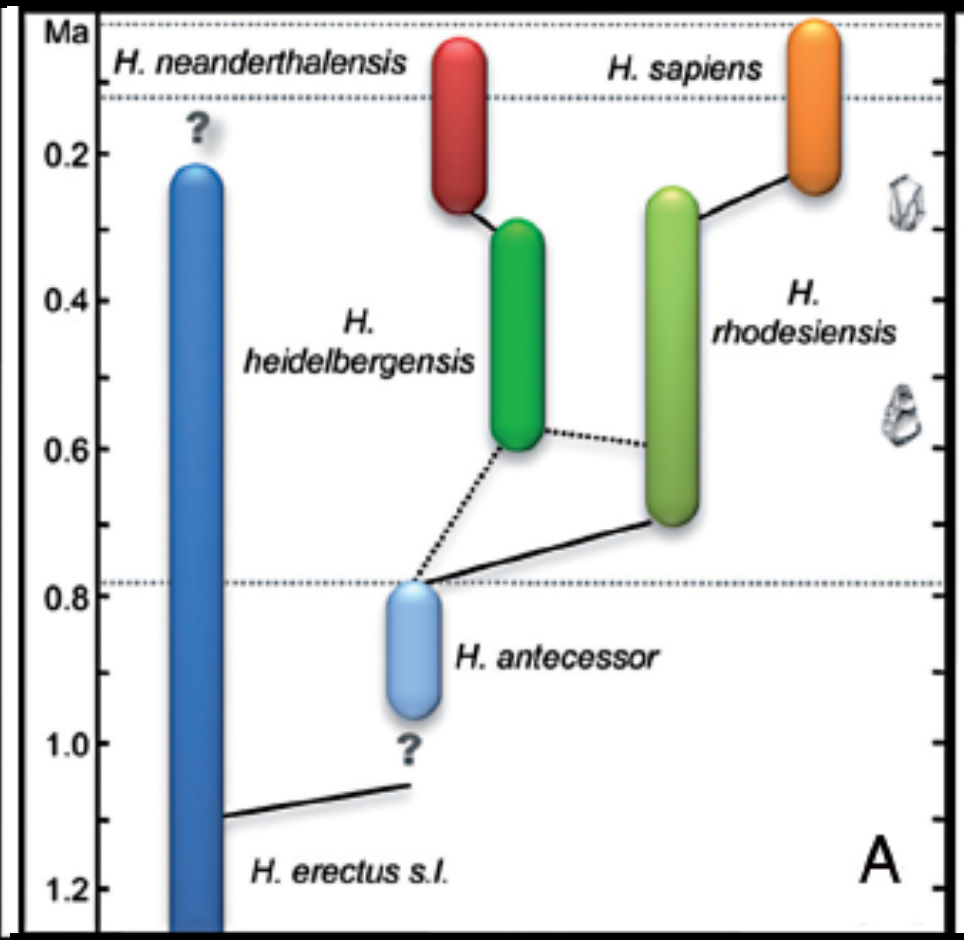
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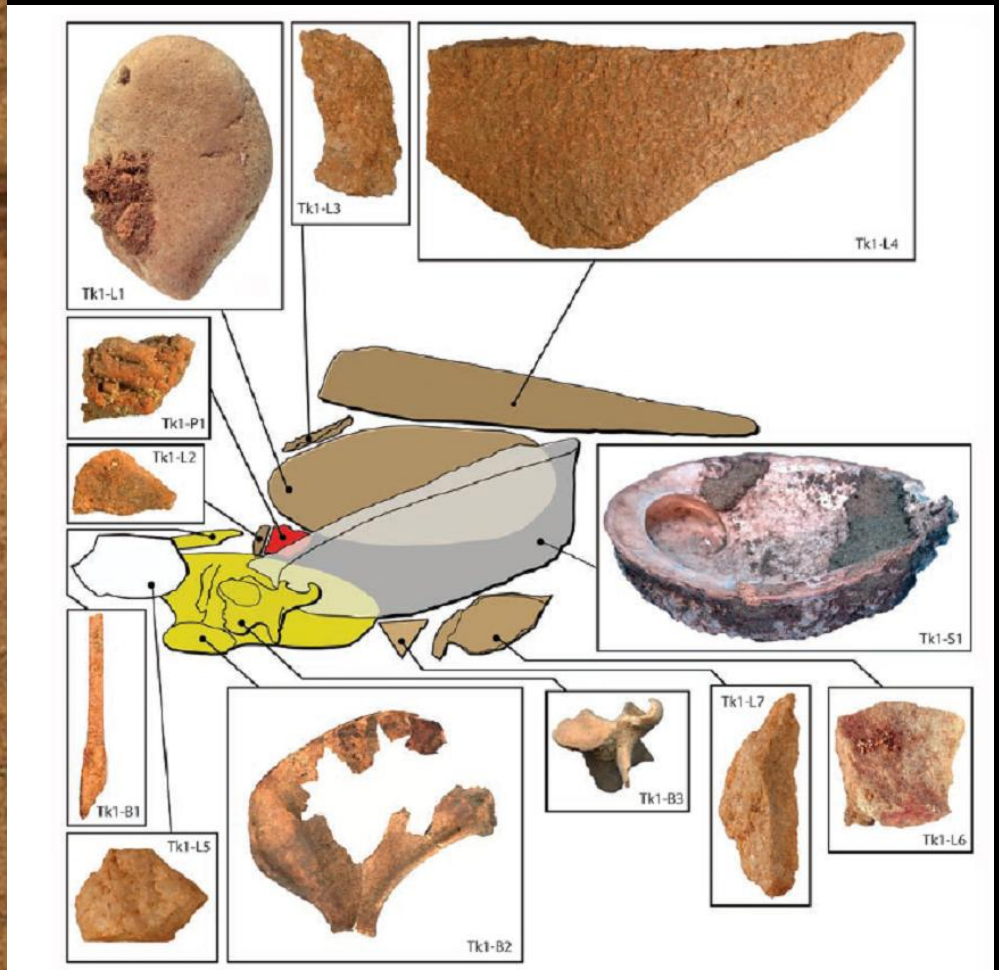
heidelbergensis
H.
rhodesiensis
H. antecessor
?
H. erectus s.l.
A

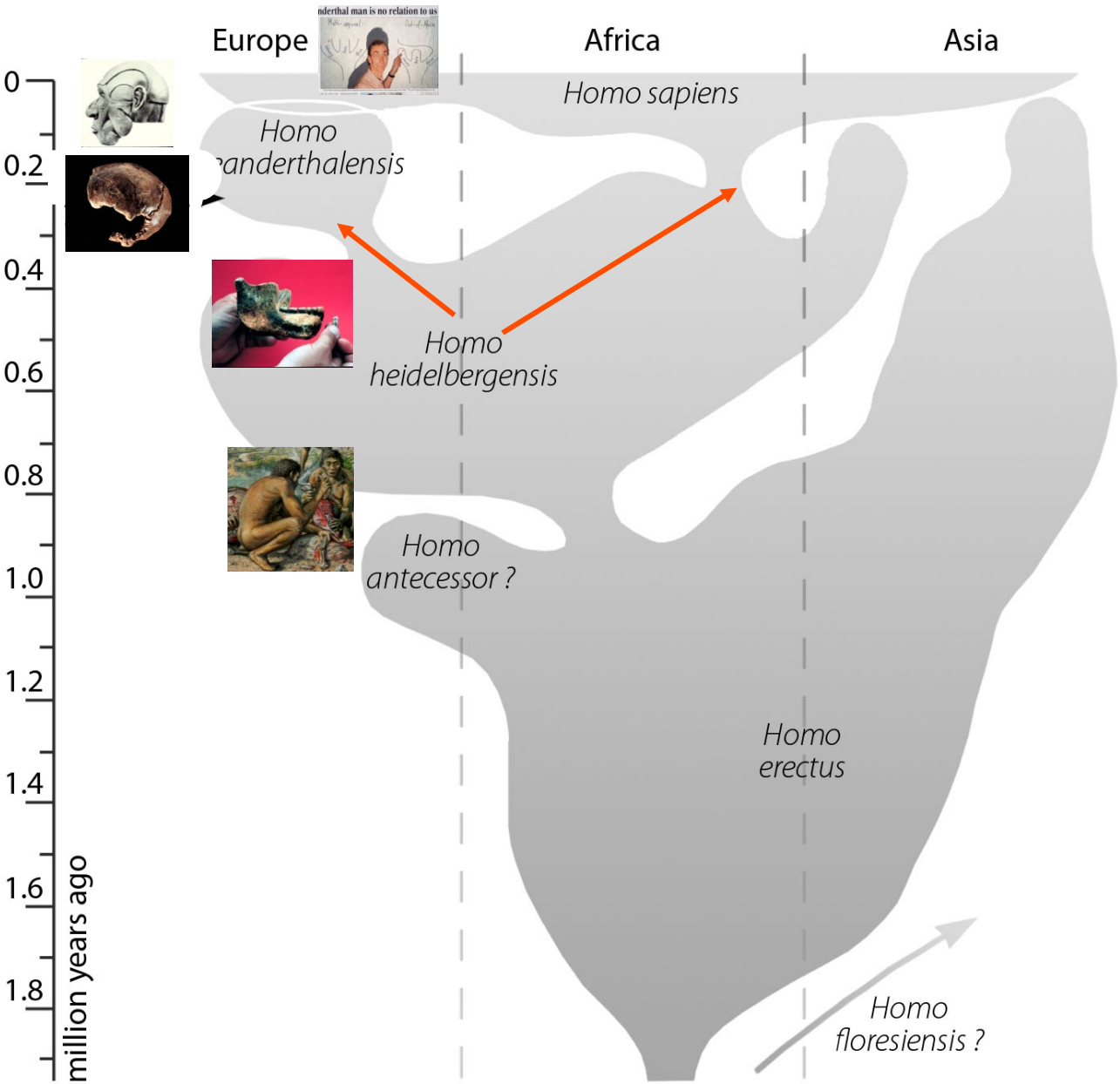
A 100,000-Year-Old Ochre-Processing Workshop at Blombos Cave, South Africa

Christopher S. Henshilwood,[1,2*] Francesco d'Errico,[3,1] Karen L. van Niekerk,[1] Yvan Coquinot,[4] Zenobia Jacobs,[5] Stein-Erik Lauritzen,[6] Michel Menu,[4] Renata García-Moreno[3]

Ochre-processing toolkits in situ showing Tk1 (**A**) and Tk2 (**B**). [Images



Artifacts making up Tk1 and their relative spatial locations. [Image: C. Henshilwood and F. d'Errico]


Europe
Africa
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million years ago
Homo sapiens
Homo
anderthalensis
Homo
heidelbergensis
Homo
antecessor ?
Homo
erectus
Homo
floresiensis ?

Human behavioural evolution: gains + losses

In the past, small populations would have been prone to extinction, or forced into relatively rapid movement or adaptation to survive, and this could have led to the regular loss of innovations that might have been useful in the longer term. Thus without the networking we find in modern humans, repeated ‘bottlenecking’ did not just remove genetic diversity, but also discoveries and inventions associated with the human populations concerned..

Evolutionary Anthropology 21:101–107 (2012)

The Status of *Homo heidelbergensis* (Schoetensack 1908)

Chris Stringer

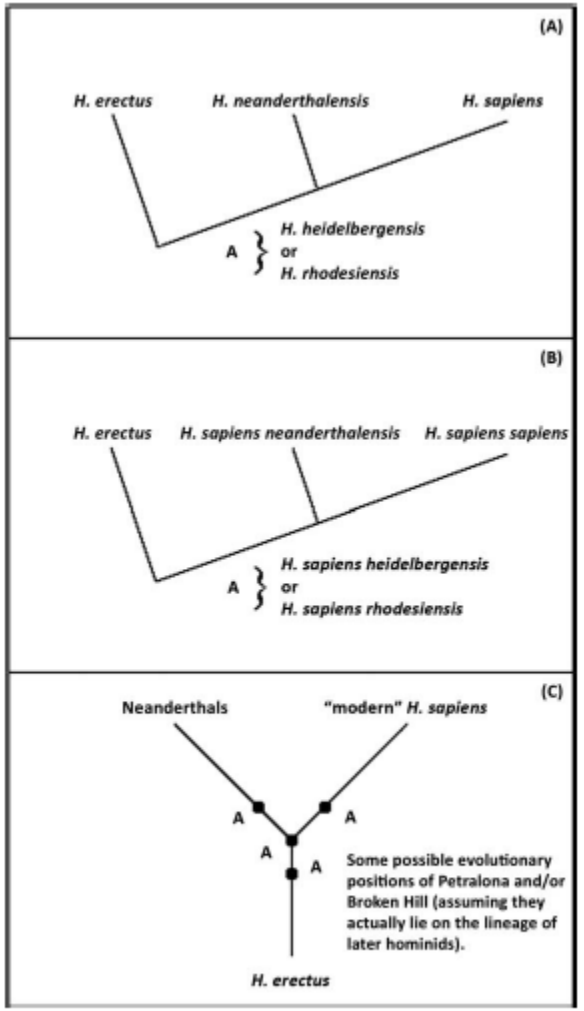
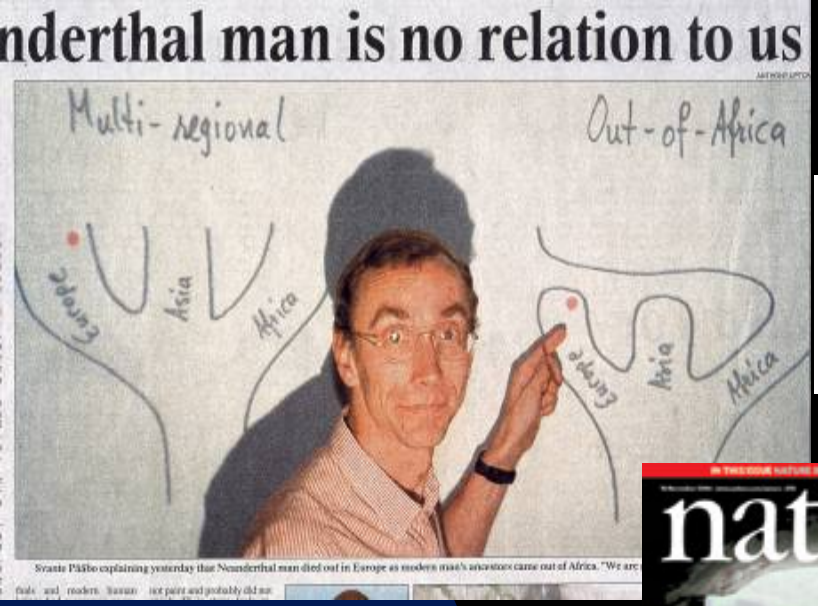


Figure 1. Illustration of the possible phylogenetic relationships of the Petralona and Broken Hill fossils. Redrawn, with permission, from Stringer.[9]

Building a Neanderthal genome….

nderthal man is no relation to us



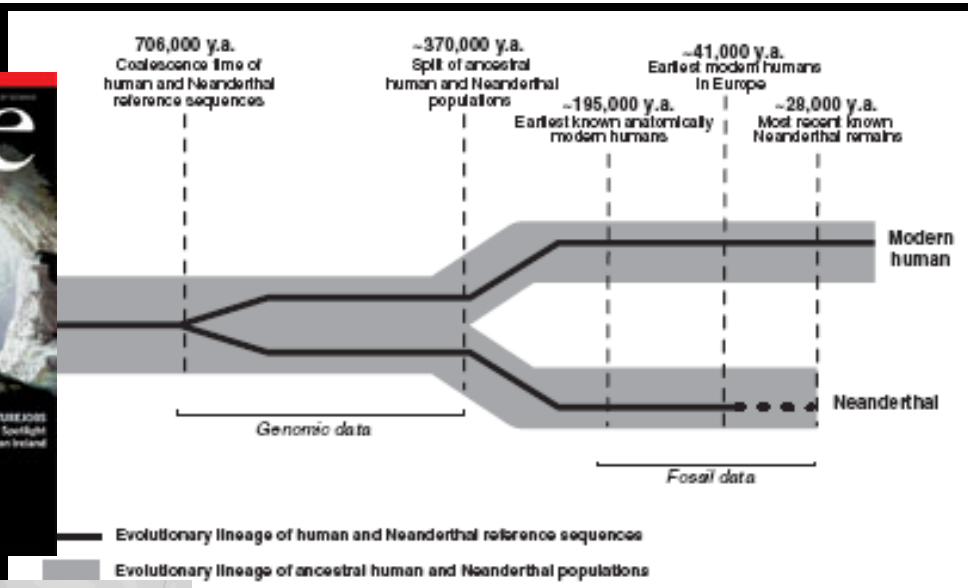
Svante Pääbo explaining yesterday that Neanderthal man died out in Europe as modern man's ancestors came out of Africa. "We are

Analysis of one million base pairs of Neanderthal DNA

Richard E. Green[1], Johannes Krause[1], Susan E. Ptak[1], Adrian W. Briggs[1], Michael T. Ronan[2], Jan F. Simons[2], Lei Du[2], Michael Egholm[2], Jonathan M. Rothberg[2], Maja Paunovic[3]‡ & Svante Pääbo[1]

Sequencing and Analysis of Neanderthal Genomic DNA

James P. Noonan,[1,2] Graham Coop,[3] Sridhar Kudaravalli,[3] Doug Smith,[1] Johannes Krause,[4] Joe Alessi,[1] Feng Chen,[1] Darren Platt,[1] Svante Pääbo,[4] Jonathan K. Pritchard,[3] Edward M. Rubin[1,2]*



DNA reveals some Neanderthals were ginger

By Natalie Paris
Last Updated: 1:01pm BST 26/10/2007

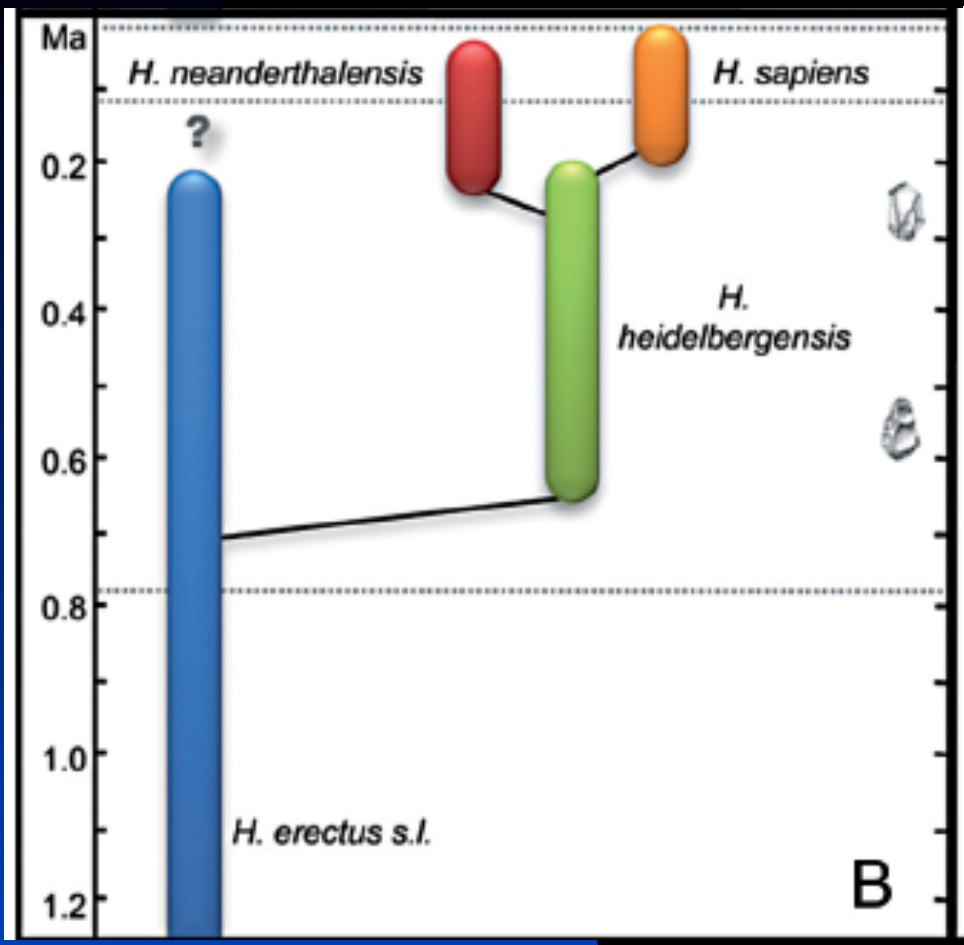
DNA evidence has revealed some Neanderthals probably had red hair after scientists discovered a pigmenting gene in ancient remains.

- Top ten ginger celebrities

Neanderthals, who lived around 400,000 to 28,000 years ago, are typically portrayed as dark skinned and dark-haired but some may have more closely resembled Europeans.

An international study of the bones of two cavemen found a gene that affects the production of melanin, associated with fair skin and fiery hair.

This indicates that some Neanderthals had pale skin and red hair, much like modern day humans.


