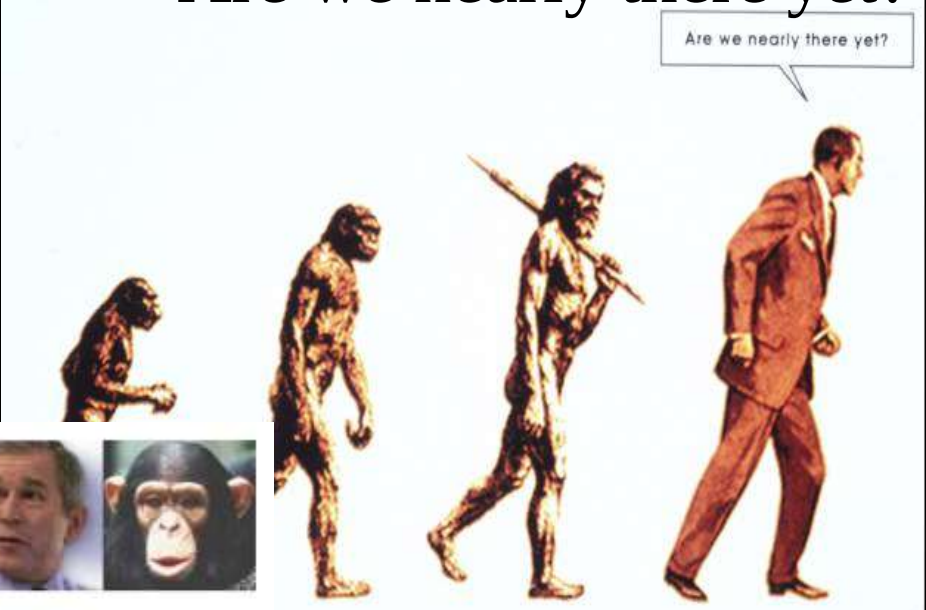
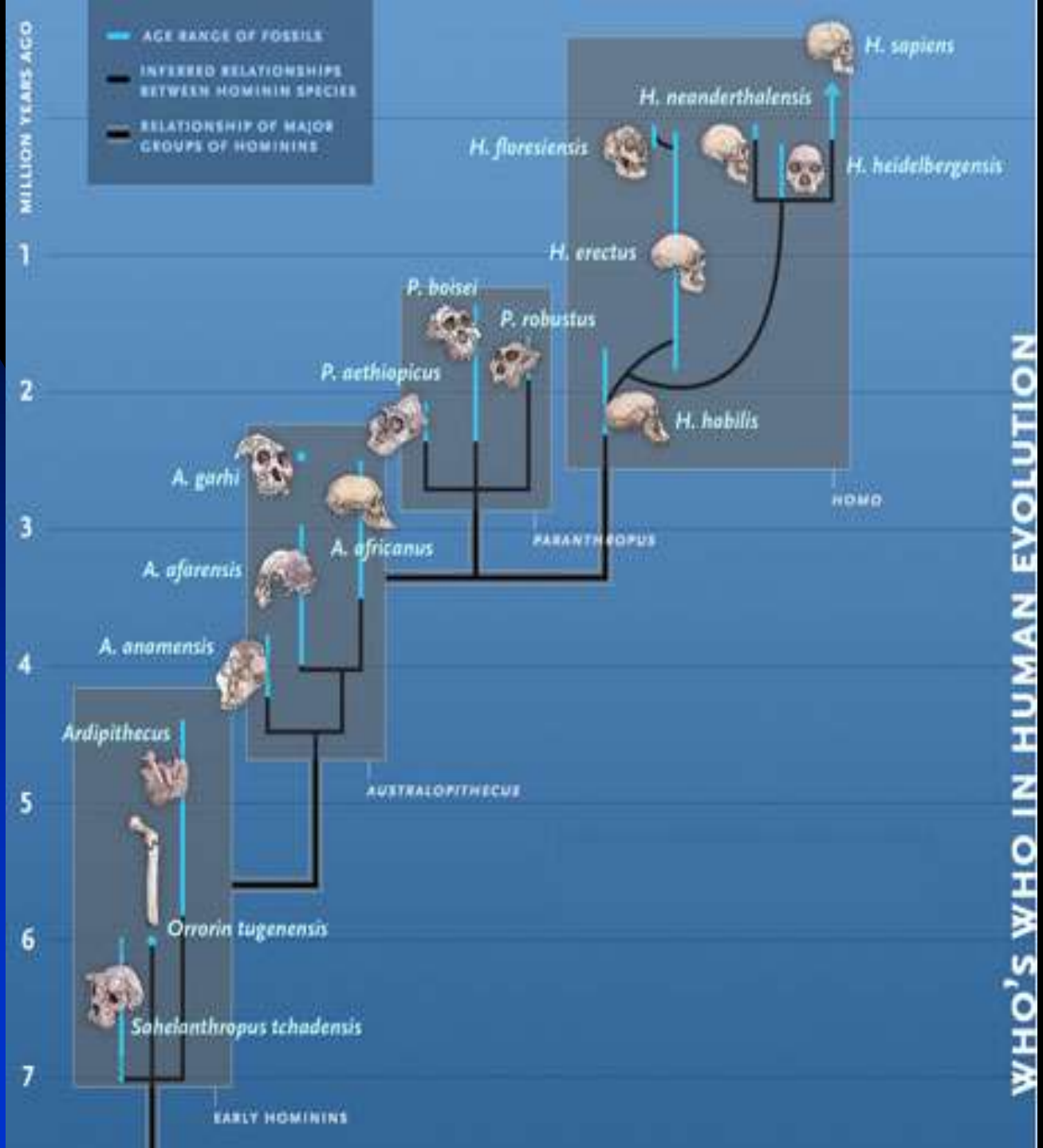
Human Evolution

Chris Stringer
The Natural History Museum
London

Are we nearly there yet?




AGE RANGE OF FOSSILS
INFERRED RELATIONSHIPS BETWEEN HOMININ SPECIES
RELATIONSHIP OF MAJOR GROUPS OF HOMININS
MILLION YEARS AGO
1
2
3
4
5
6
7
H. sapiens
H. neanderthalensis
H. floresiensis
H. heidelbergensis
H. erectus
P. boisei
P. robustus
P. aethiopicus
H. habilis
A. garhi
A. africanus
A. afarensis
A. anamensis
Ardipithecus
Orrorin tugenensis
Sahelanthropus tchadensis
HOMO
PARANTHROPUS
AUSTRALOPITHECUS
EARLY HOMININS
WHO'S WHO IN HUMAN EVOLUTION

Paranthropus (Australopithecus) robustus

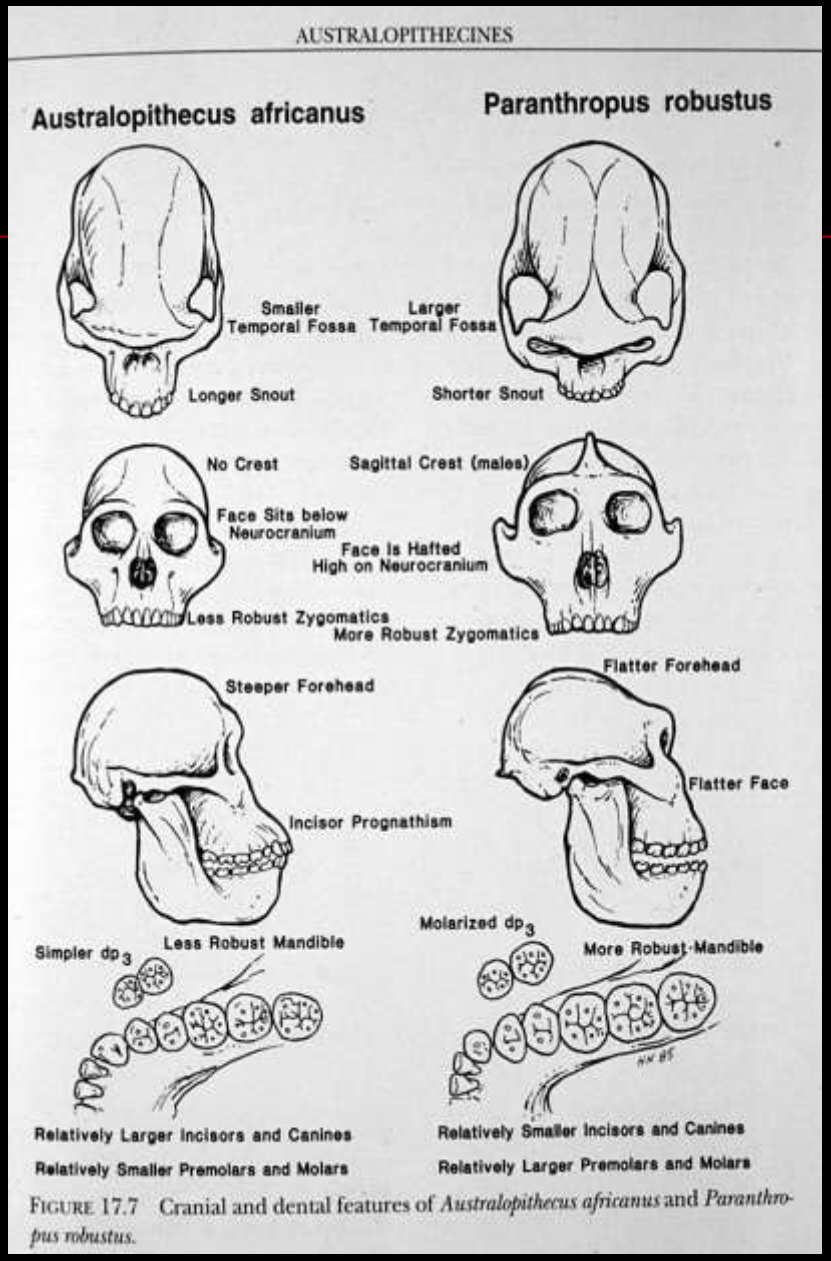
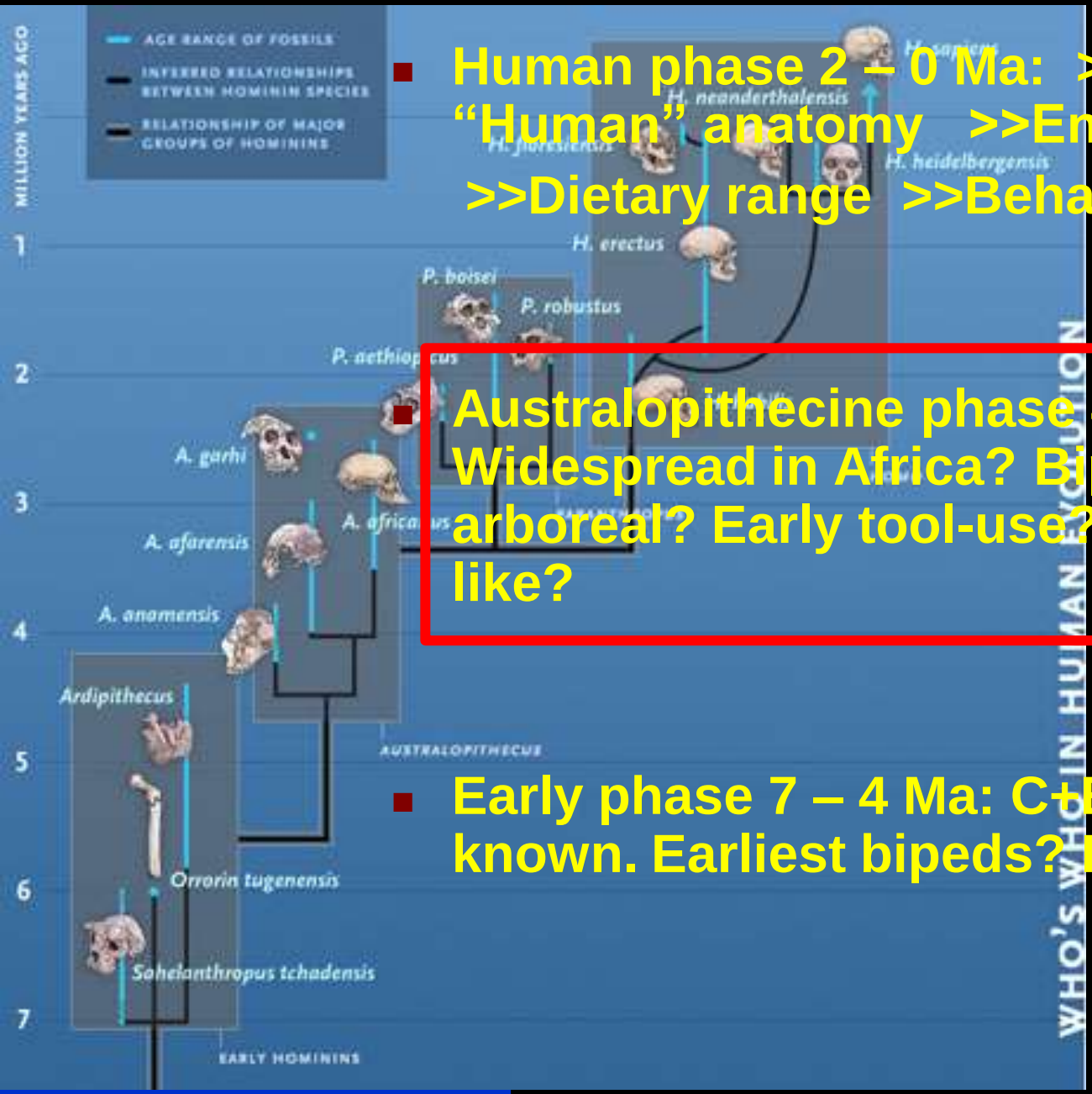


FIGURE 17.7 Cranial and dental features of *Australopithecus africanus* and *Paranthropus robustus*.