Ma
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H. sapiens
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heidelbergensis
H. erectus s.l.
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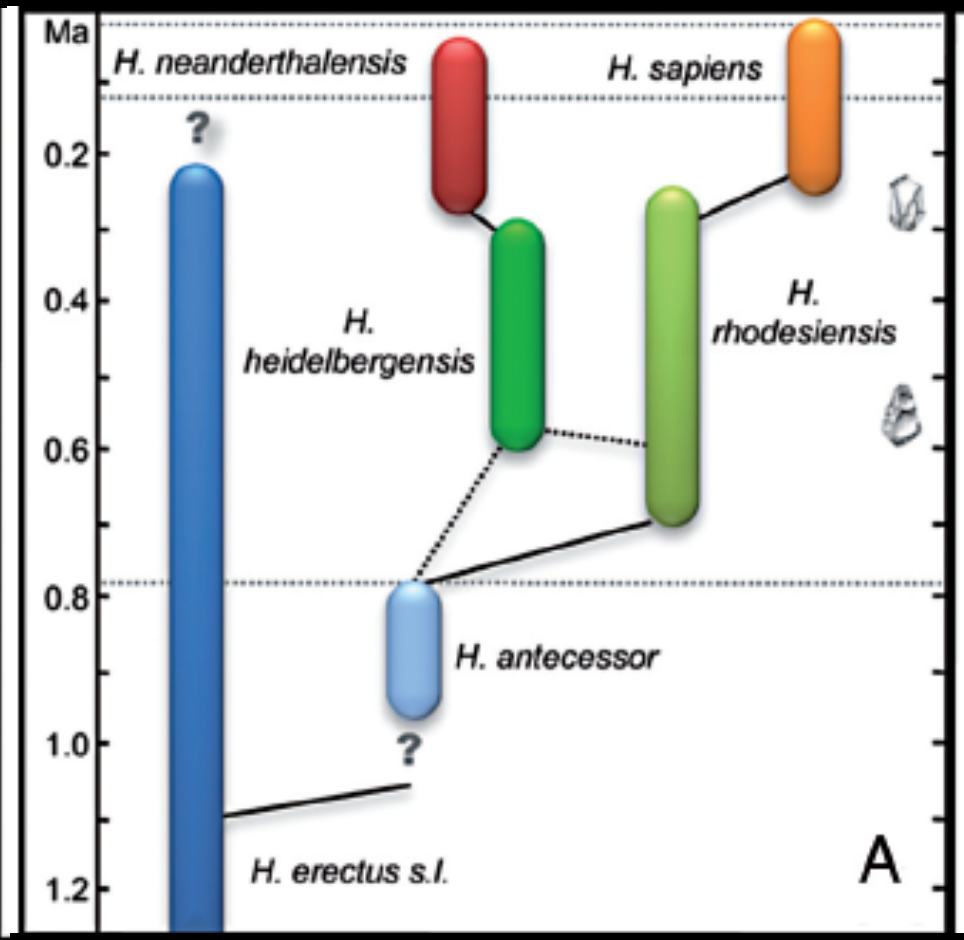
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heidelbergensis
H.
rhodesiensis
H. antecessor
?
H. erectus s.l.
A

PALEOANTHROPOLOGY

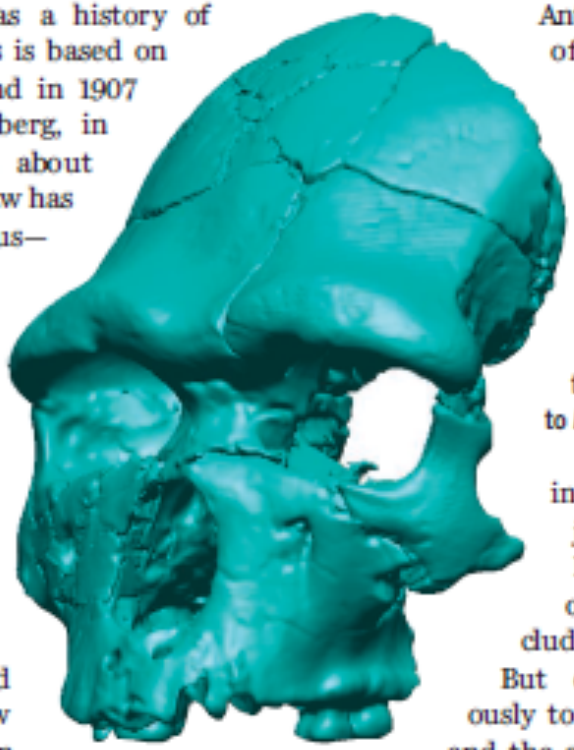
RIP for a key Homo *species?*

Researchers consider killing off a claimed common ancestor of Neandertals and modern humans

By **Michael Balter**, *in Tautavel, France*

"If someone kills one person they go to jail," anthropologist Zeresenay Alemseged of the California Academy of Sciences in San Francisco noted last month at a meeting here in France's deep south. "But what happens if you kill off a whole species?" The answer soon became apparent: anguished debate. In the balance was *Homo heidelbergensis*, a big-brained human ancestor generally seen as a pivotal figure during a murky period of evolution. At the invitation-only meeting, researchers ally was a paleo- *nsis* has e human many as humans

H. heidelbergensis has a history of controversy. The species is based on a single lower jaw found in 1907 at Mauer, near Heidelberg, in Germany. Estimated at about 600,000 years old, the jaw has an unusually thick ramus—the vertical projection that hinges to the skull—and nothing quite like it has been found since. For decades, the name failed to catch on, until anthropologists including Rightmire and Chris Stringer of the Natural History Museum in London noted distinctive thick brow ridges and large faces in skulls of roughly similar



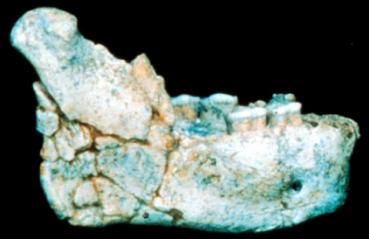
This new reconstruction ties France's Arago skull to *Homo heidelbergensis*.

species is based, cannot be closely matched with any other fossil, in part because few other jaws are preserved. To keep the species alive, researchers need to find and designate a new type specimen that has both a jaw and skull, but such a specimen would surely spark new debates, Arsuaga said. The better course "would be to let the species die."

Anthropologist Yoel Rak of Tel Aviv University in Israel supported this argument by comparing the Mauer jaw with the few jaws claimed to be *H. heidelbergensis* fossils, including three partial jaws from Arago. "The Mauer specimen is one of a kind," Rak concluded in his talk.

But others fought vigorously to save both the species and the simpler, more straightforward view of human evolu

heidelbergensis: moving beyond Mauer



Asian *H. heidelbergensis*?

Yunxian

Dali

Narmada

Jinniushan

Atapuerca


El mapa de los yacimientos
REGISTRO CRONOLÓGICO
PRINCIPALES HALLAZGOS
VISTA AÉREA
GRAN DOLINA
ENTRE 1.000.000 Y 200.000 AÑOS
Principales restos de 'Homo antecessor'. Huesos de grandes carnívoros
GALERÍA
ENTRE 400.000 Y 200.000 AÑOS
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HALLAZGO DE LA MANDÍBULA
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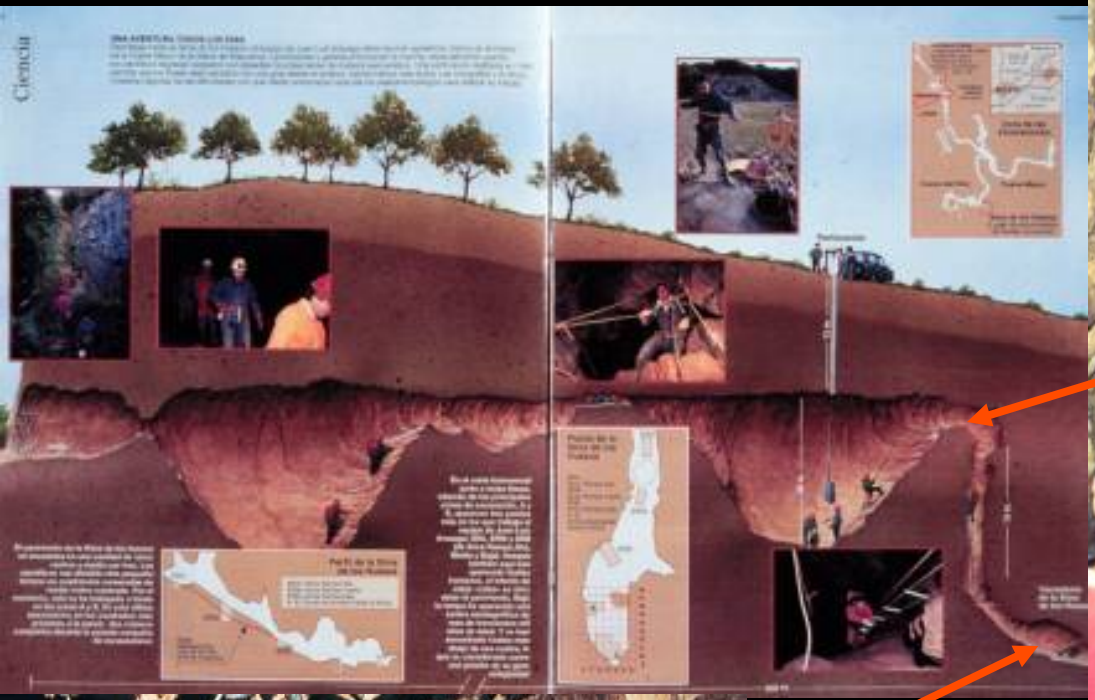
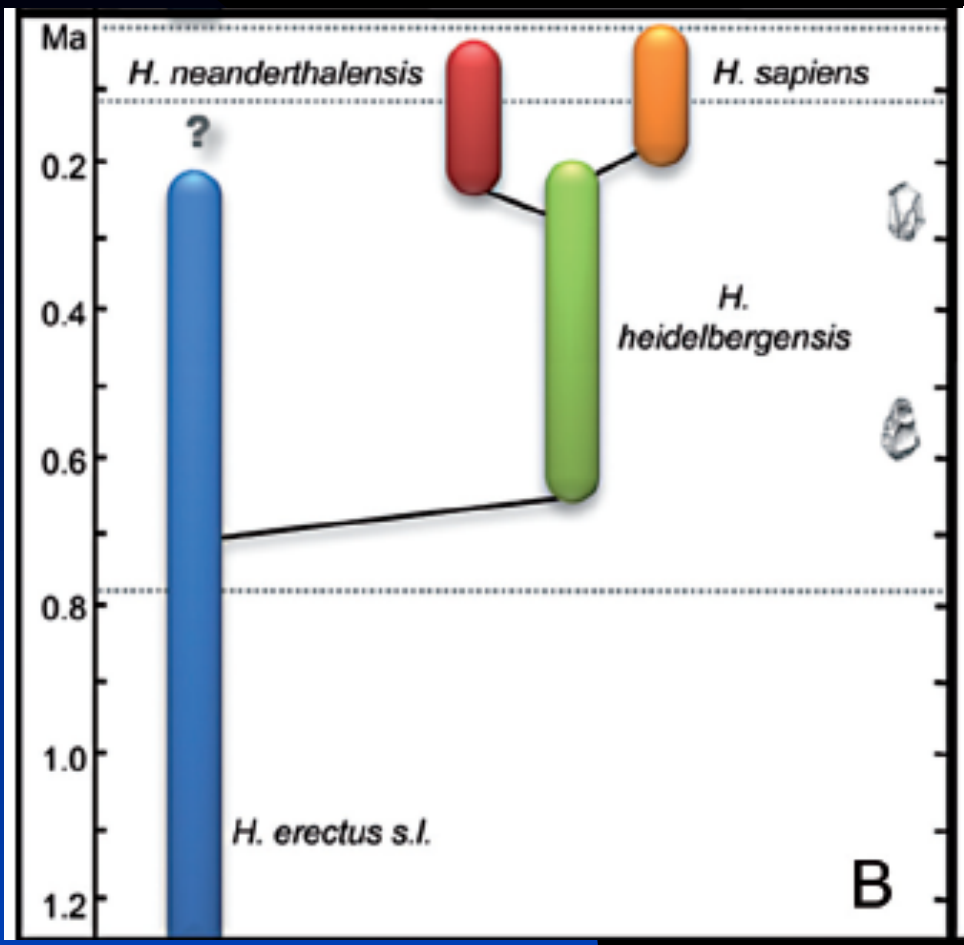
Lascas de Modo 1 (Olduvayense)
SIMA DE LOS HUESOS
400.000 AÑOS
'Homo heidelbergensis'.
fósiles humanos
PORTALÓN
3.000 AÑOS (EDAD DEL BRONCE)
Adornos de hueso y marfil
0 50M

Into “The Pit of the Bones” Atapuerca



The Sima de los Huesos, Atapuerca ~400 ka and early Neanderthal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H. neanderthalensis
H. sapiens
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H.
heidelbergensis
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H. erectus s.l.
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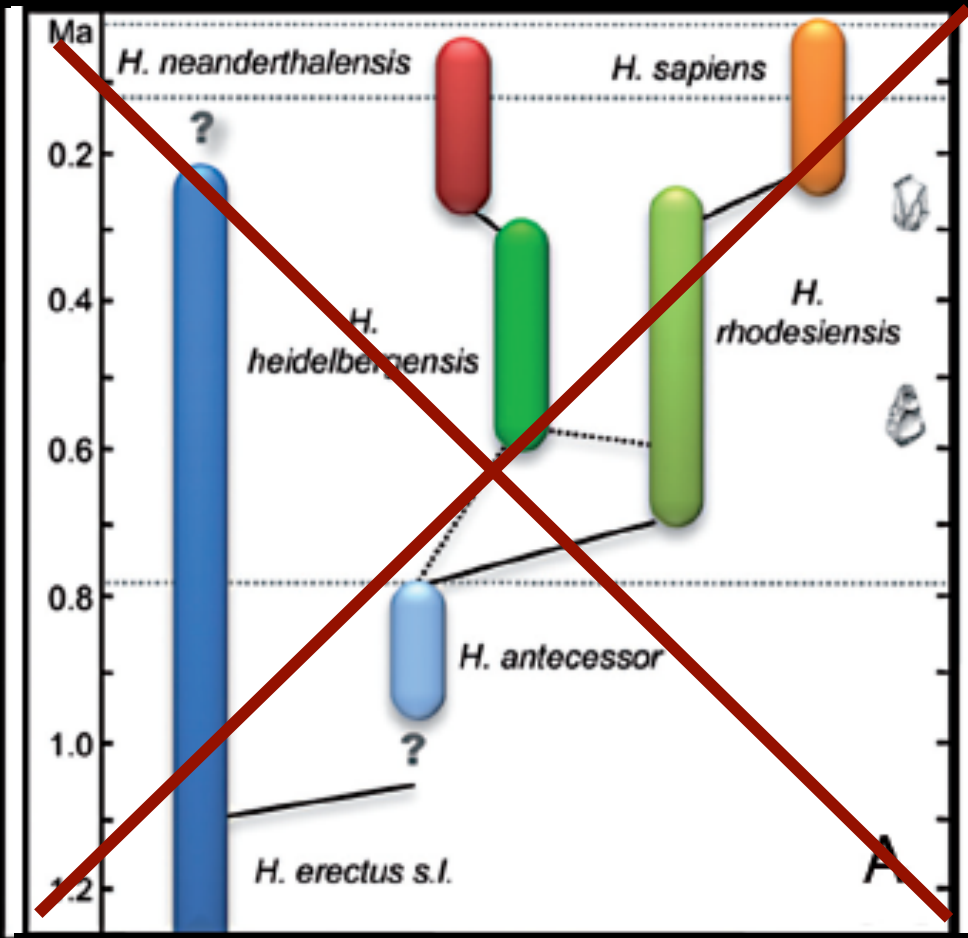
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H. sapiens
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heidelbergensis
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rhodesiensis
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H. antecessor
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H. erectus s.l.
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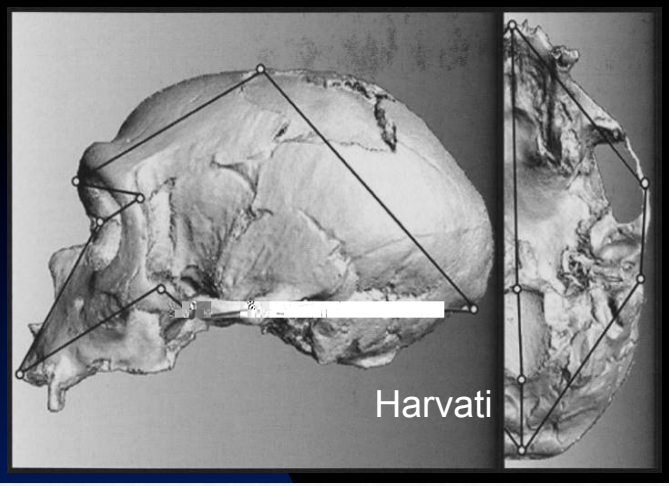
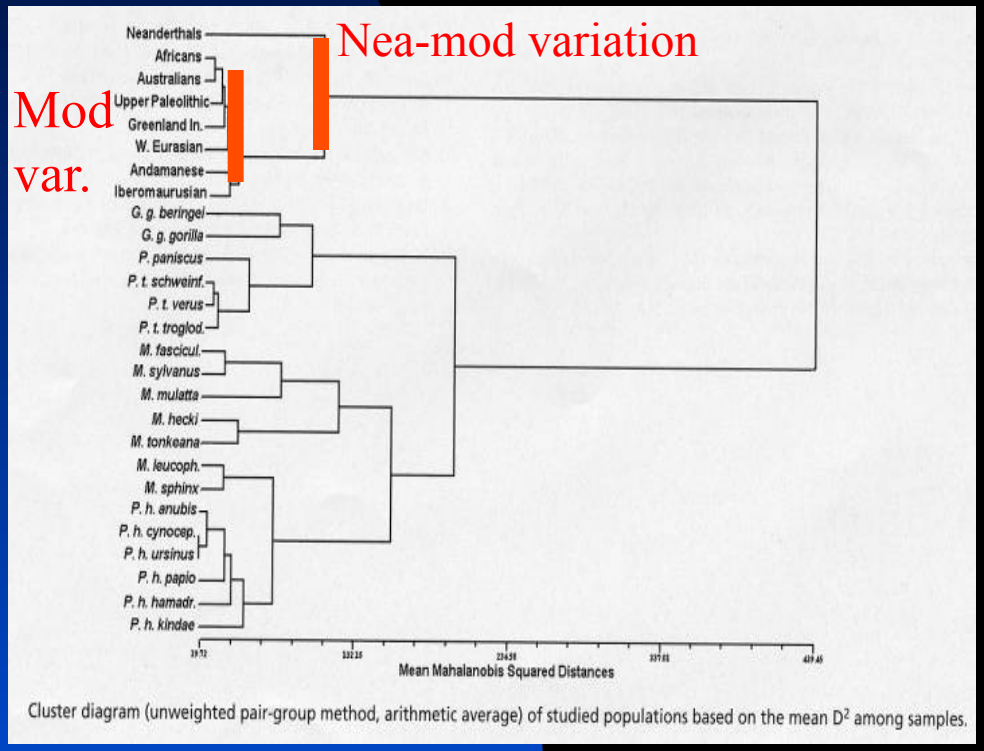
A

Neanderthals: a different species?



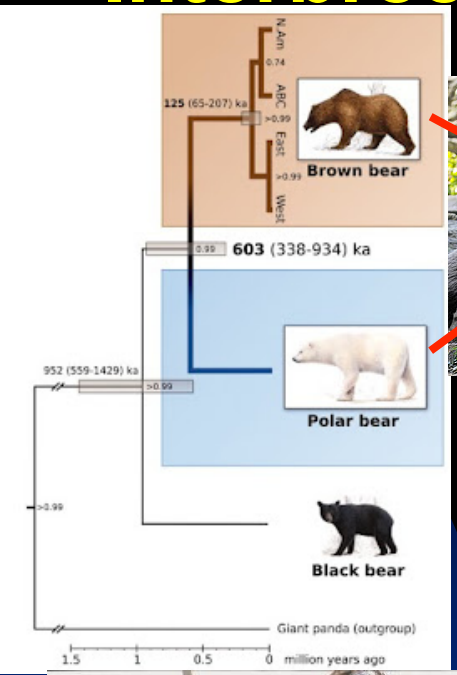


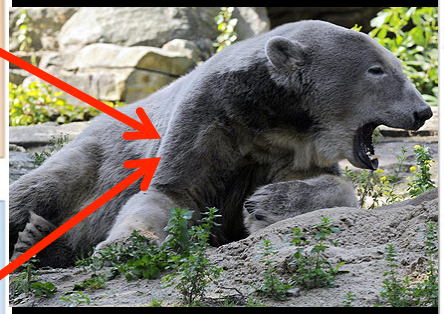
Cluster diagram (unweighted pair-group method, arithmetic average) of studied populations based on the mean D^2 among samples.