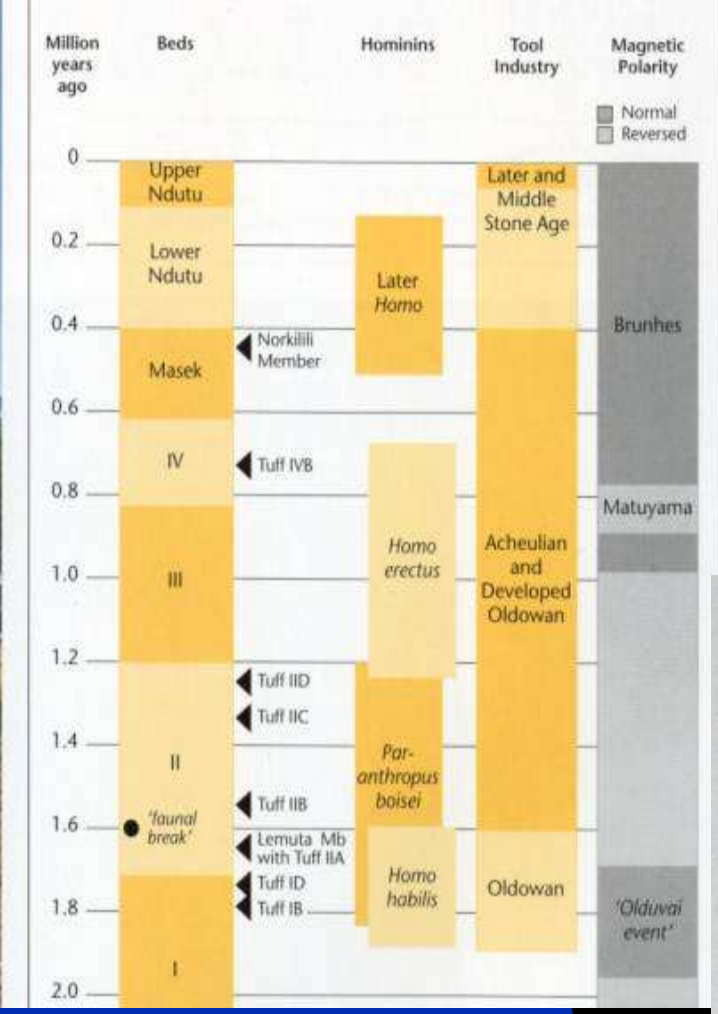
Australopithecines: thousands of fossils and at least 8 species in S., E. and C. Africa

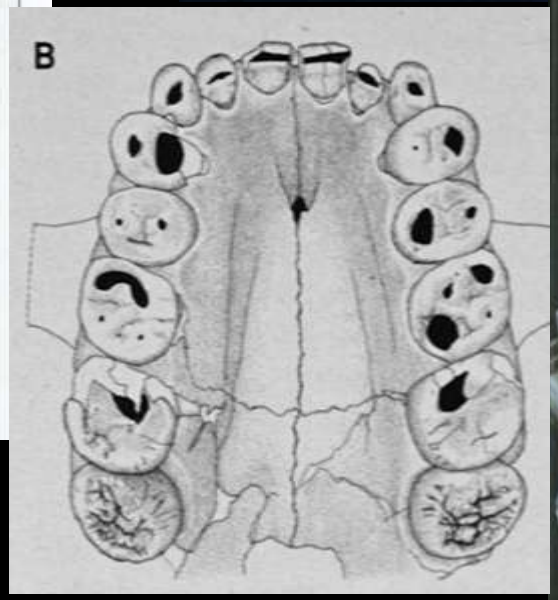
“Phases” of human evolution



- **Human phase 2 – 0 Ma: >>Global spread “Human” anatomy >>Encephalised >>Dietary range >>Behavioural complexity**
- **Australopithecine phase 4 – 2 Ma: 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? Largely ape-like?**