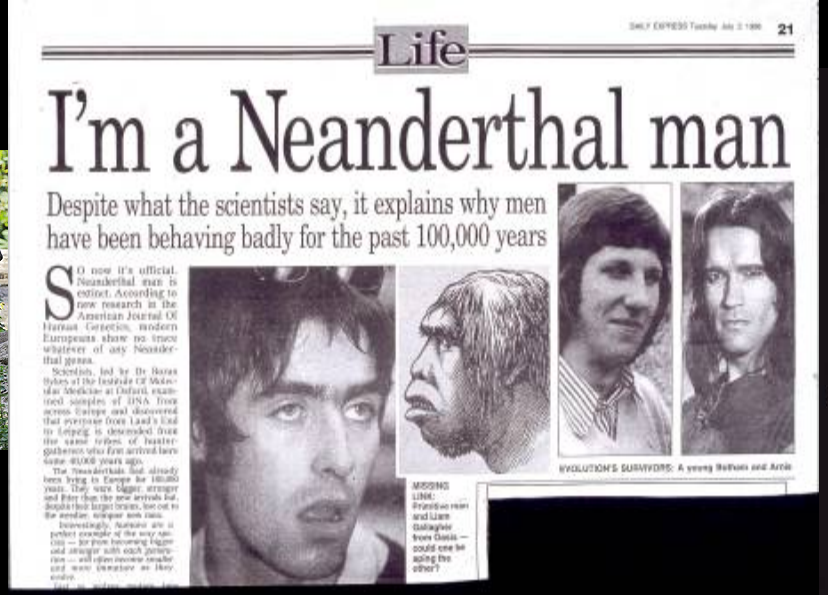
Harvati

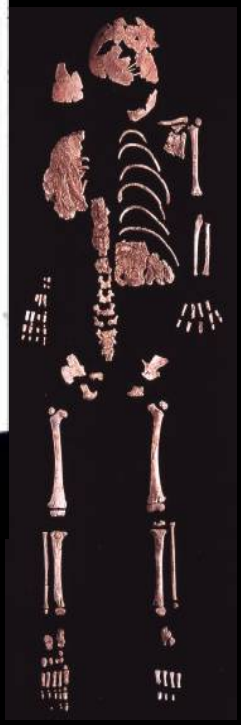
omegaparque.com

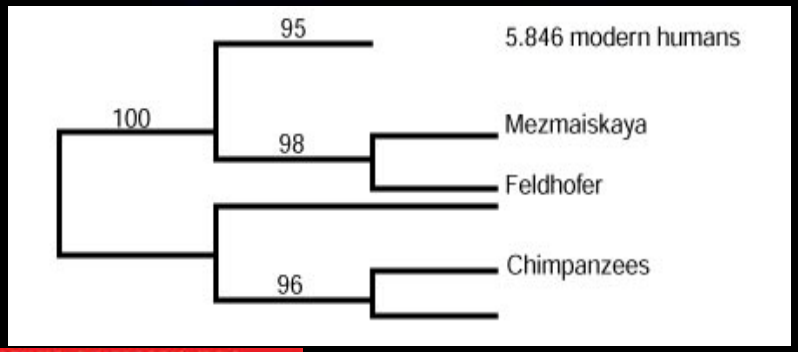
Interbreeding?

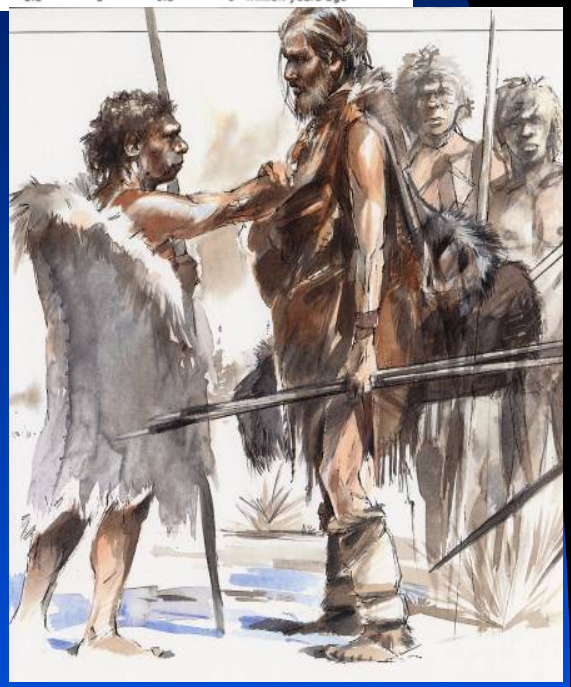












What happened to the Neanderthals?

Continuity?

~~Evolved into the Cro-Magnons~~

Genetically absorbed

Extinction?

Interpopulation conflict

Demographic disadvantage

Competitive exclusion

Infectious diseases

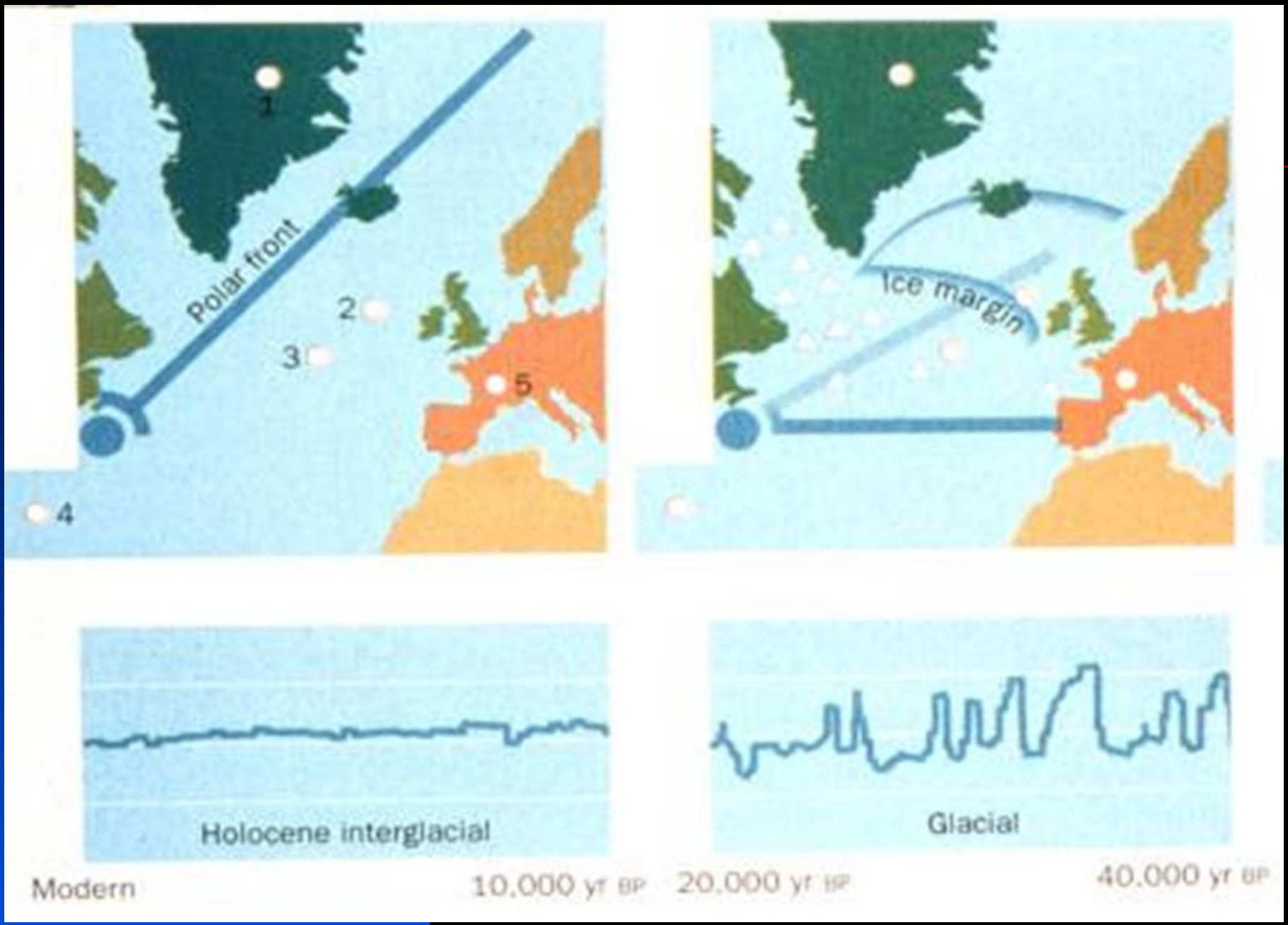
Distinct physiologies/diets

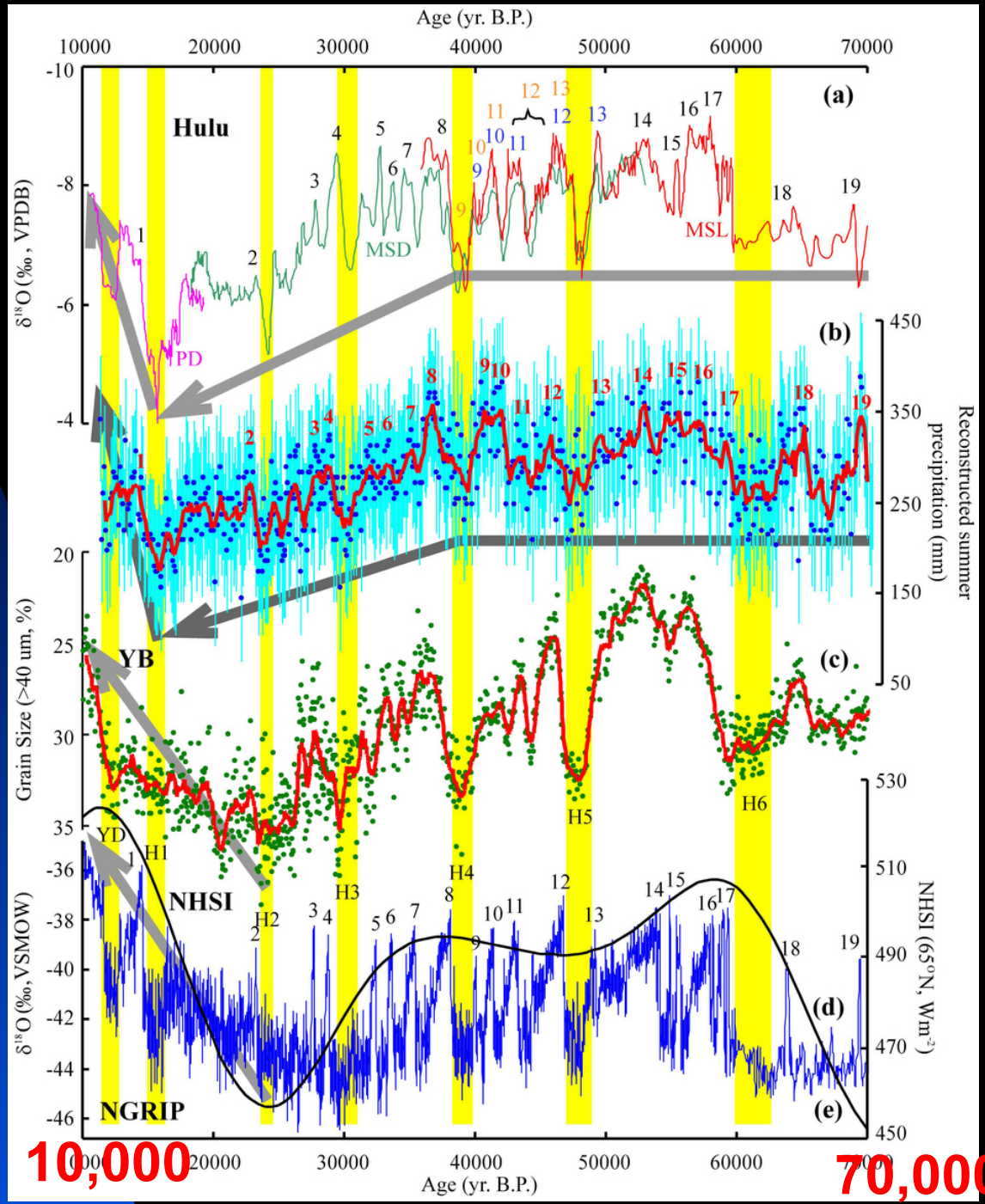
Competition/fluctuating climates

Climate change

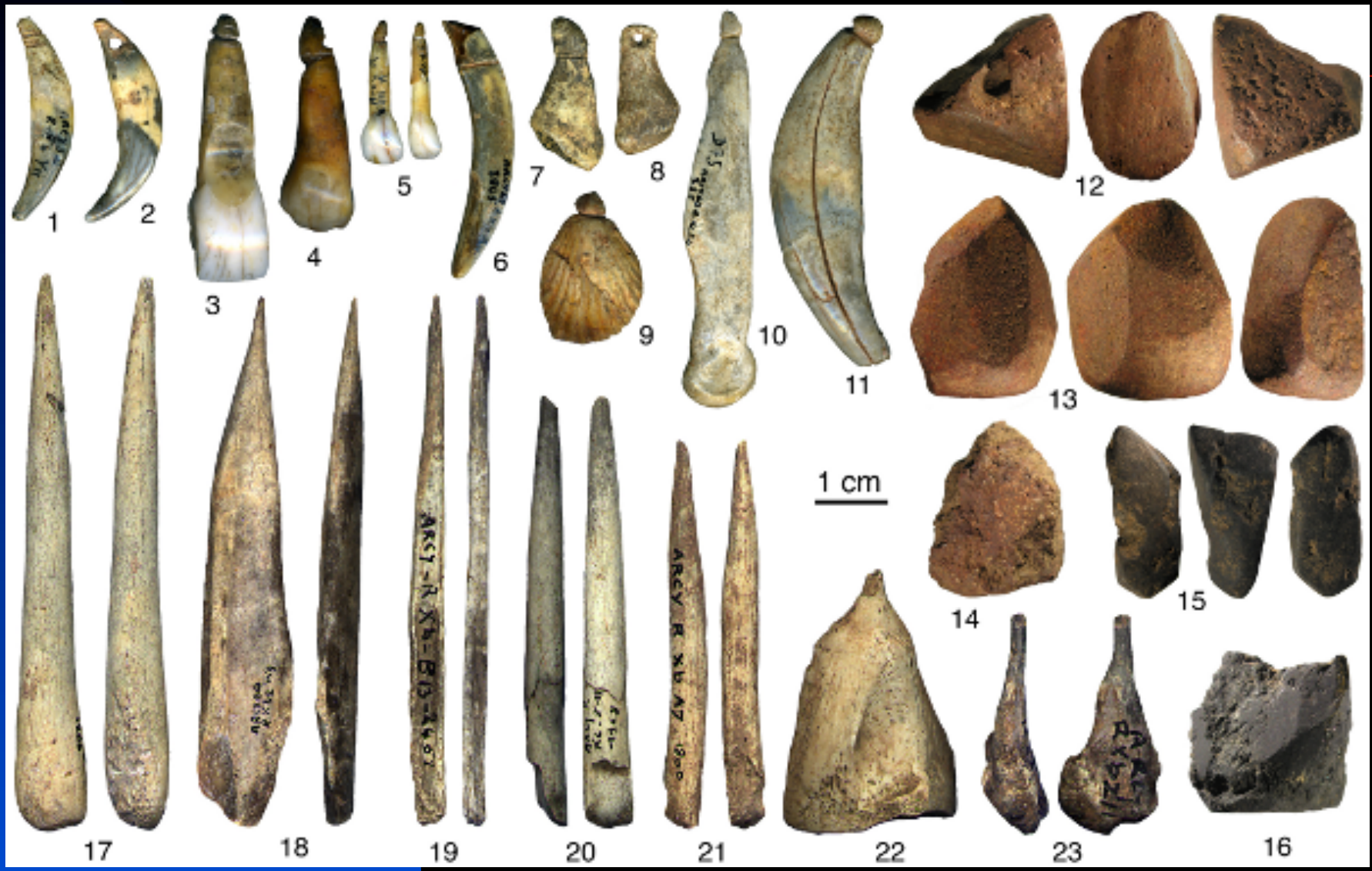
Part of megafaunal extinctions

Rapid climate change 20-70 ka



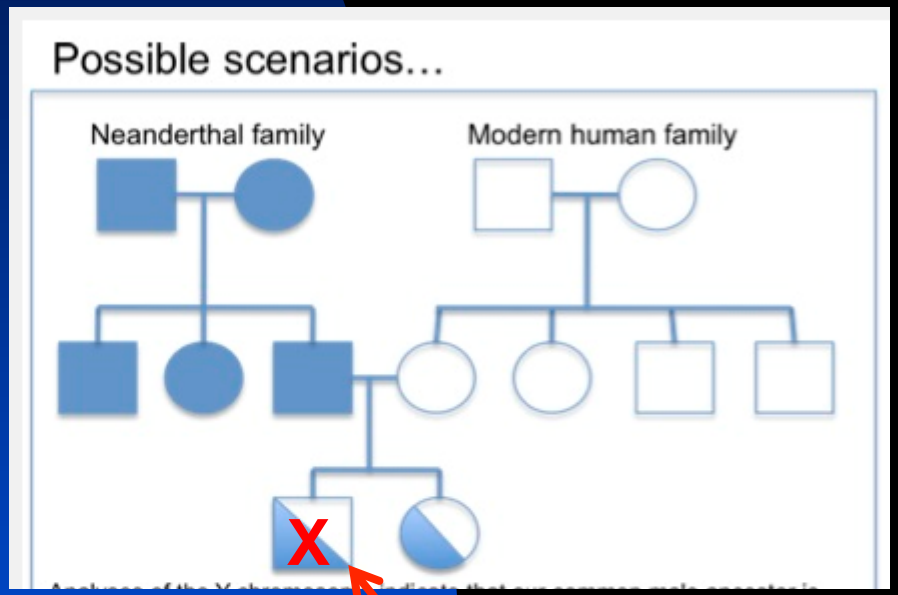

Age (yr. B.P.)
10000
20000
30000
40000
50000
60000
70000
(a)
Hulu
MSD
MSL
PD
δ18O (‰, VPDB)
(b)
Reconstructed summer precipitation (mm)
(c)
YB
Grain Size (>40 um, %)
H1
H2
H3
H4
H5
H6
YD
NHSI
NGRIP
δ18O (‰, VSMOW)
NHSI (65°N, Wm-2)
(d)
(e)
10,000
70,000

Châtelperronian material: the product of Neanderthals ~42,000 years ago?



These results suggest that part of the explanation for reduced Neanderthal ancestry near certain genes is that Neanderthal alleles caused decreased fertility in males when moved to a modern human genetic background.

This suggests that when ancient humans met and mixed with Neanderthals, the two species were at the edge of biological incompatibility



Sterility of male offspring – Haldane's rule operating?

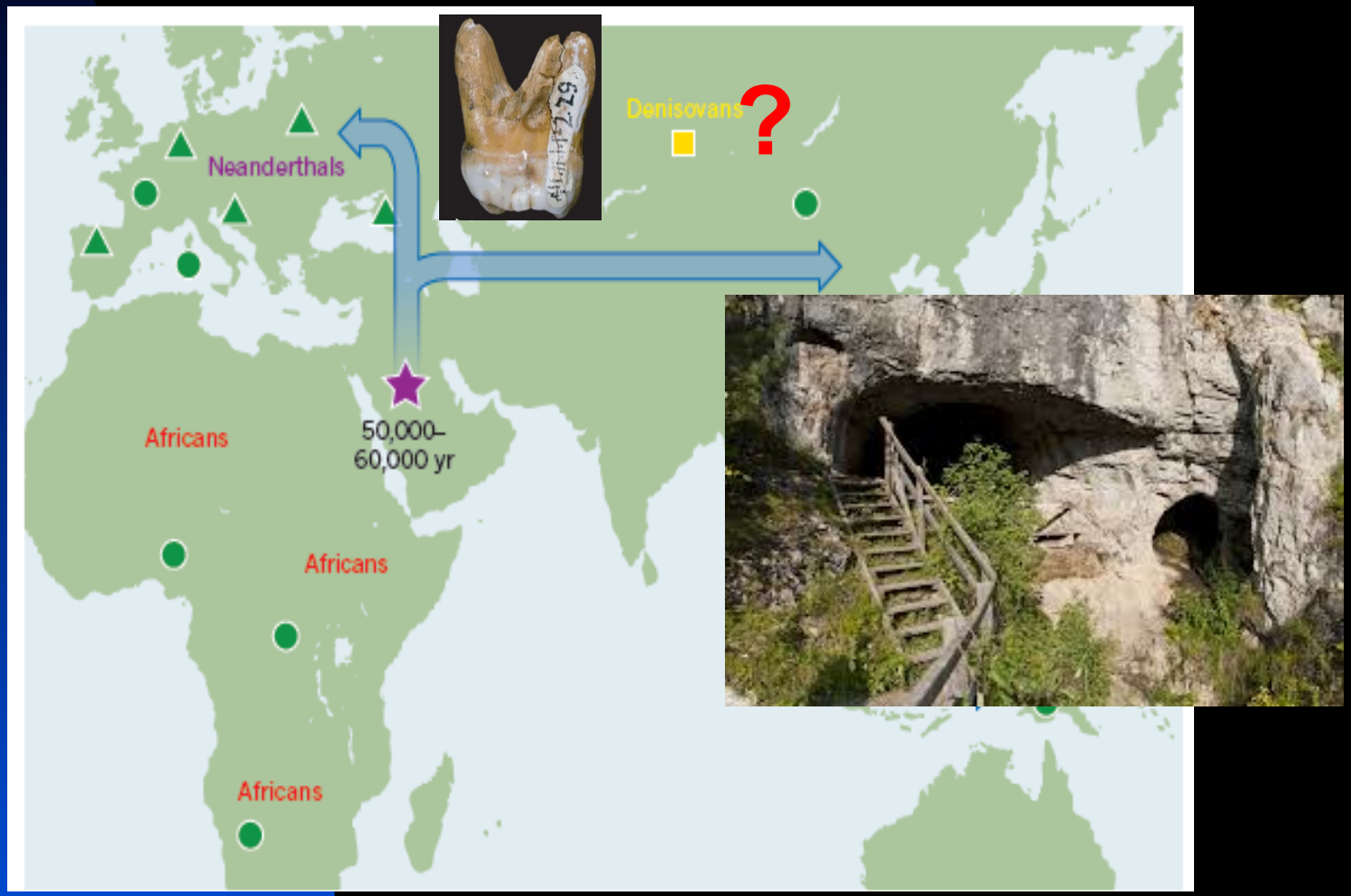
Extended Data Table 2 | Neanderthal-derived alleles that have are associated with phenotypes in genome-wide association studies

rs id	Coordinates	Derived allele	Derived allele frequency (%)		Phenotype
			Europeans	East Asians	
rs12531711	7:128,617,466	G	10.03	0.17	Systemic lupus erythematosus, Primary biliary cirrhosis
rs3025343	9:136,478,355	A	8.44	0.00	Smoking behavior
rs7076156	10:64,415,184	A	26.52	8.74	Crohn's disease
rs12571093	10:70,019,371	A	16.35	14.86	Optic disc size
rs1834481	11:112,023,827	G	21.50	0.35	Interleukin-18 levels
rs11175593	12:40,601,940	T	1.98	3.32	Crohn's disease
rs75493593	17:6,945,087	T	1.85	12.06	
rs75418188	17:6,945,483	T	1.85	11.54	Type-2 Diabetes
rs117767867	17:6,946,330	T	1.85	11.54	

We identified alleles that are likely to have been introduced by Neanderthal gene flow (Supplementary Information section 10) and intersected these alleles with SNPs that have been shown to be associated with phenotypes (from the NHGRI GWAS catalogue[19] as well from a recent GWAS for type 2 diabetes[20]).