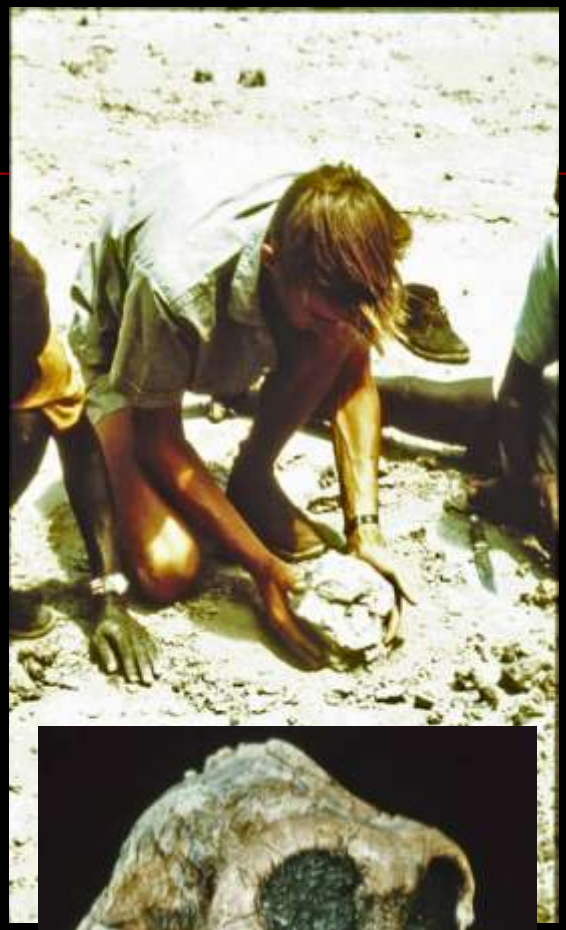
Olduvai Gorge and the Leakeys



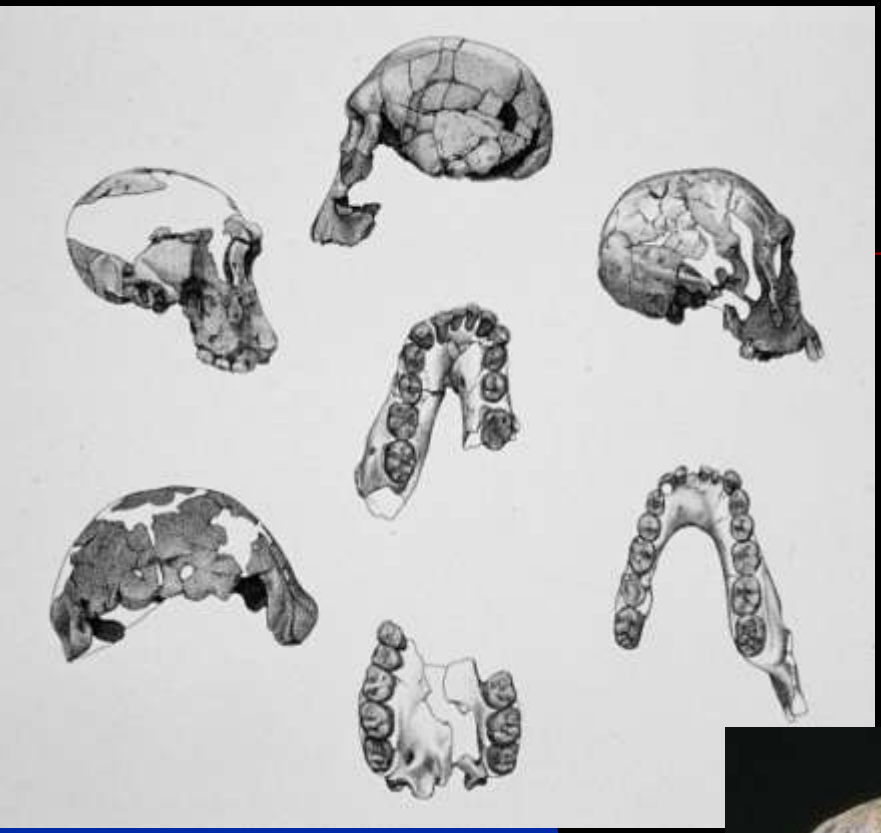


"*Zinjanthropus*": human or australopithecine?