Remnants of Neanderthal DNA in modern humans are associated with genes affecting type 2 diabetes, Crohn's disease, lupus, biliary cirrhosis, and smoking behavior.They also concentrate in genes that influence skin and hair characteristics.

Enter the Denisovans…



Genetic history of an archaic hominin group from Denisova Cave in Siberia

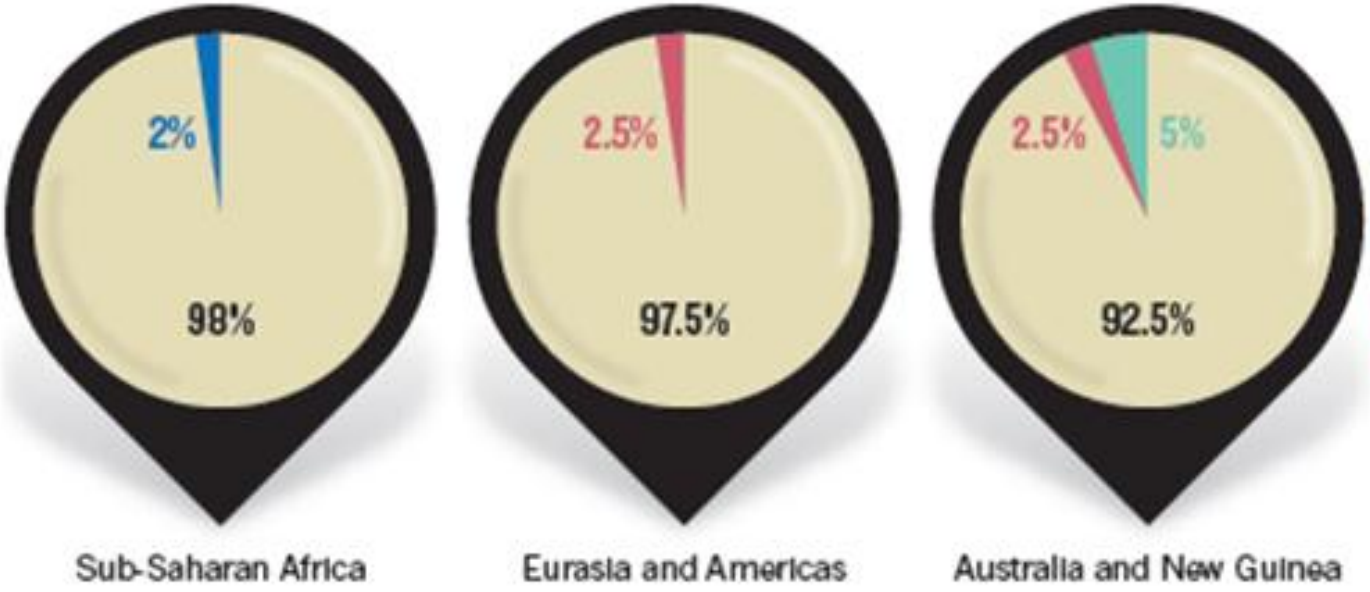
3 MAY 2012 | VOL 485 | NATURE

ILLUSTRATION BY CHRISTIAN HOARDMAN

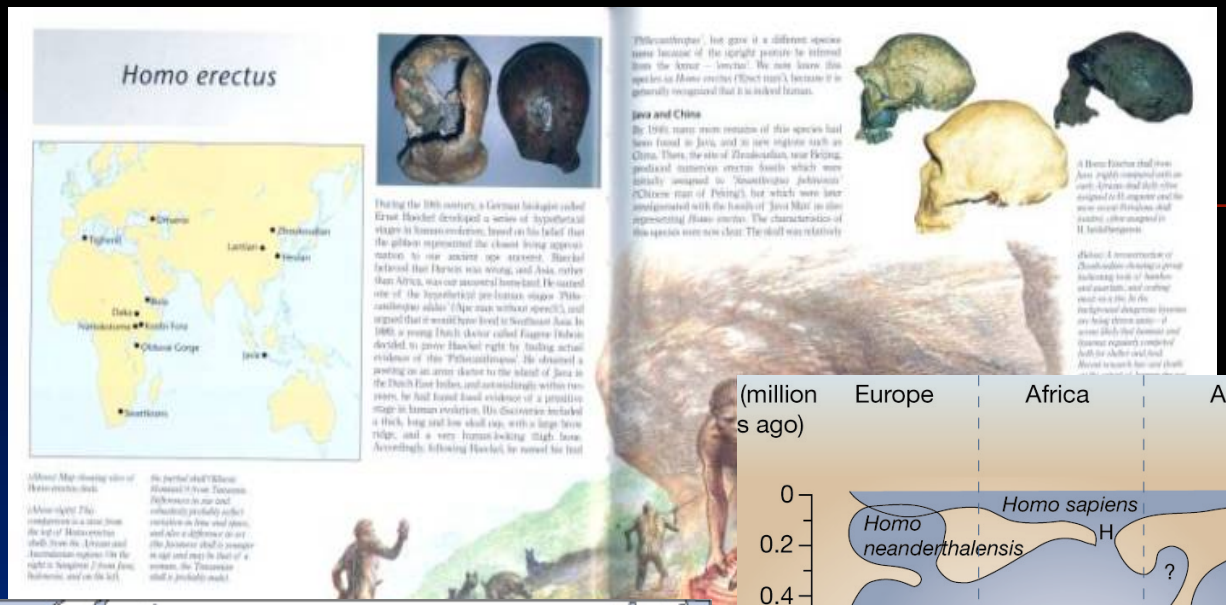
What makes a modern human

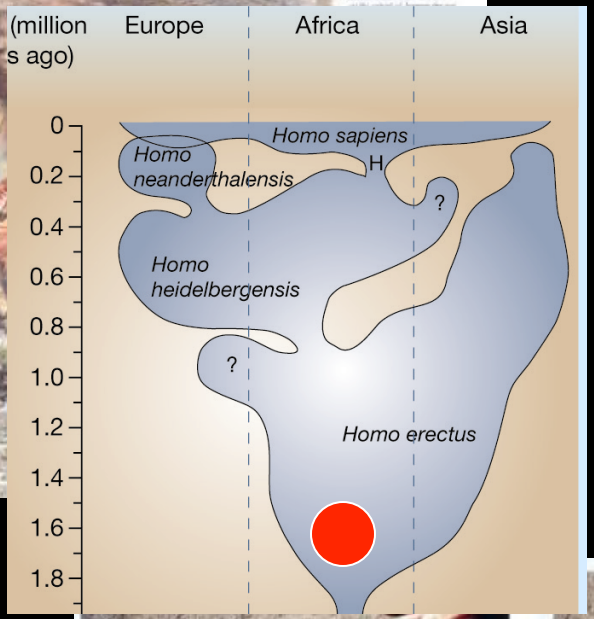
PATCHWORK PLANET

Most people's genomes contain remnants of archaic DNA from ancient interbreeding[3–6].

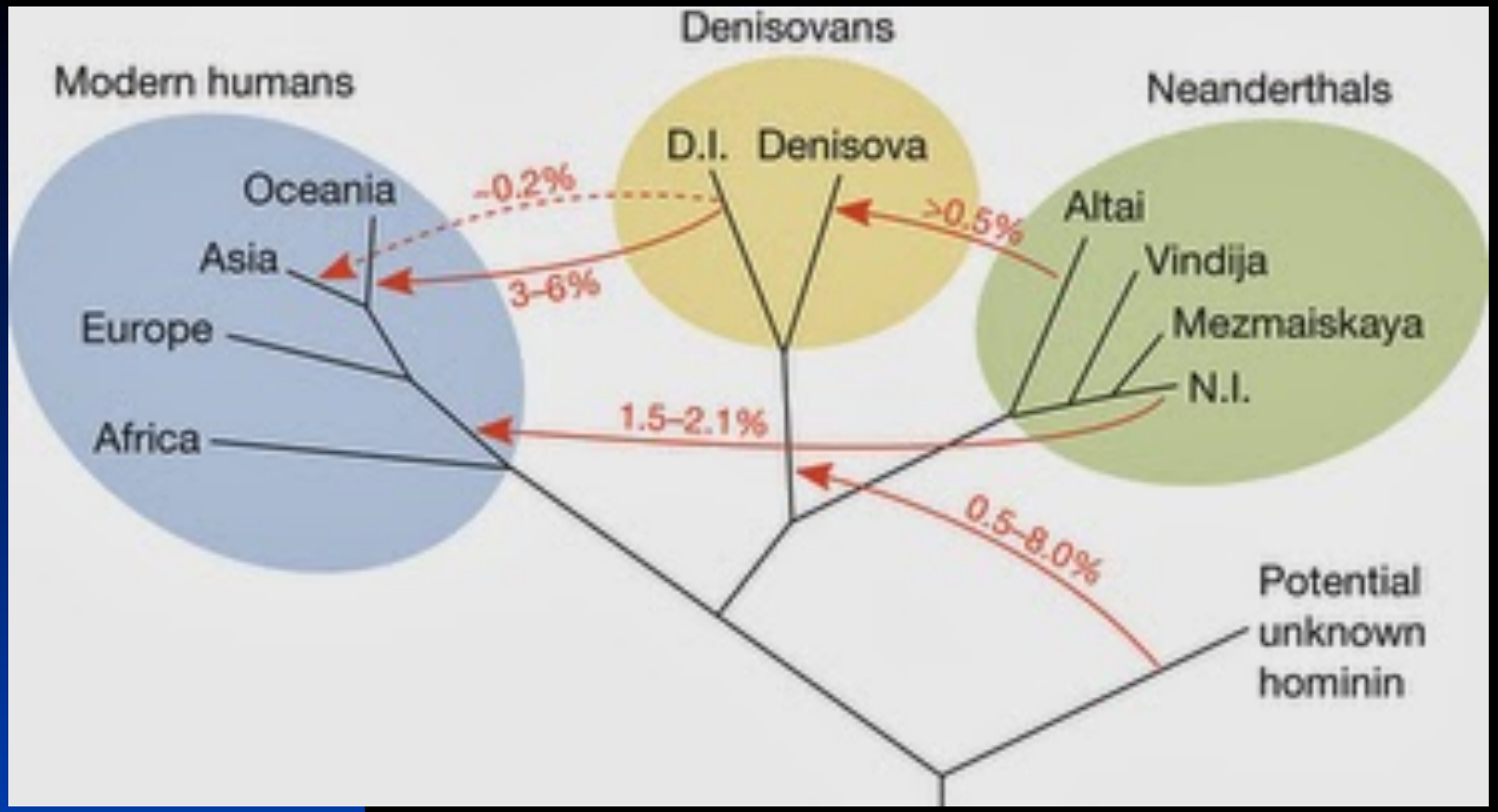


Early humans 1.5-1.8 Ma: ‘Out of Africa 1’



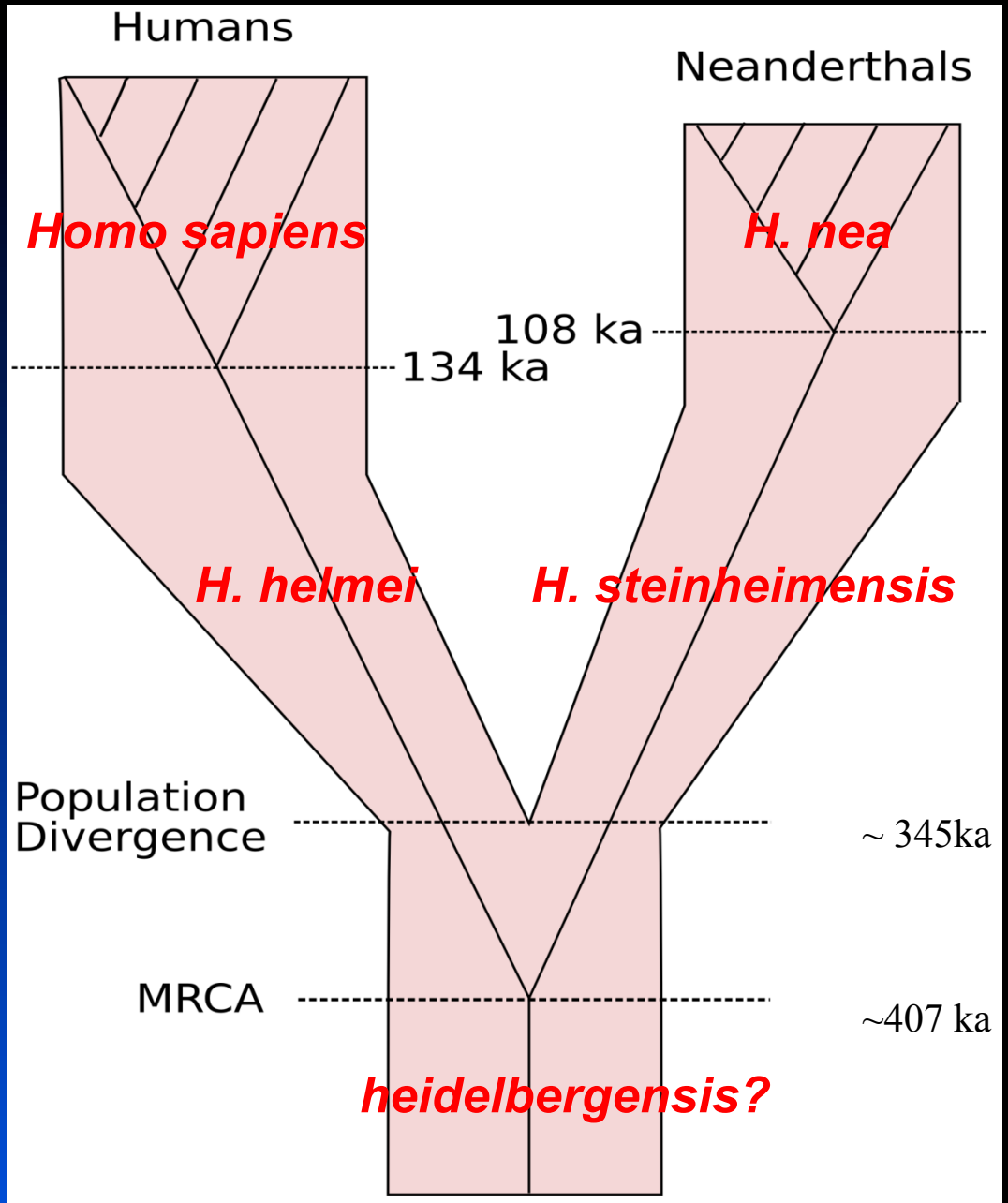


Ancient interbreeding: common but at a low level?



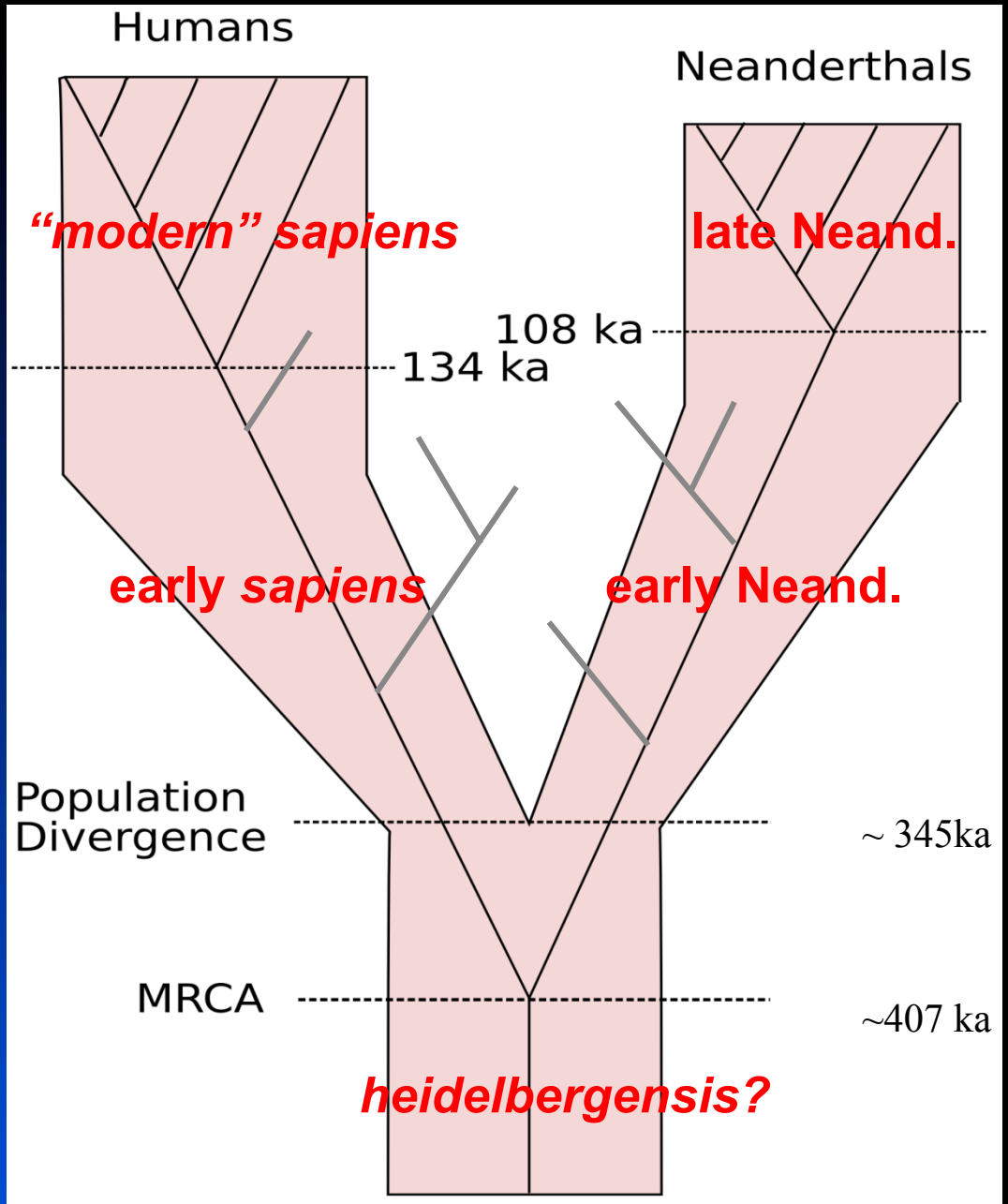
Nature 2013

Latest genetic calibration (5 complete Nea, 54 complete modern mtDNA sequences)



The Neanderthal and modern humans lines began to split about 400,000 years ago

Latest genetic calibration (5 complete Nea, 54 complete modern mtDNA sequences)



The Neanderthal and modern humans lines began to split about 400,000 years ago

Variation in the European Middle Pleistocene MIS 7-11: *heidelbergensis* vs *neanderthalensis*?

Bilz 9 or 11?

Swanscombe 11

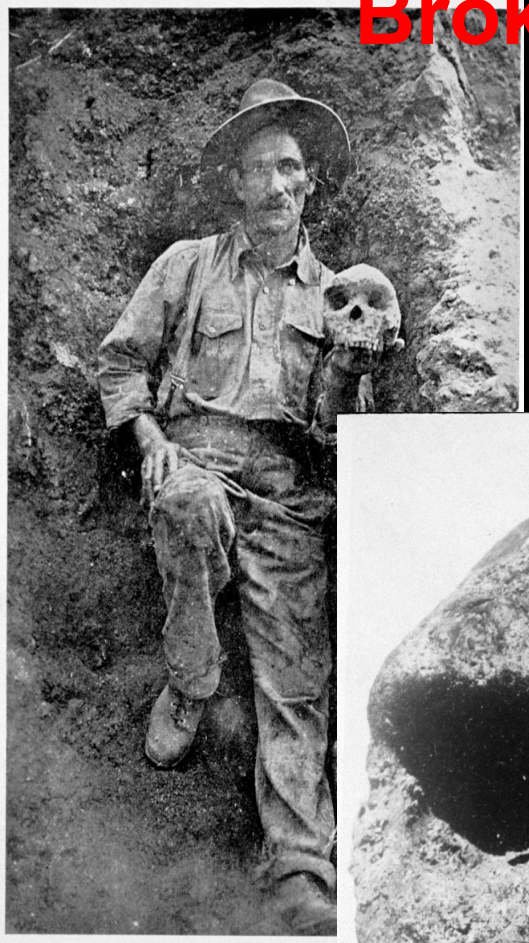
Petralona 7-15?