East Turkana (N. Kenya): 1.5 –2.0 Ma

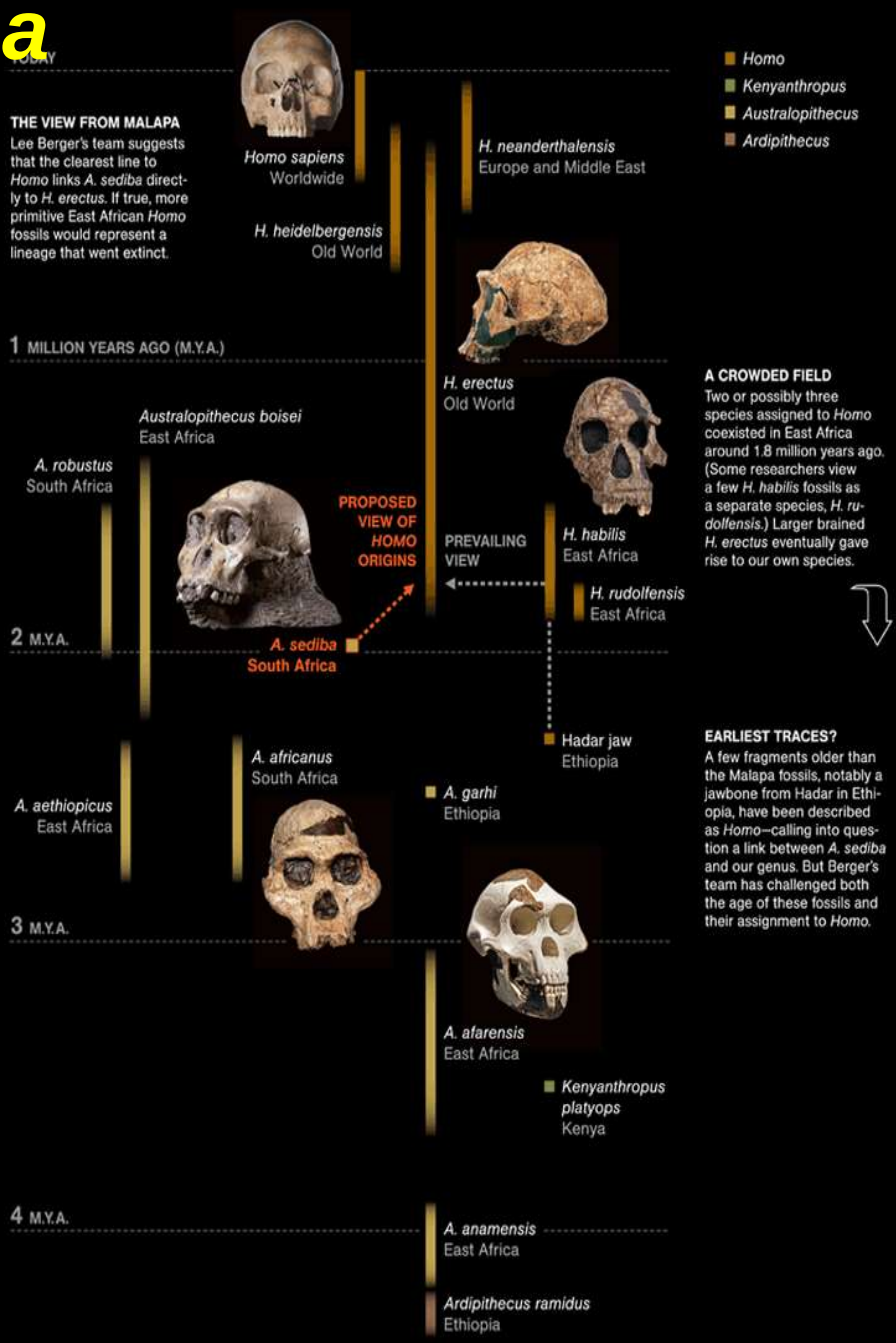


Homo habilis: one or more species?

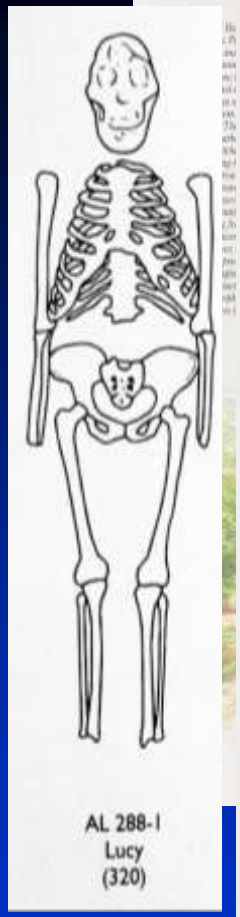


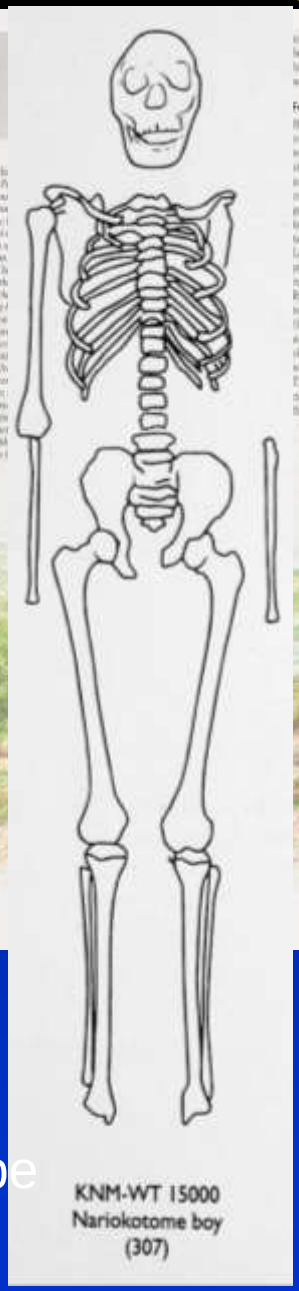
Homo rudolfensis and *Homo habilis*?

Australopithecus sediba (Malapa Cave, S. Africa)