Grün 1995: an age of 150–250 ka for the speleothems bracketing the cranium.

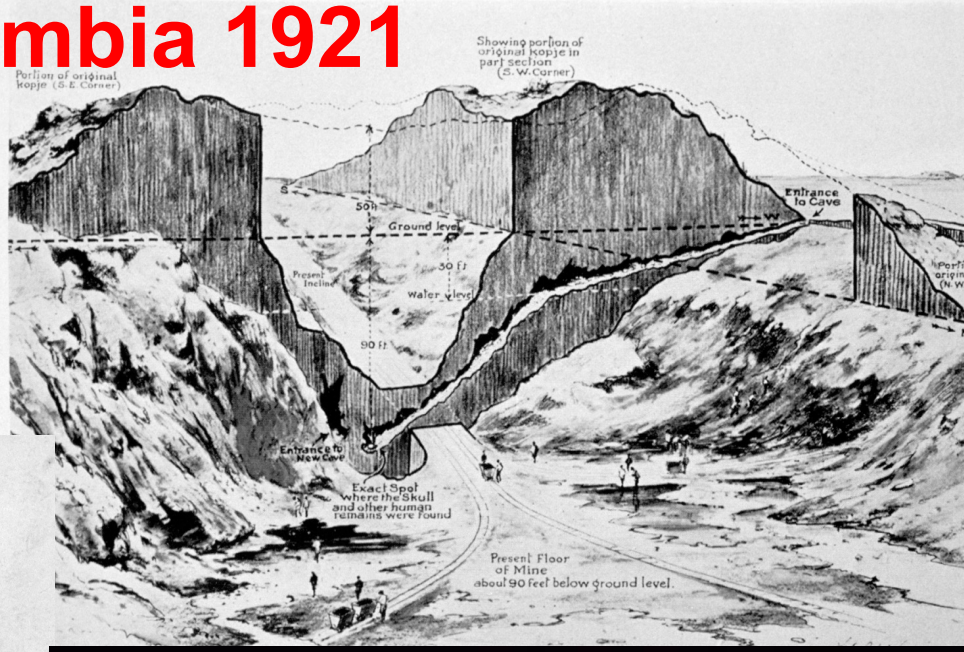
Vertsz 7 or 9?

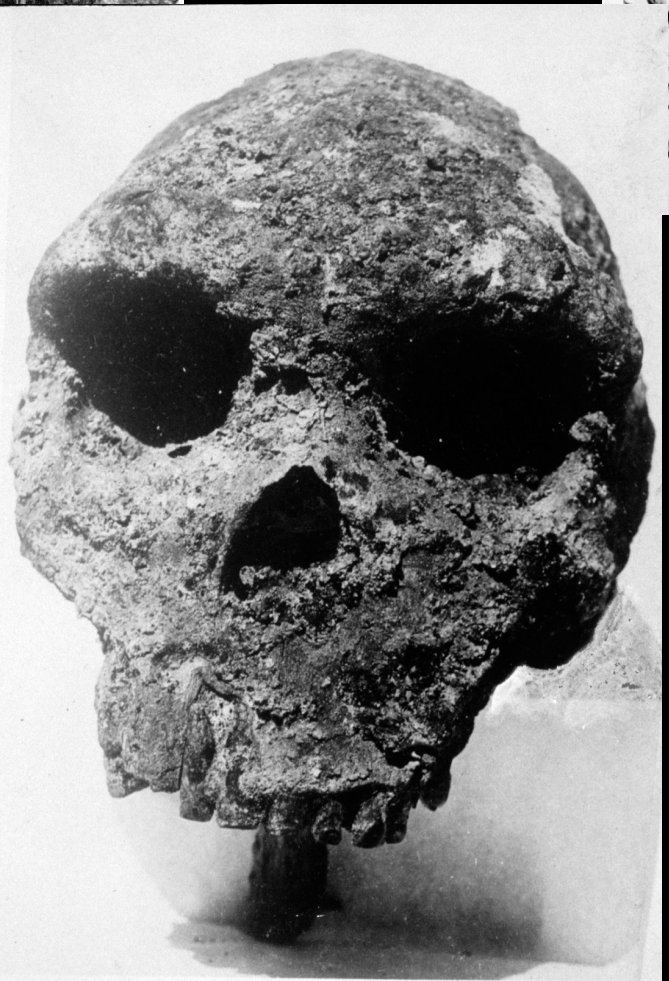
Ceprano 11?

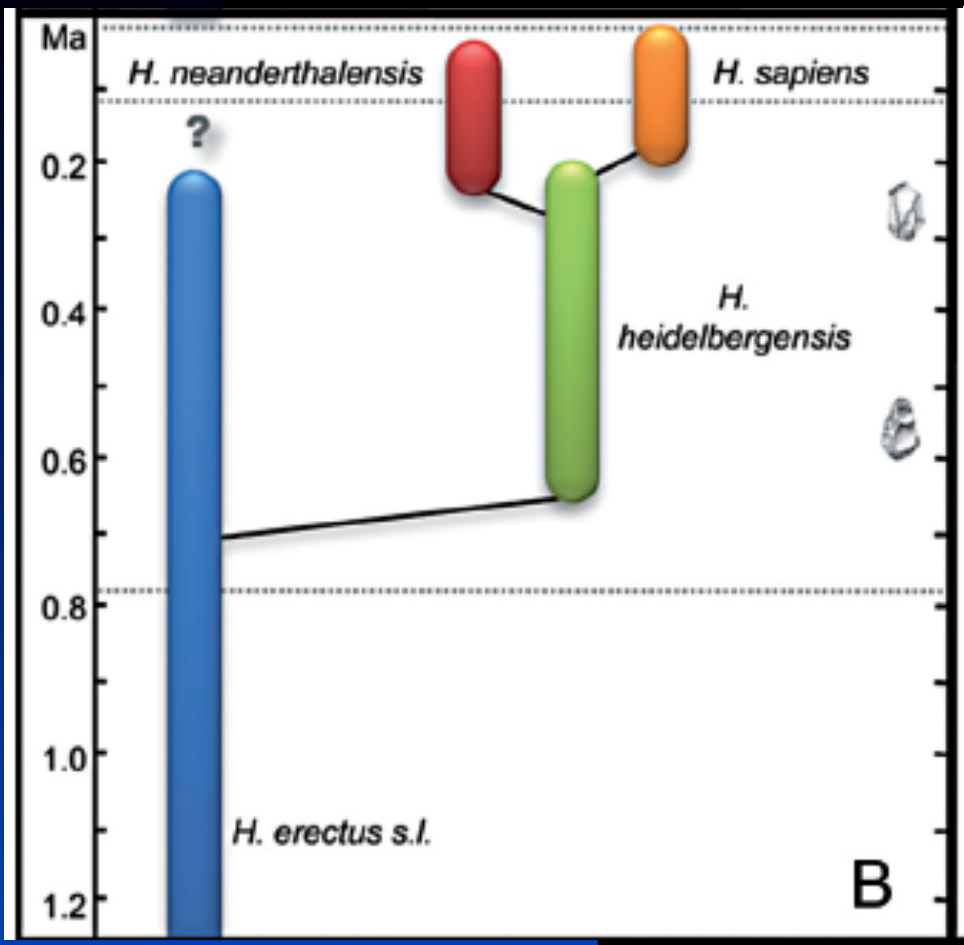
Broken Hill, Zambia 1921

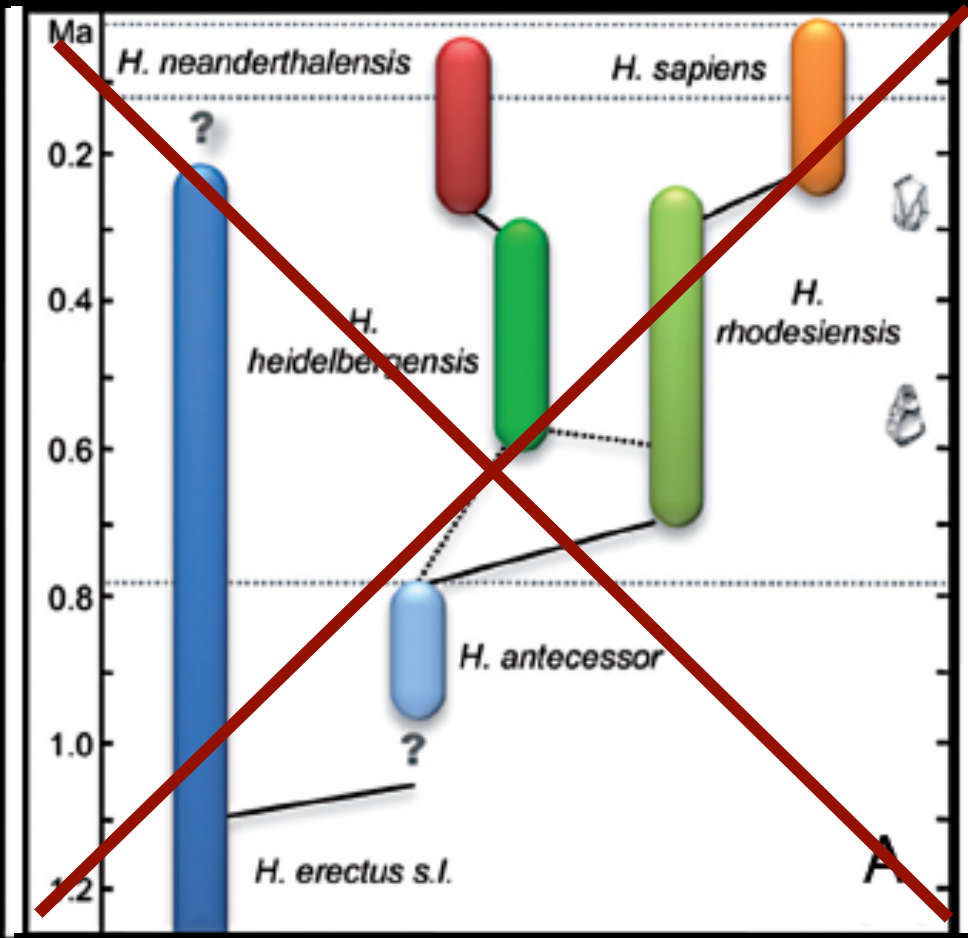


Mr. Zwigelaar, the discoverer of the Rhodesian skull, sh
(Photograph given Hrdlička by Mr. Zw






Ma
H. neanderthalensis
H. sapiens
?
0.2
0.4
H.
heidelbergensis
0.6
0.8
1.0
H. erectus s.l.
1.2
B


Ma
H. neanderthalensis
H. sapiens
?
0.2
0.4
H.
heidelbergensis
H.
rhodesiensis
0.6
0.8
H. antecessor
?
1.0
H. erectus s.l.
1.2
A

heidelbergensis: Broken Hill

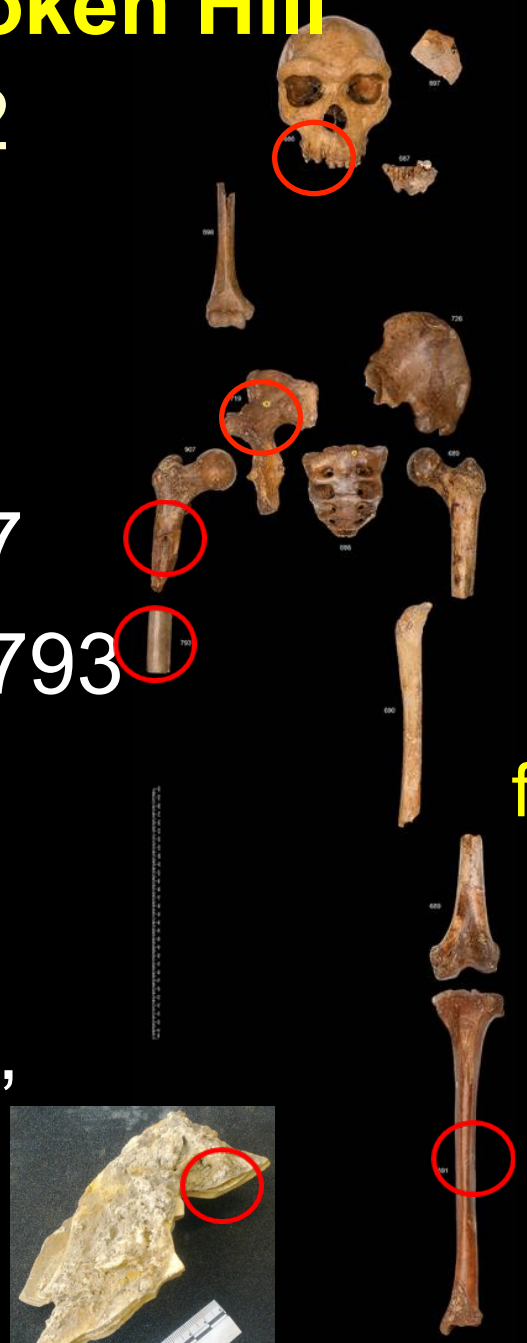
enamel frag right M2

os coxa E 719

proximal femur E 907

femoral midshaft EM 793

mineralised silty ‘skin’

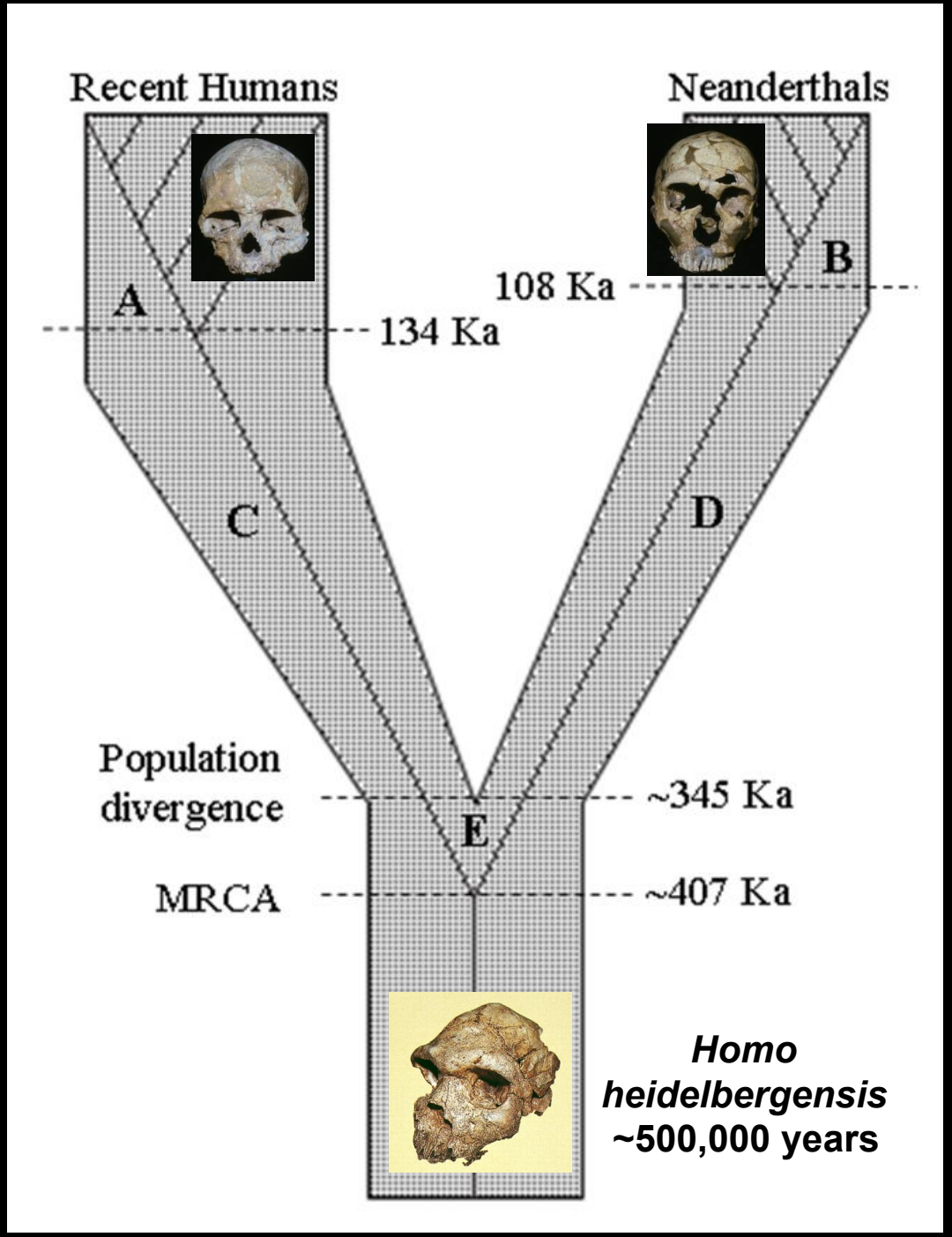


Samples ESR and/or U-S dated

Results range from 175-300ka: analyses ongoing….

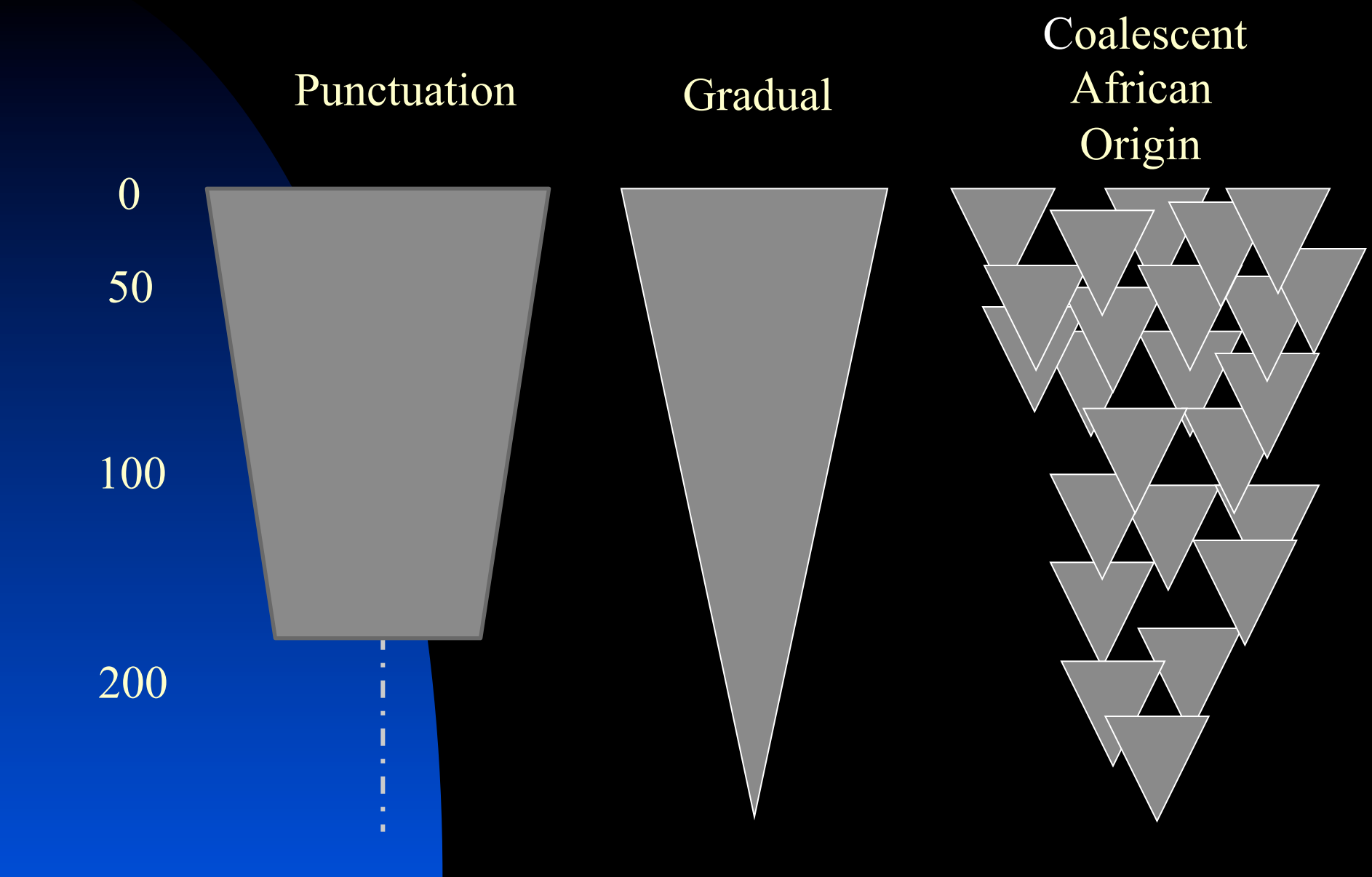
The evolution of Modern Humans and Neanderthals