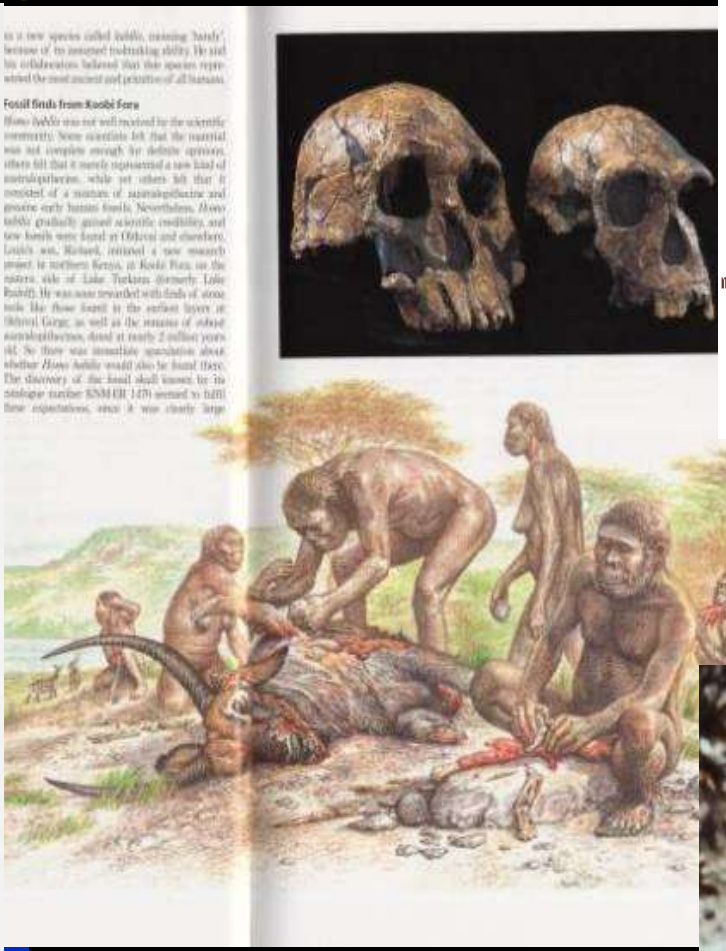


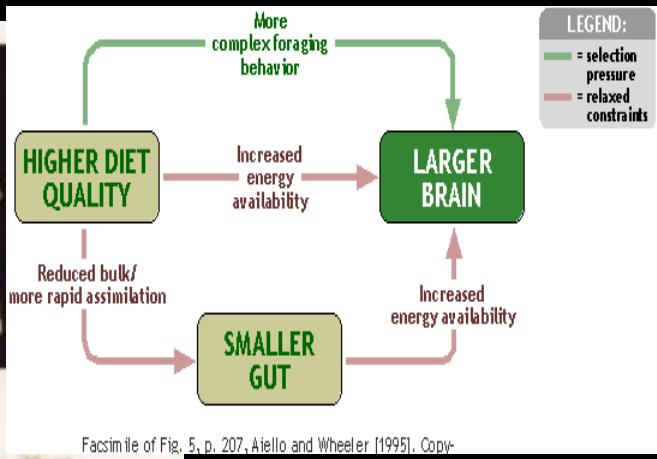
Becoming human





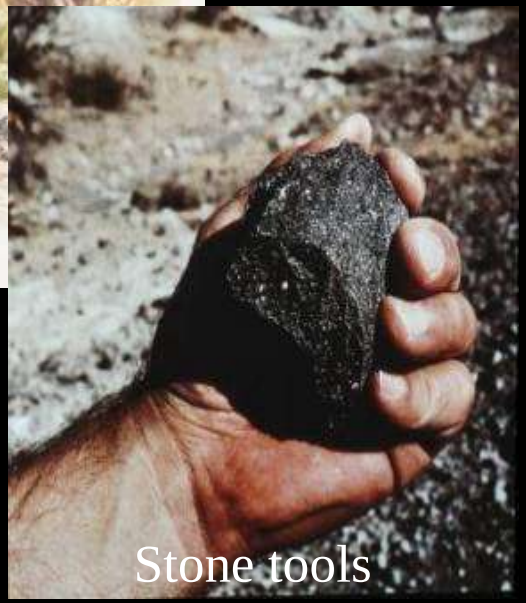
Body shape





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