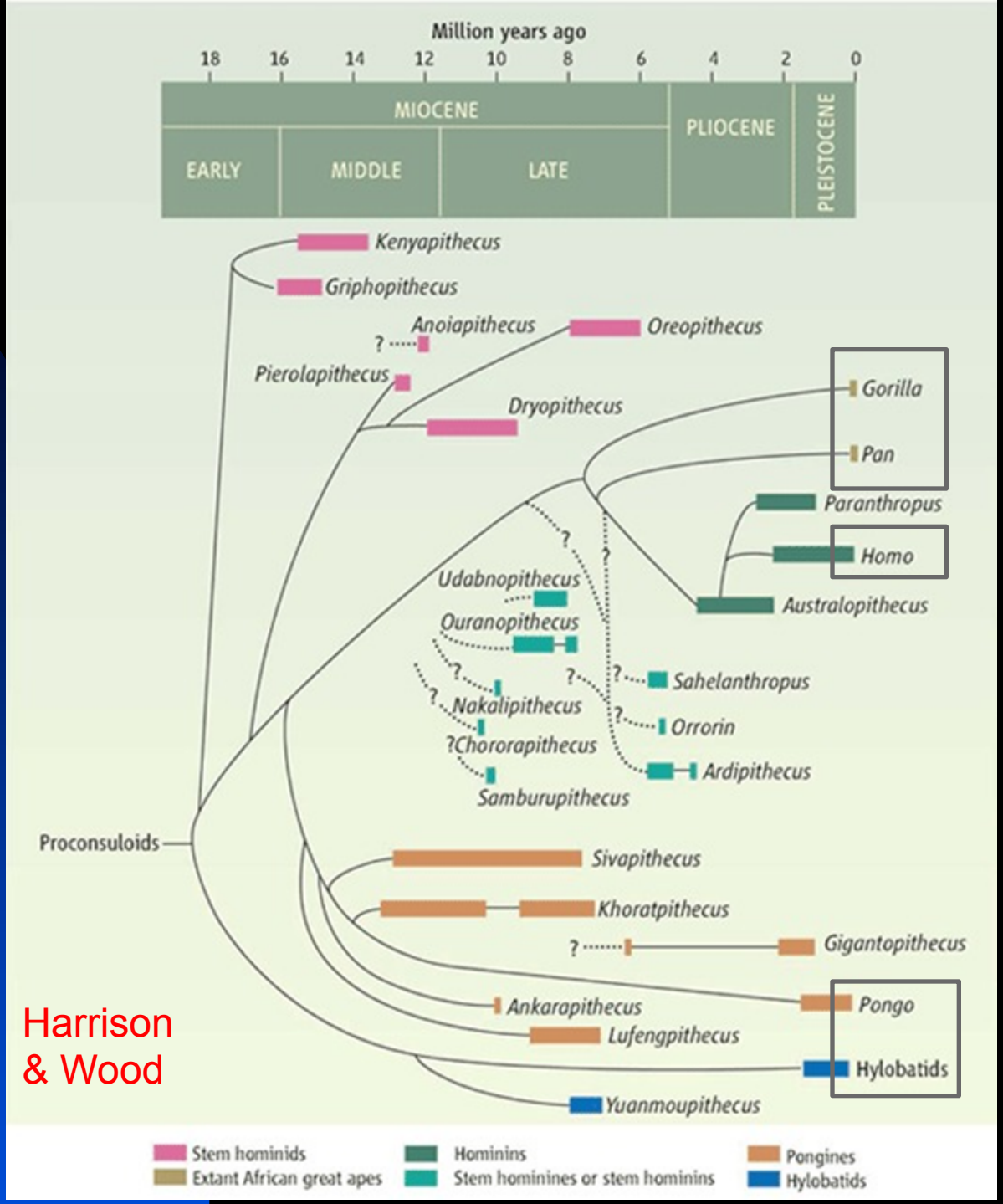
(based on fossil and genetic data)



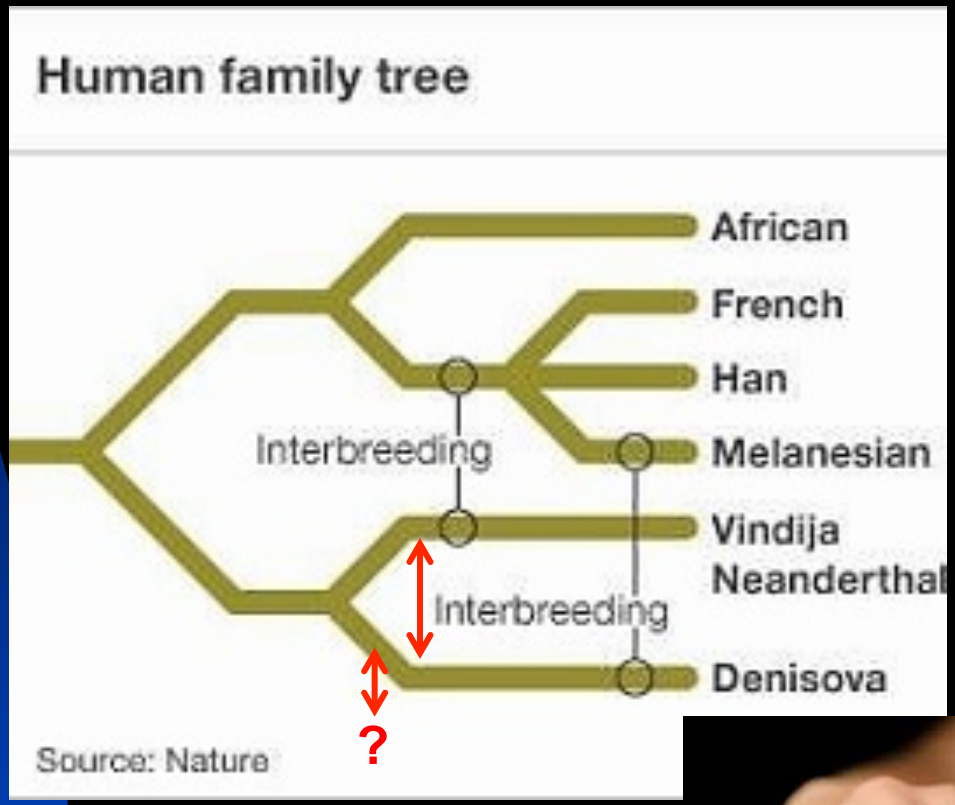
Neanderthals and Us

Patterns of Physical and Behavioural Evolution?

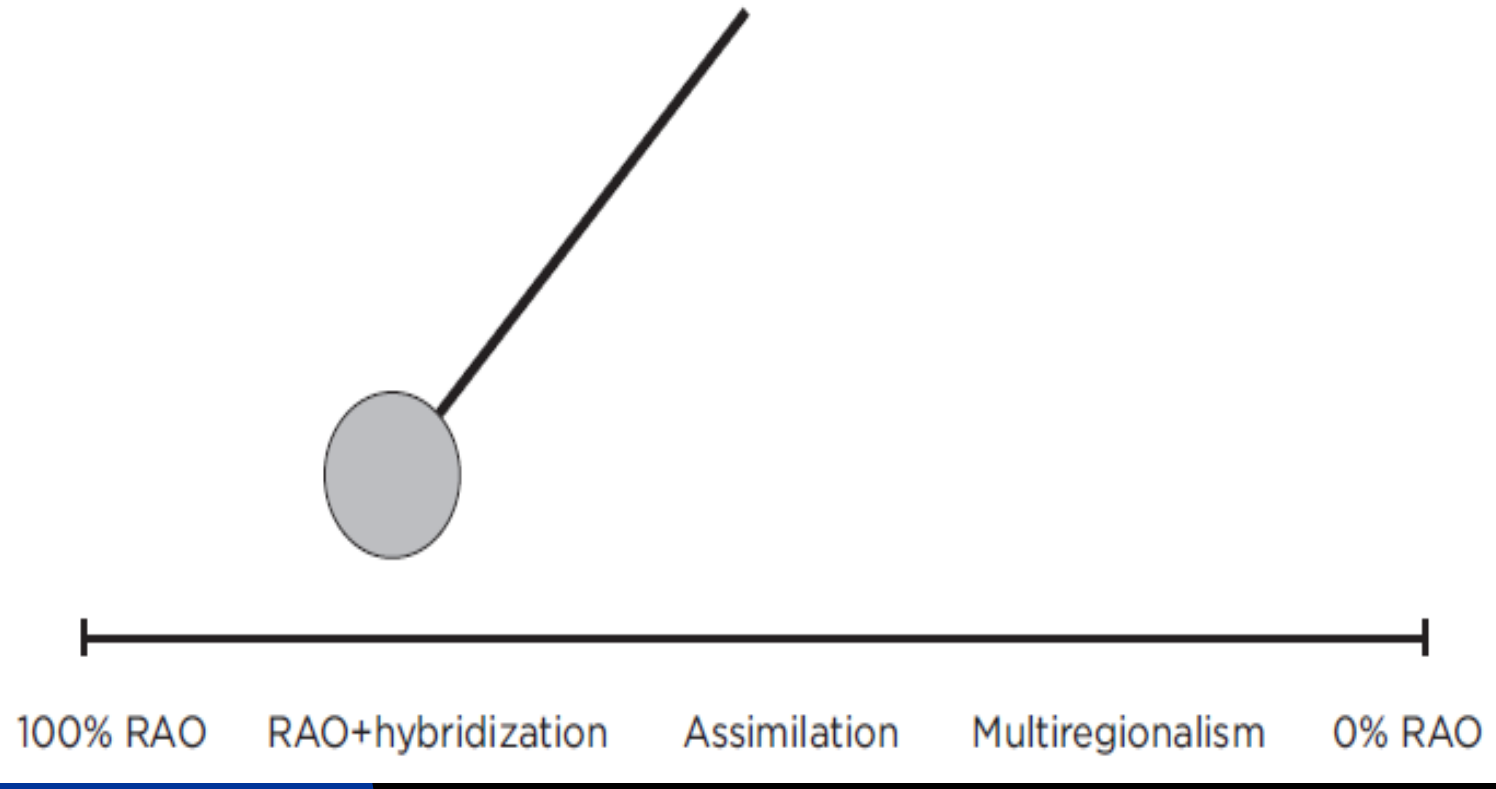



Million years ago
18
16
14
12
10
8
6
4
2
0
MIOCENE
EARLY
MIDDLE
LATE
PLIOCENE
PLEISTOCENE
Kenyapithecus
Griphopithecus
Anoiapithecus
Oreopithecus
?
Pierolapithecus
Dryopithecus
Gorilla
Pan
Paranthropus
Homo
Australopithecus
Udabnopithecus
Ouranopithecus
Sahelanthropus
Nakalipithecus
Orrorin
?Chororapithecus
Ardipithecus
Samburupithecus
Proconsuloids
Sivapithecus
Khoratpithecus
Gigantopithecus
Pongo
Ankarapithecus
Lufengpithecus
Hylobatids
Yuanmoupithecus
Harrison
& Wood
Stem hominids
Extant African great apes
Hominins
Stem hominines or stem hominins
Pongines
Hylobatids

Genetic history of an archaic hominin group from Denisova Cave in Siberia



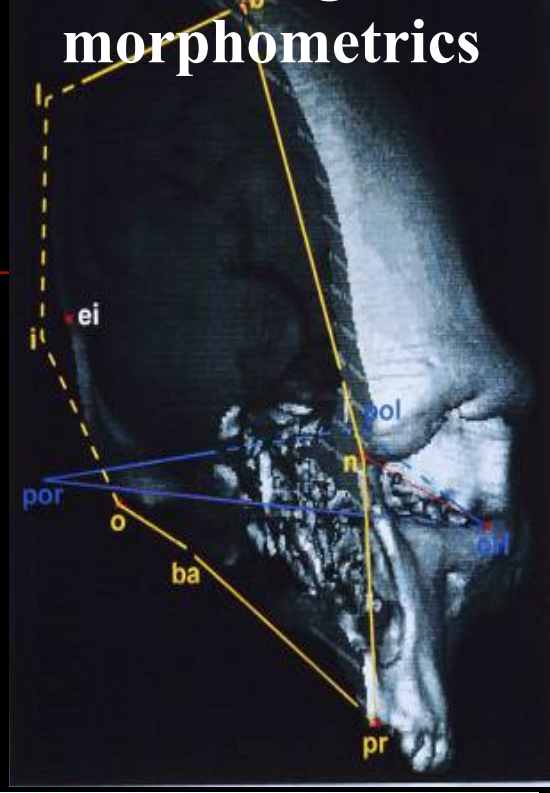
Models of modern human origins



1984 1970

New techniques of investigation

Scanning and morphometrics

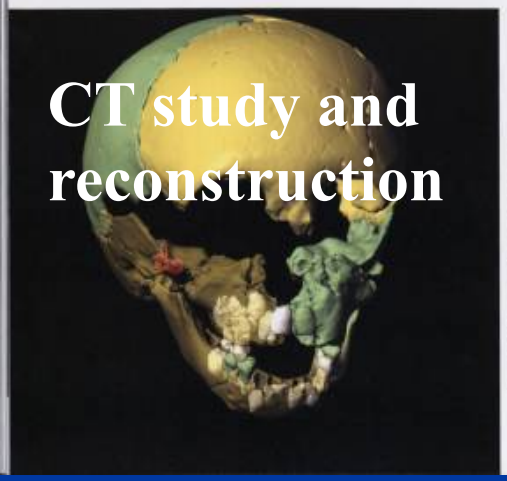


SEM, MicroCT, Synchrotron

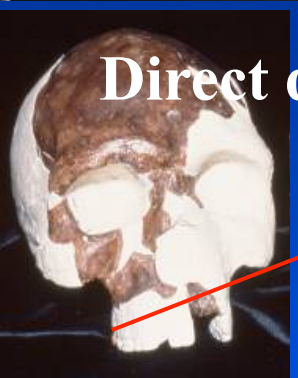
New Techniques for Studying Fossils

Calculus

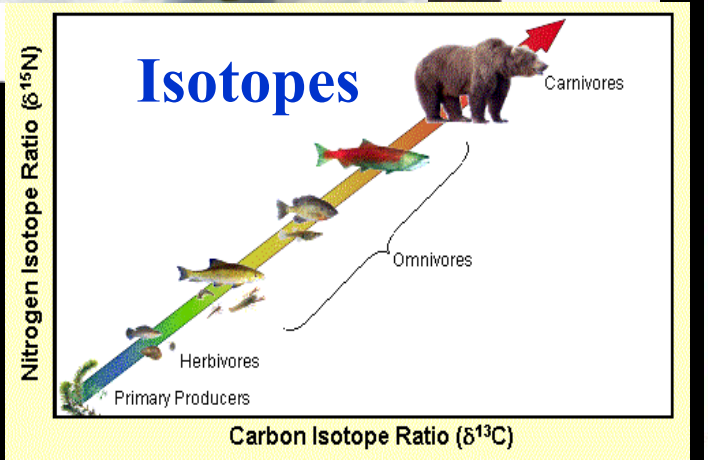
CT study and reconstruction



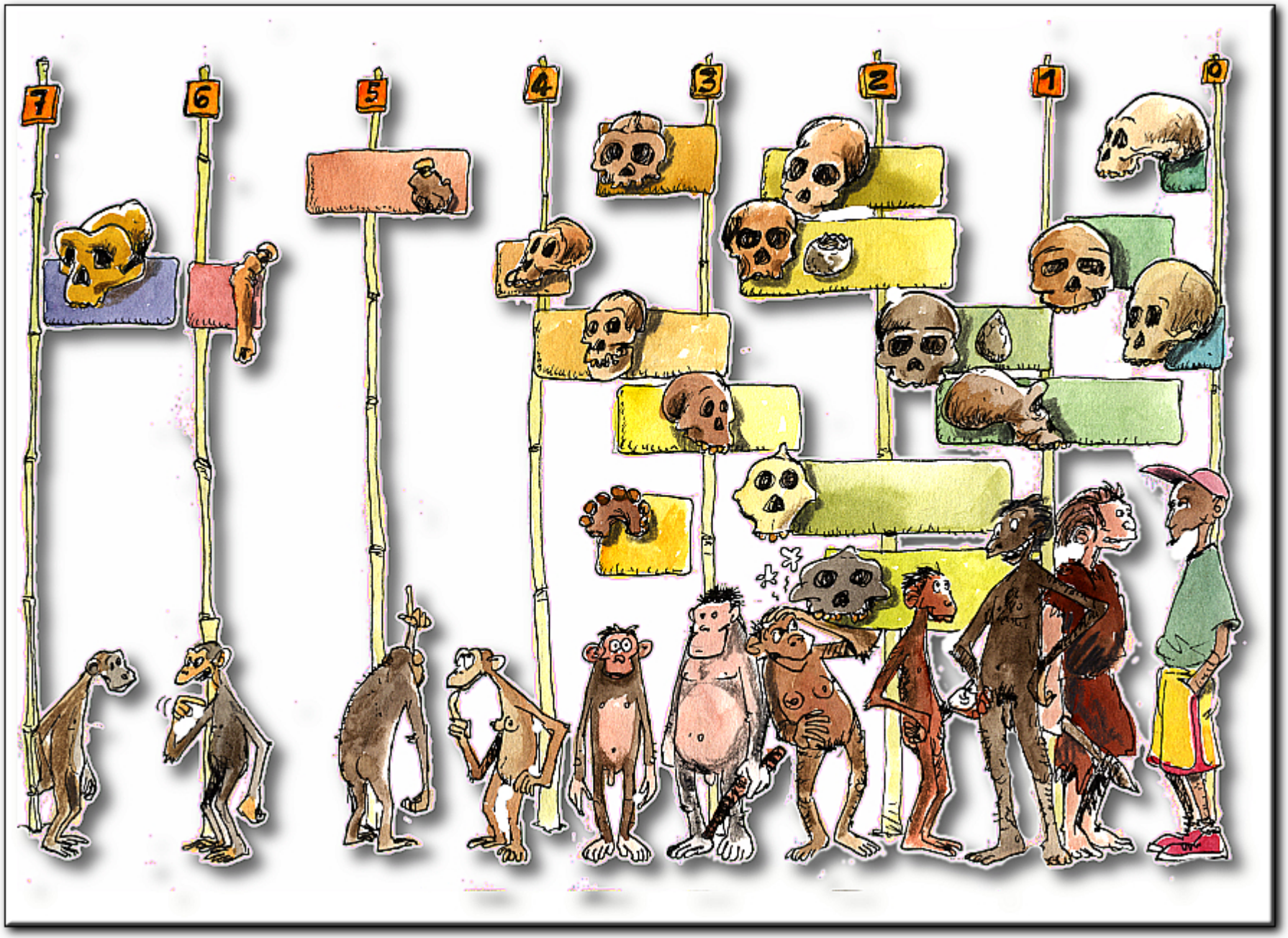
Direct dating

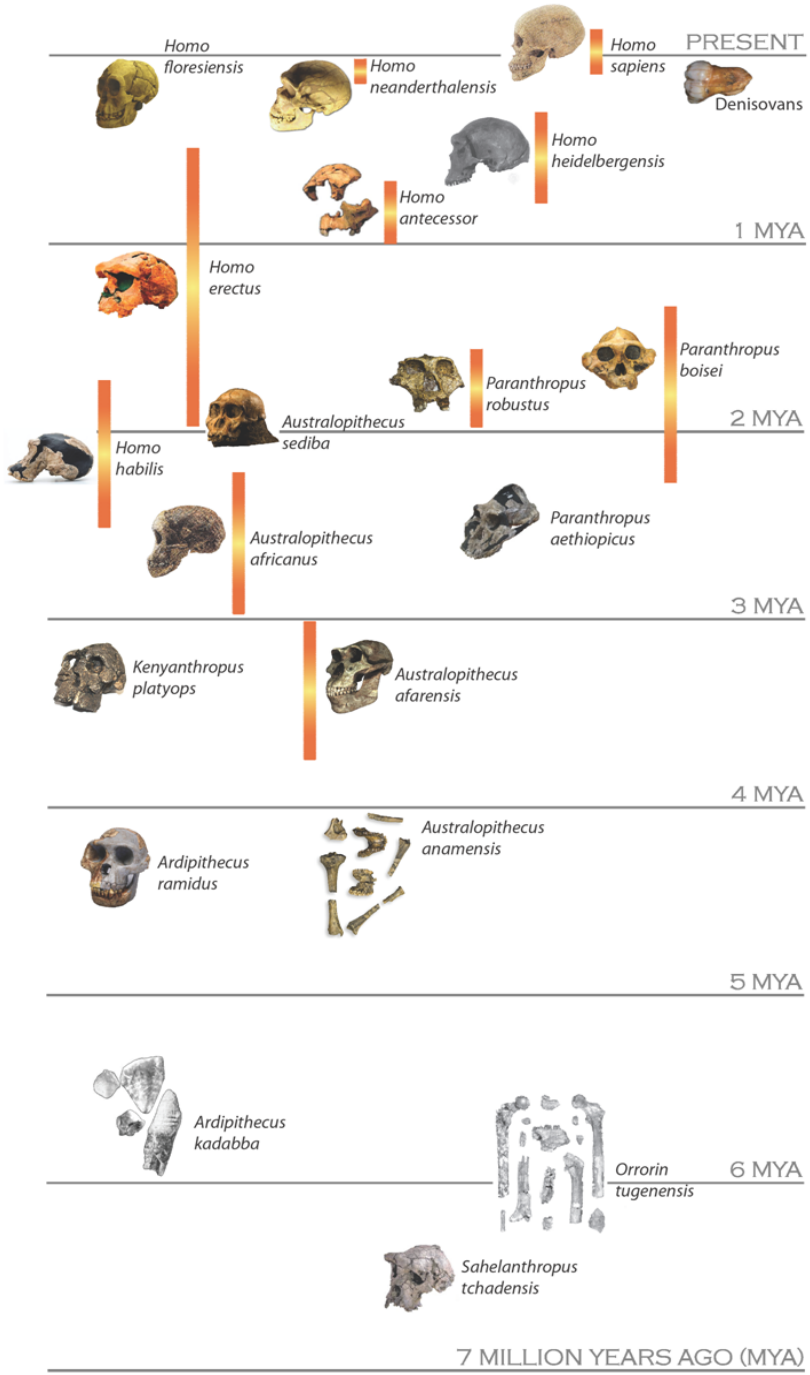


Isotopes

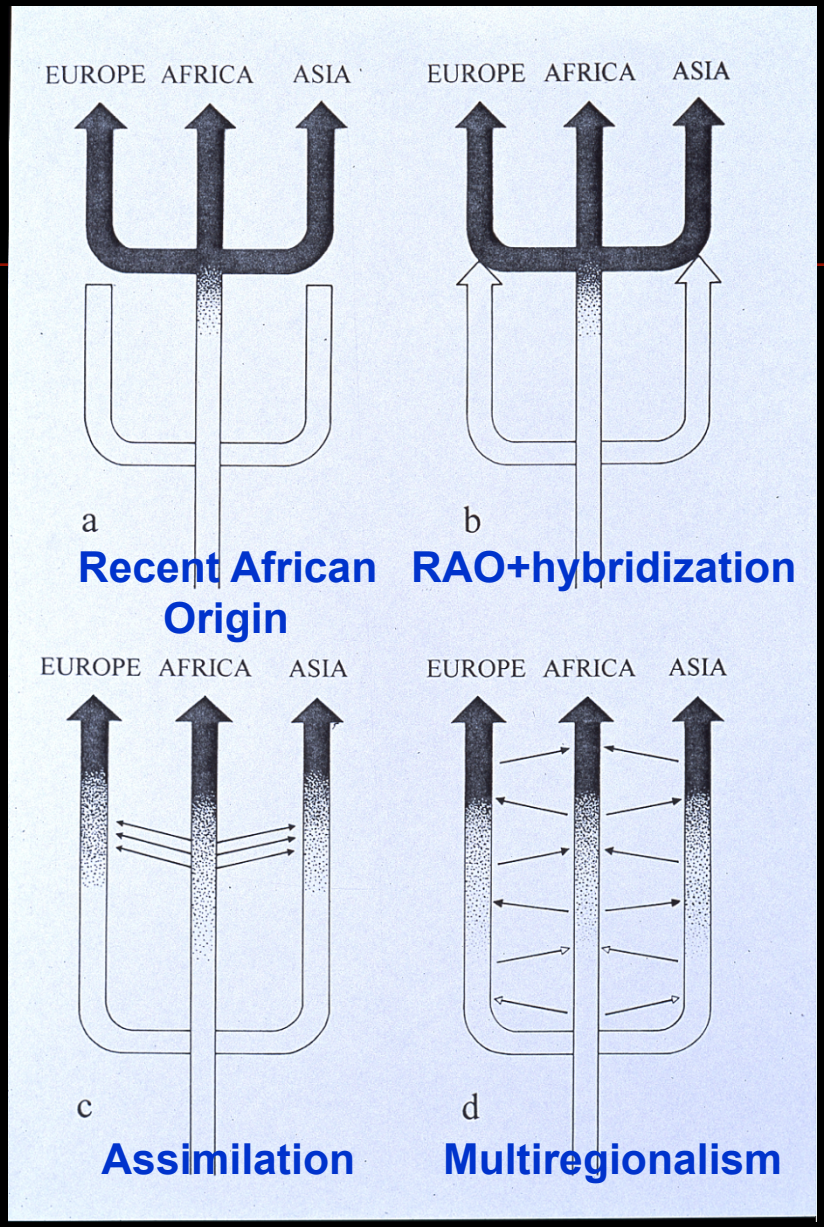


DNA

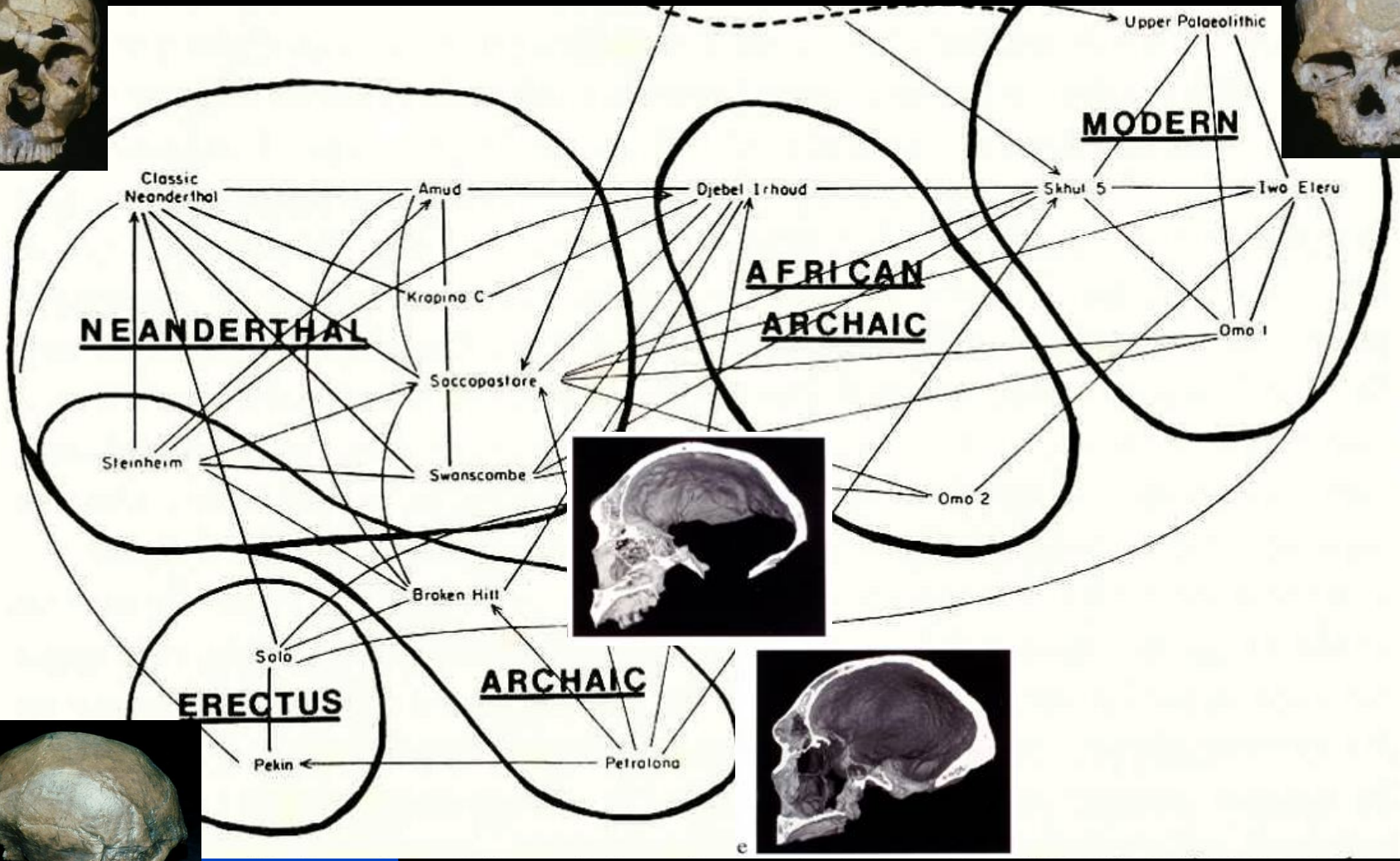

7
6
5
4
3
2
1
0

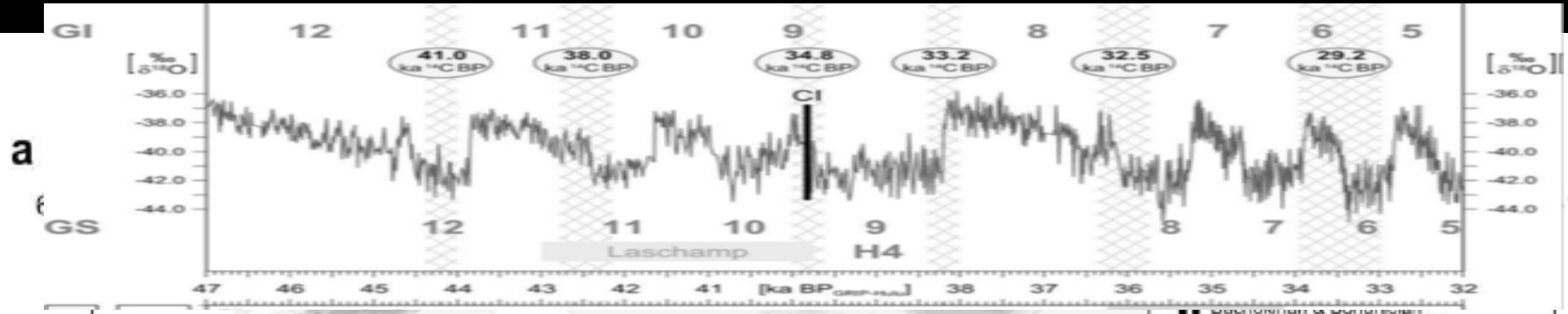

PRESENT
Homo sapiens
Homo floresiensis
Homo neanderthalensis
Denisovans
Homo heidelbergensis
Homo antecessor
1 MYA
Homo erectus
Paranthropus boisei
Paranthropus robustus
Australopithecus sediba
2 MYA
Homo habilis
Australopithecus africanus
Paranthropus aethiopicus
3 MYA
Kenyanthropus platyops
Australopithecus afarensis
4 MYA
Ardipithecus ramidus
Australopithecus anamensis
5 MYA
Ardipithecus kadabba
Orrorin tugenensis
6 MYA
Sahelanthropus tchadensis
7 MILLION YEARS AGO (MYA)

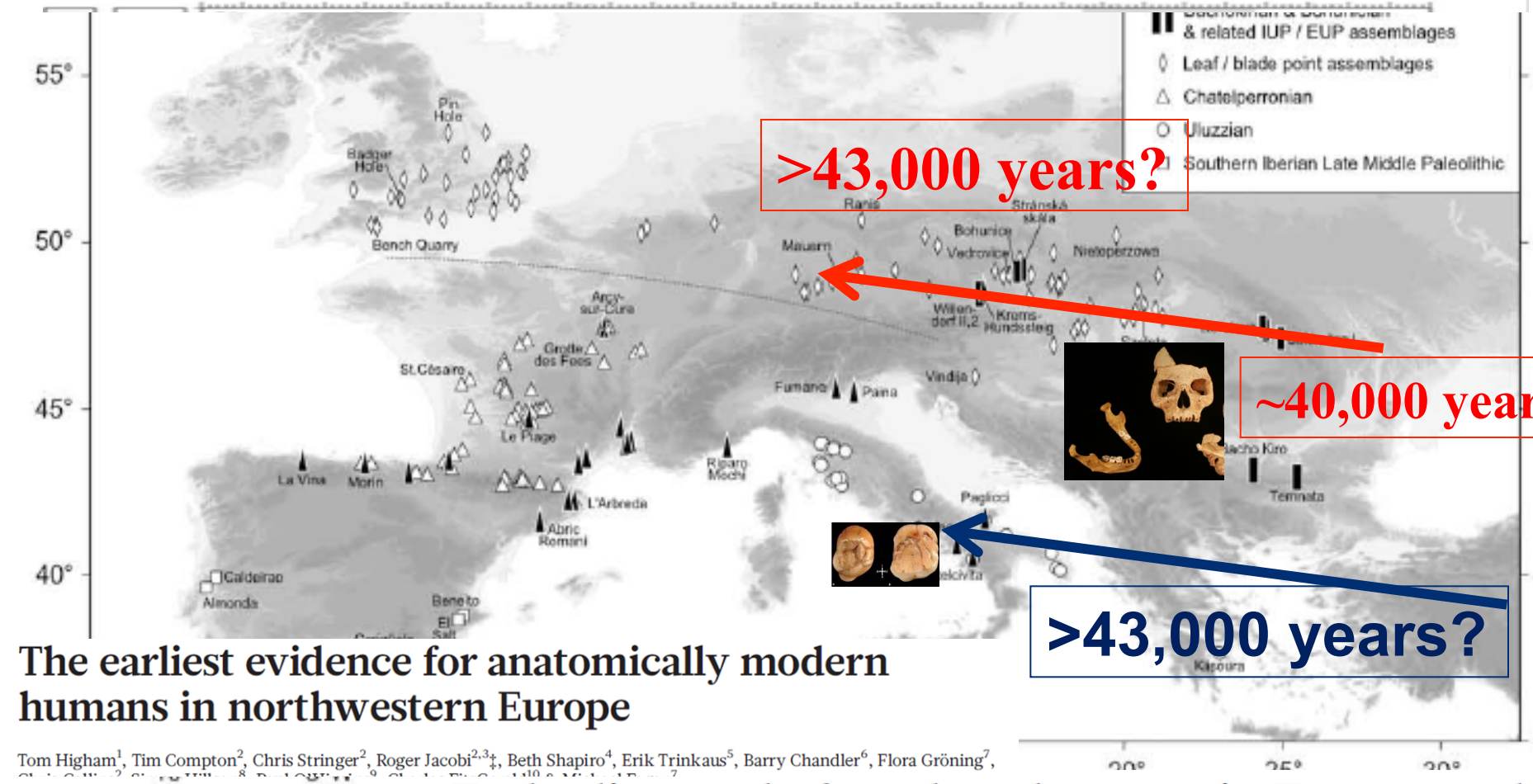
How did modern humans evolve? Models of the1990s



Stringer 1974: cranial metrics suggest Neanderthals are not good ancestors for modern humans







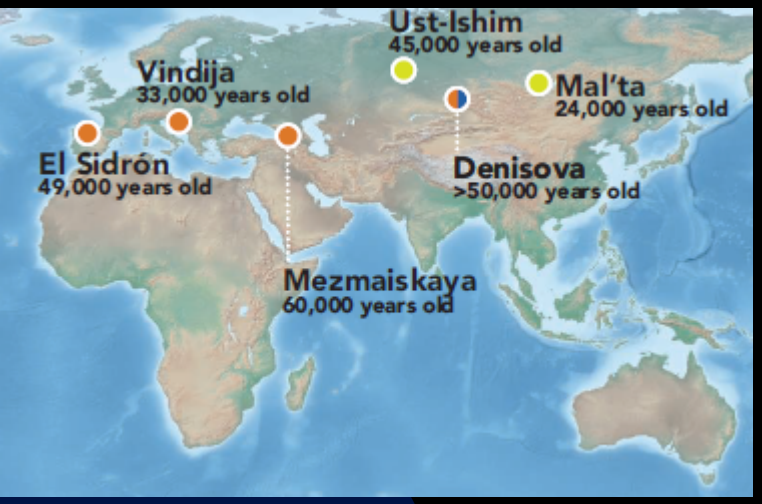
The earliest evidence for anatomically modern humans in northwestern Europe

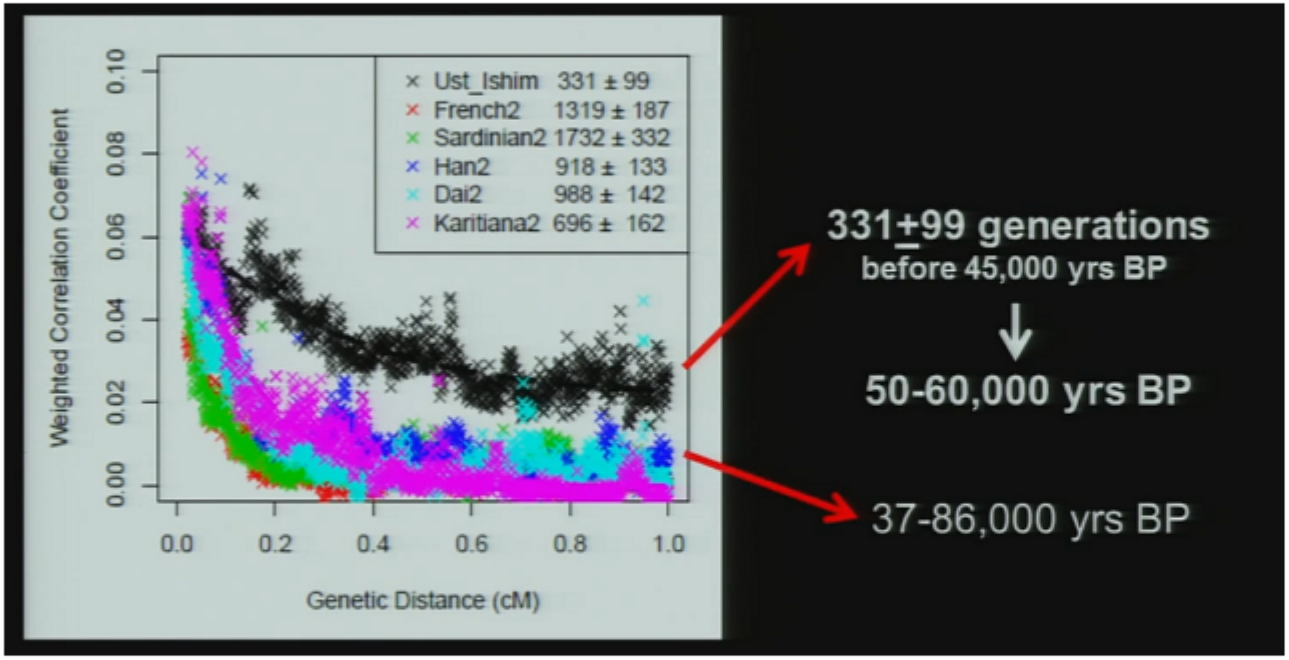
Tom Higham[1], Tim Compton[2], Chris Stringer[2], Roger Jacobi[2,3]‡, Beth Shapiro[4], Erik Trinkaus[5], Barry Chandler[6], Flora Gröning[7],

Early dispersal of modern humans in Europe and implications for Neanderthal behaviour

Stefano Benazzi[1], Katerina Douka[2], Cinzia Fornai[1], Catherine C. Bauer[3], Ottmar Kullmer[4], Jiří Svoboda[5,6], Ildikó Pap[7],

Ust-Ishim femur DNA constrains time of Nea-modern interbreeding





According to Dr. Paabo, Ust-Ishim has longer Neandertal chunks than modern humans and this can be used to estimate that the admixture with Neandertals happened 331+/-99 generations before its time of 45,000y BP, or around 50-60,000y BP.

Sriram Sankararaman[1,2], Swapan Mallick[1,2], Michael Dannemann[3], Kay Prüfer[3], Janet Kelso[3], Svante Pääbo[3], Nick Patterson[1,2] & David Reich[1,2,4]

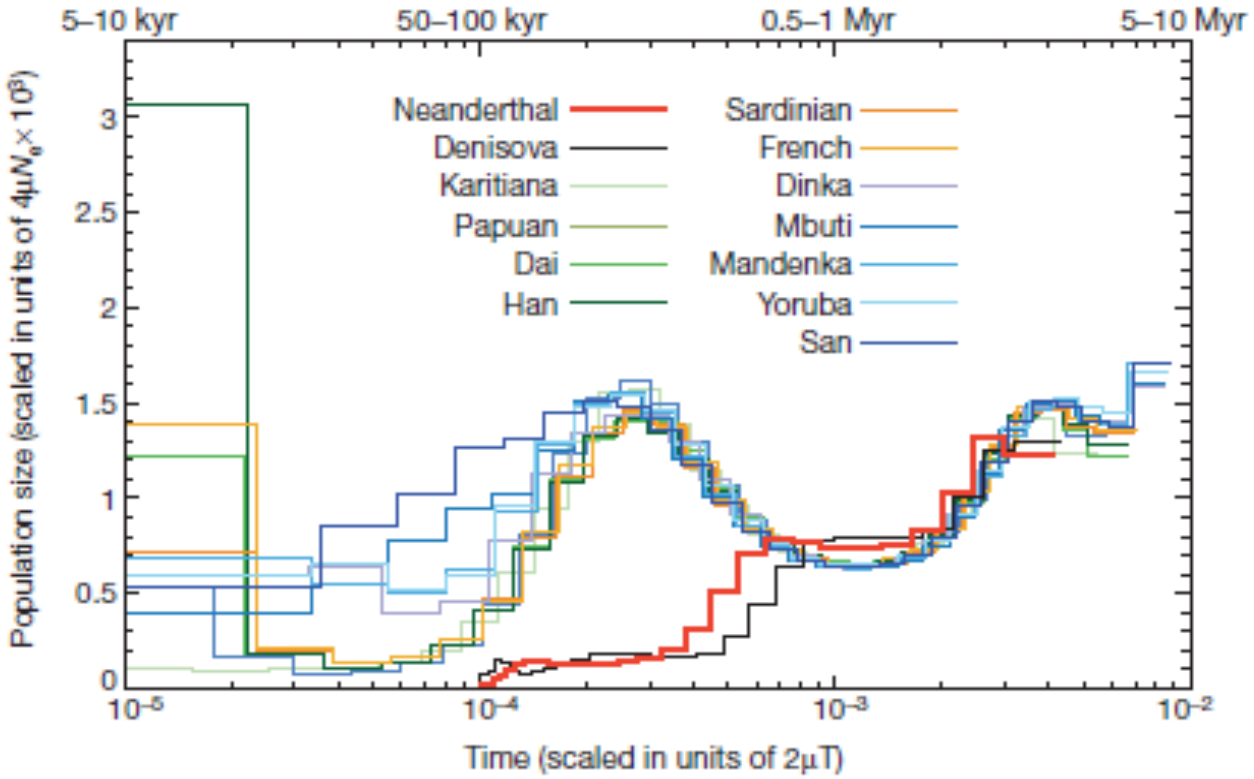
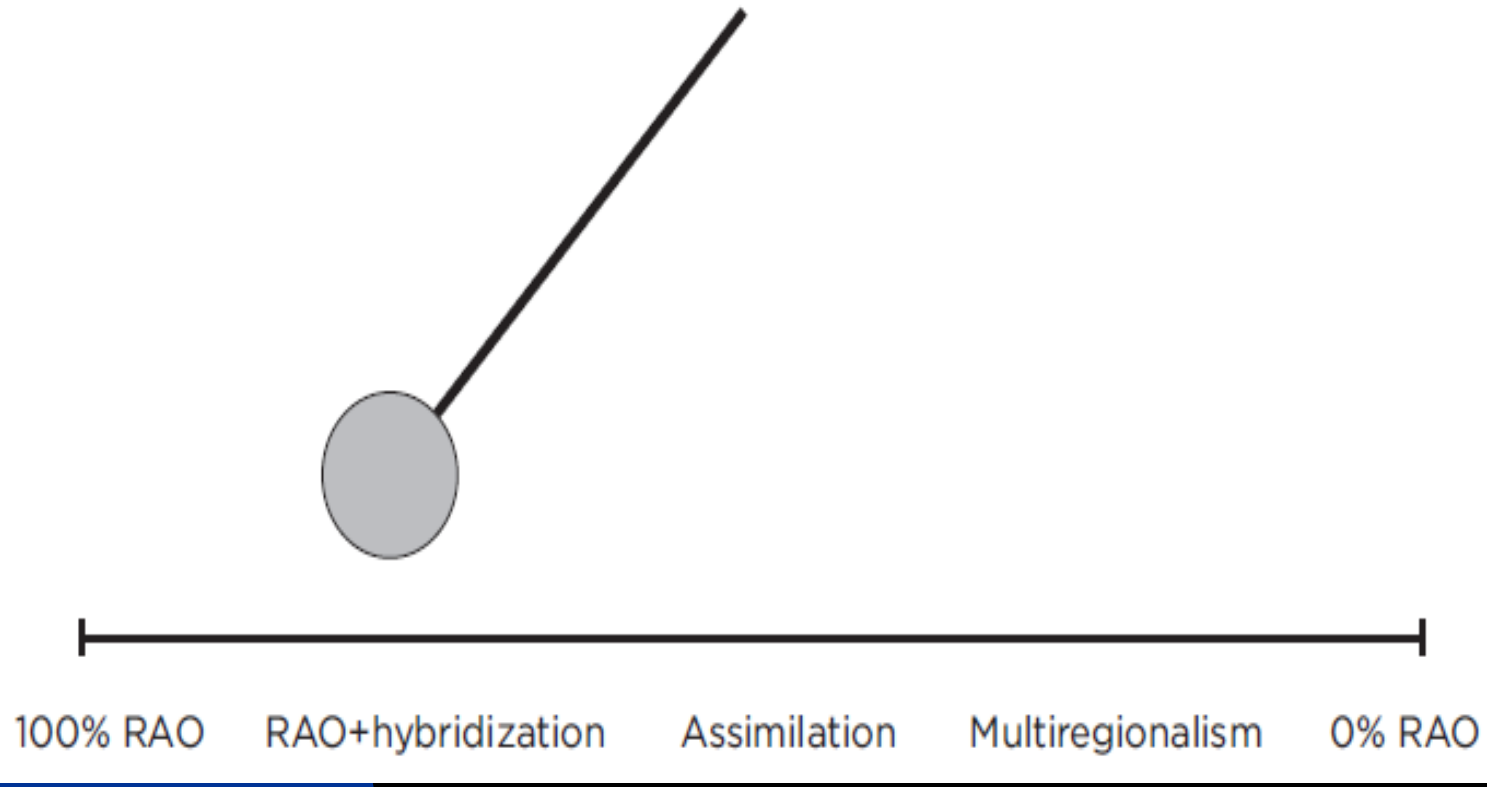


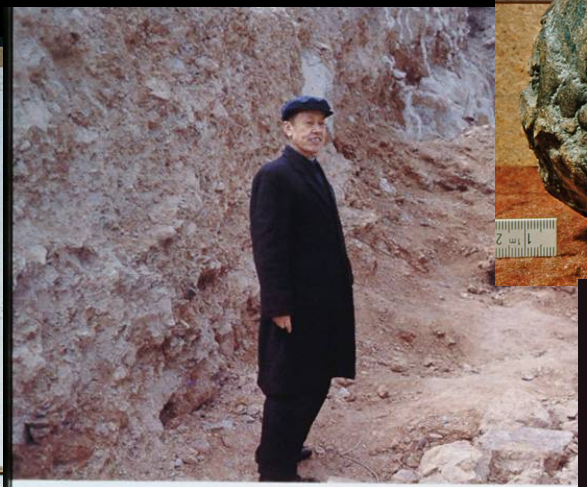
Figure 4 | Inference of population size change over time. The *y* axis specifies a number proportional to the population size N_e. The *x* axis specifies time in units of divergence per base pair (along the top in years for mutation rates of 0.5×10^{-9} to 1.0×10^{-9} per site per year). The analysis assumes that the Neanderthal and Denisova remains are of the same age, whereas archaeological evidence and the branch shortening indicate that the Neanderthal bone is older than the Denisovan bone. However, because the exact difference in ages is not known, it is not possible to determine whether the reduction in population size experienced by both archaic groups (but not by modern humans) coincided in time.

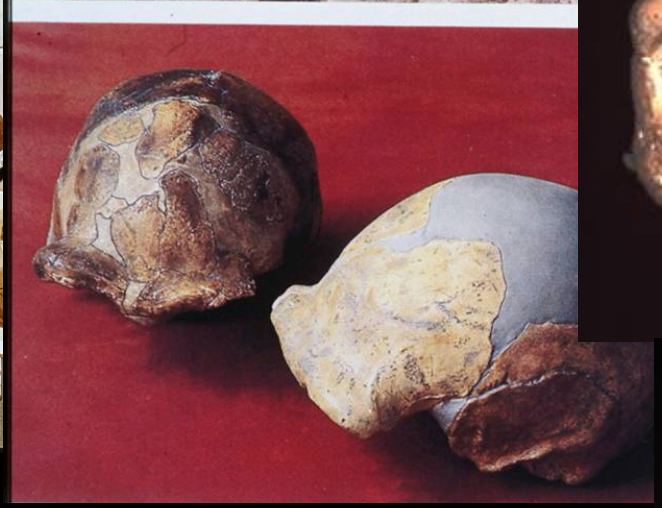
It is thus clear that the demographic histories of both archaic populations differ substantially from that of present-day humans.

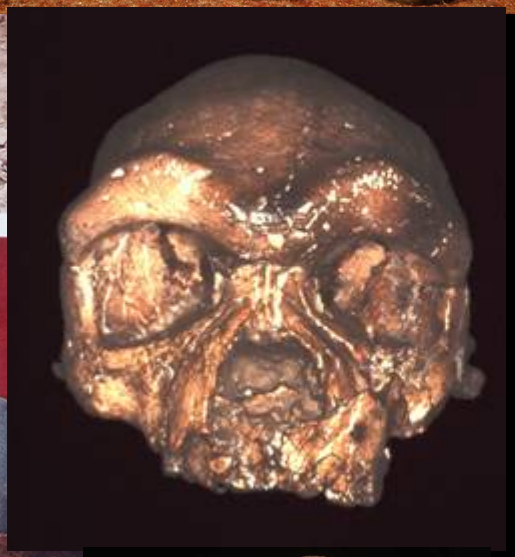
The pendulum starts swinging…



The Asian story…



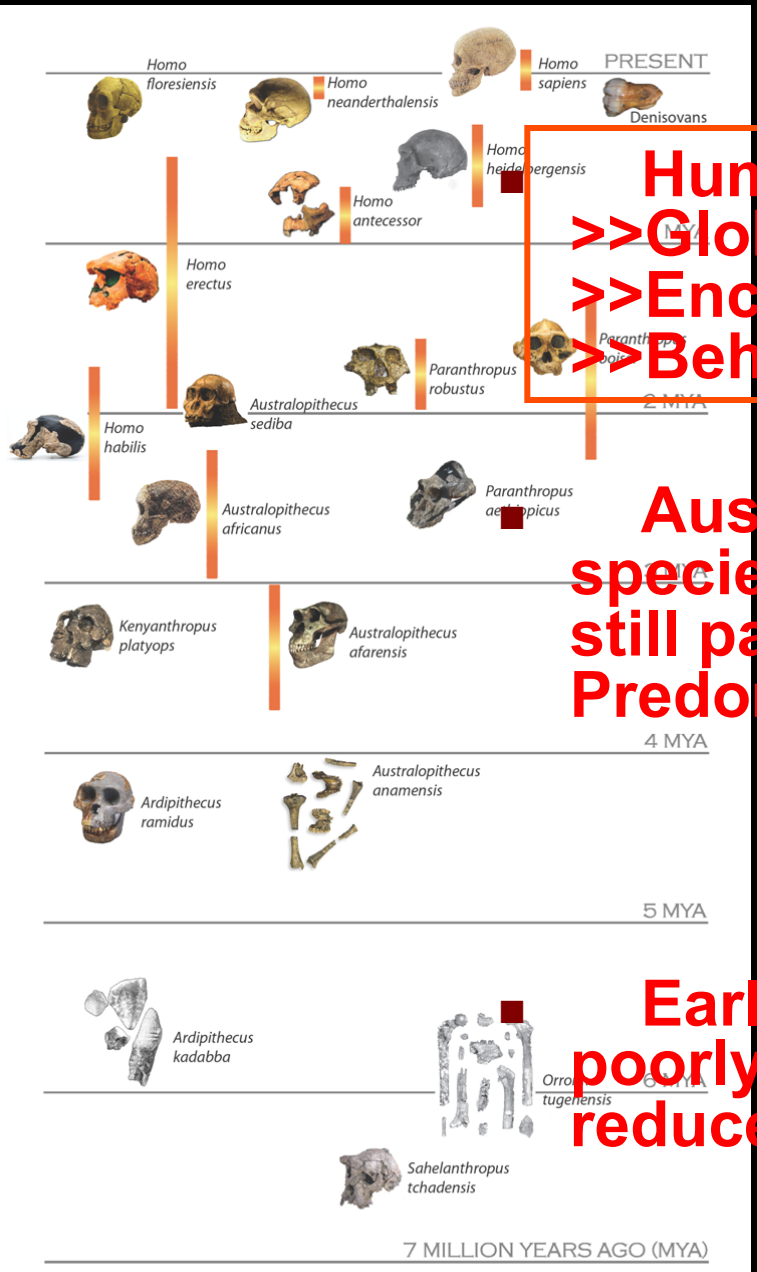




Atapuerca


El mapa de los yacimientos
REGISTRO CRONOLÓGICO
PRINCIPALES HALLAZGOS
VISTA AÉREA
GRAN DOLINA
ENTRE 1.000.000 Y 200.000 AÑOS
Principales restos de 'Homo antecessor'. Huesos de grandes carnívoros
GALERÍA
ENTRE 400.000 Y 200.000 AÑOS
'Homo heidelbergensis' y herramientas de Modo 2 (Achelense).
TRINCHERA DEL FERROCARRIL
Los yacimientos afloraron durante la construcción de una línea de ferrocarril (1896-1901) hoy abandonada
HALLAZGO DE LA MANDÍBULA
SIMA DEL ELEFANTE
ENTRE 1,3 MILLONES Y 150.000 AÑOS
Lascas de Modo 1 (Olduvayense)
SIMA DE LOS HUESOS
400.000 AÑOS
'Homo heidelbergensis'. Es el yacimiento más rico en fósiles humanos
PORTALÓN
3.000 AÑOS (EDAD DEL BRONCE)
Adornos de hueso y marfil
0 50M

“Phases” of human evolution



Human phase 2 – 0 Ma: several species >>Global spread, “Human” anatomy >>Encephalised >>Dietary range >>Behavioural complexity

Australopithecine phase 4 – 2 Ma: Many species, widespread in Africa. Bipedal but still partly arboreal? Early tool-use? Predom. still ape-like?

Early phase 7 – 4 Ma: C+E. Africa. Still poorly known. Earliest bipeds? Canines reduced. Largely ape-like?

Neanderthals and "Hobbit" extinct
Homo sapiens 'Out of Africa 2'

Homo sapiens in Africa
Early Neanderthals in Europe

Homo heidelbergensis appears
Changes in glacial intensity

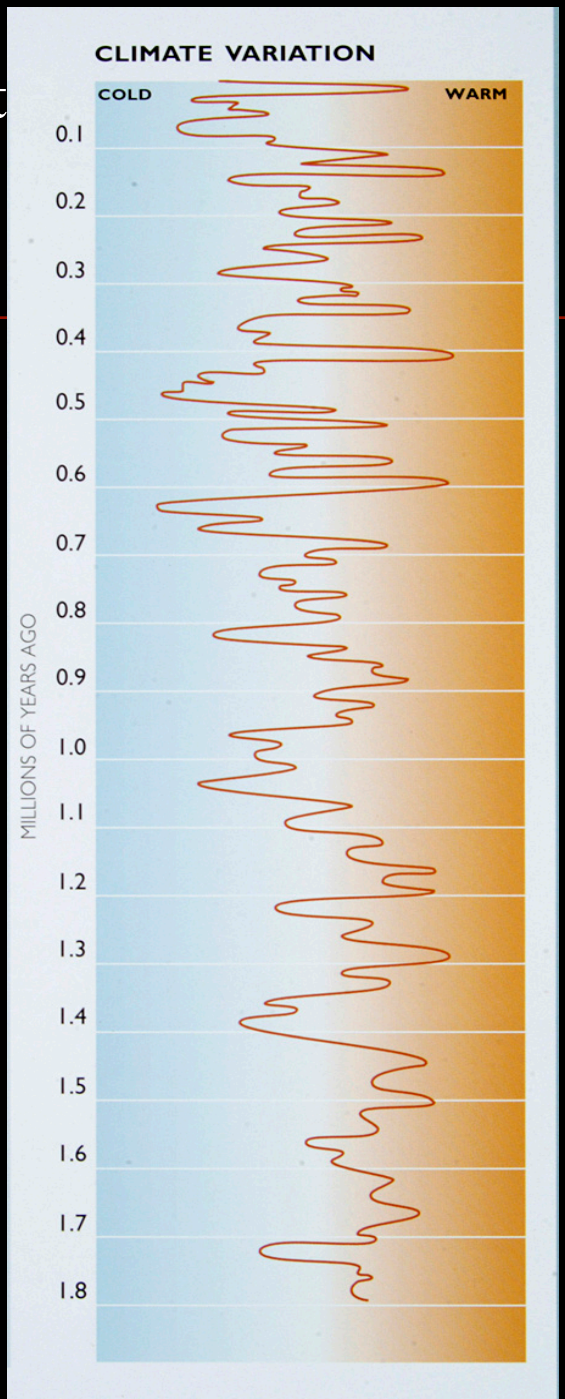
First humans in N. Europe/Britain?

Some "recent" events in human evolution

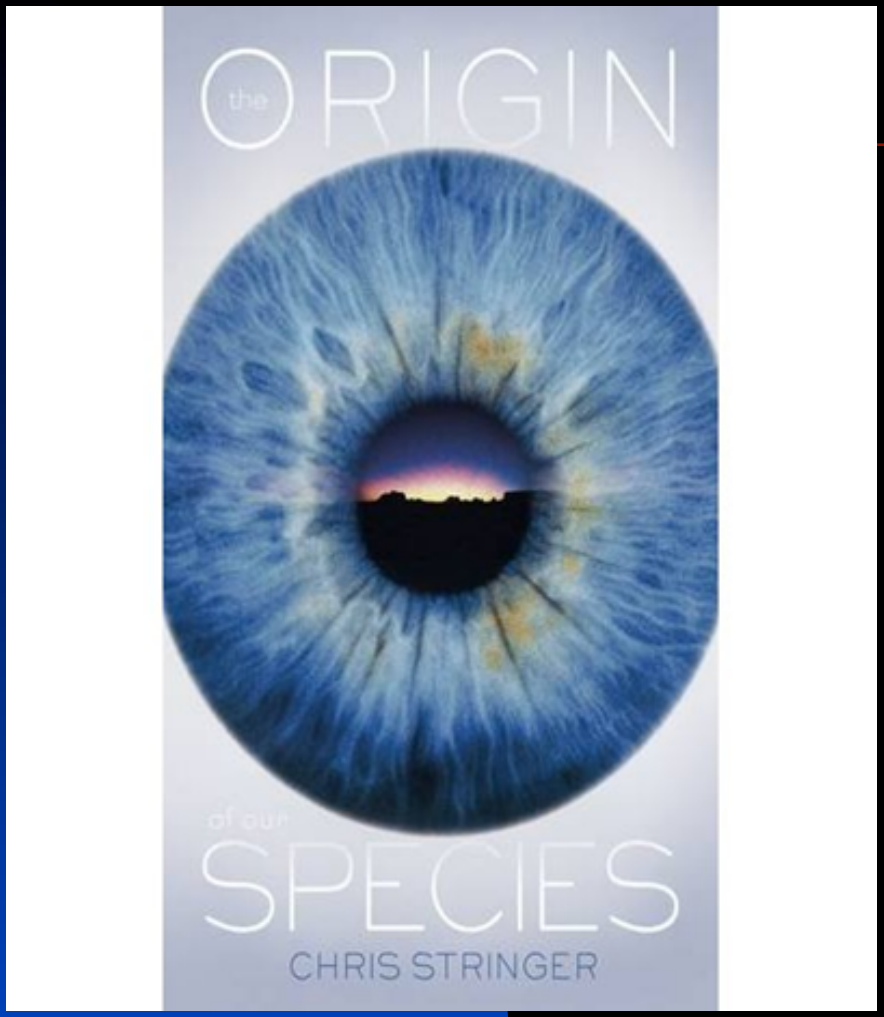
First humans in S. Europe?

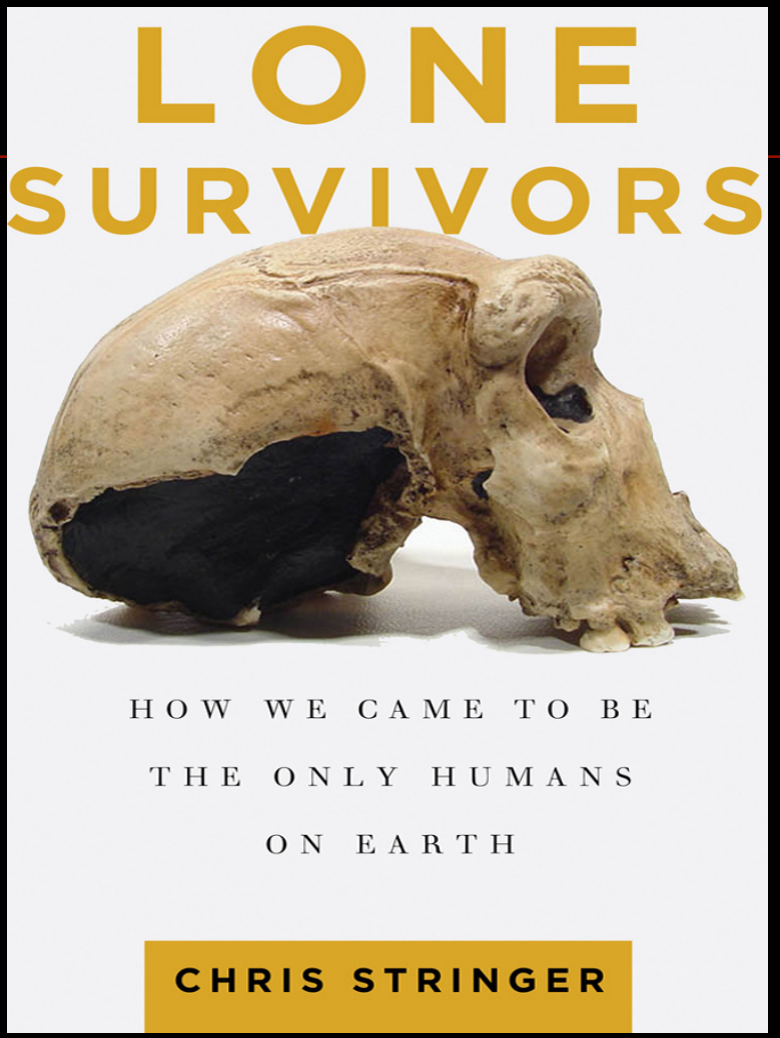
Homo erectus in Java & China

'Out of Africa 1'?
Homo erectus in Africa



The Origin of our Species





Chris Stringer, The Natural History Museum London

The Enigma of the Handaxe

Africa 1.5Ma

Britain 0.4Ma

If they were talking to each other, they were saying the same thing, over and over and over...
Desmond Clark

Today innovations spread and take hold…….