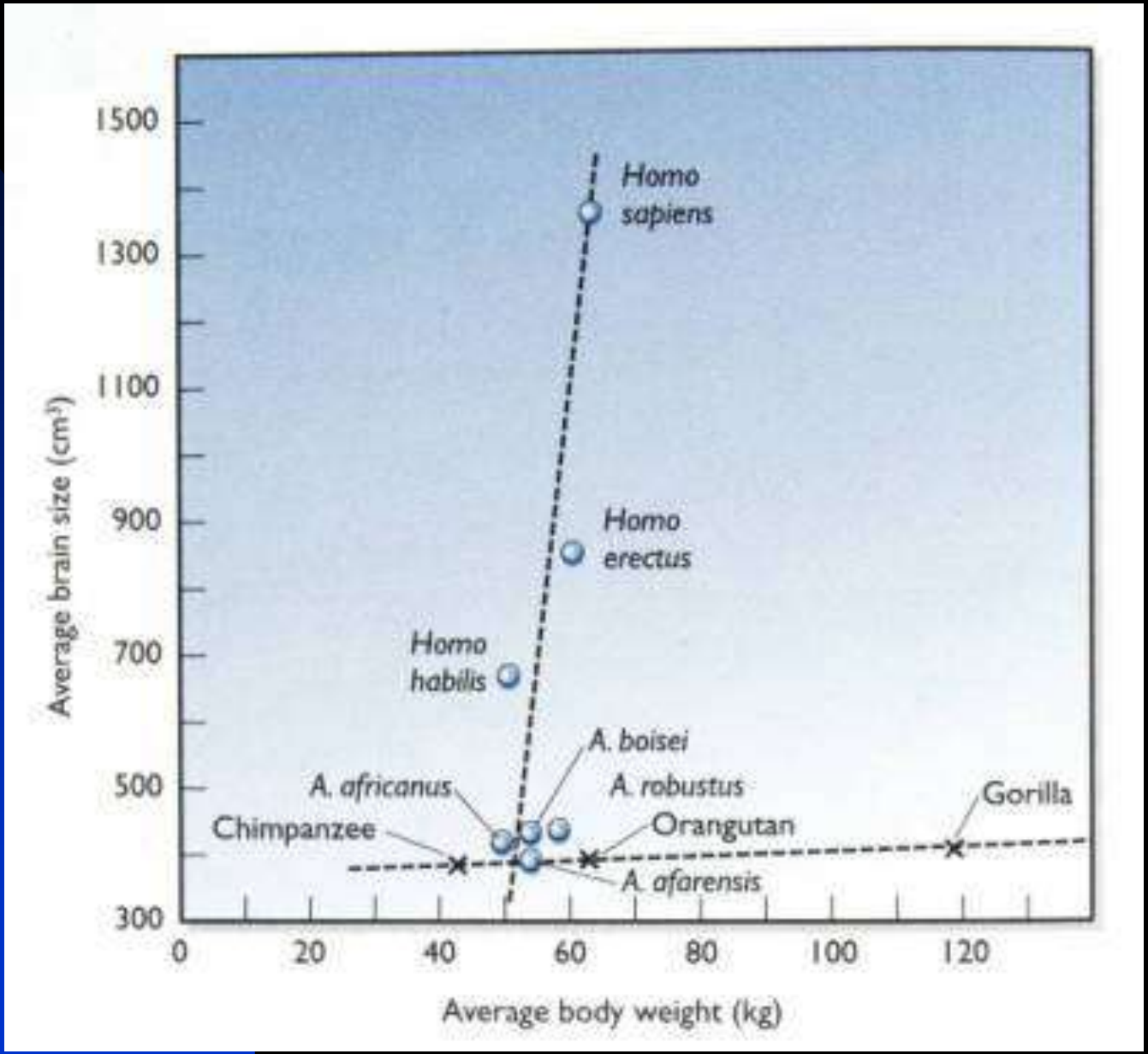
Meat, guts, and brains



Stone tools

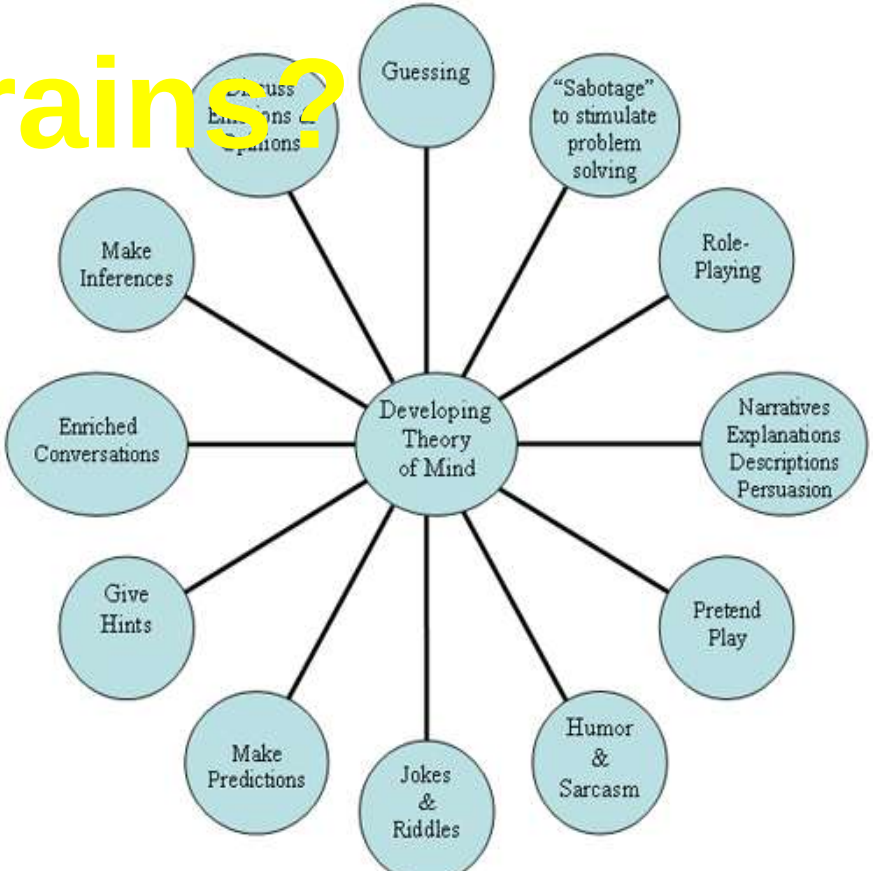
~2.6 Ma

Brain size increase



Lewin

Social brains?



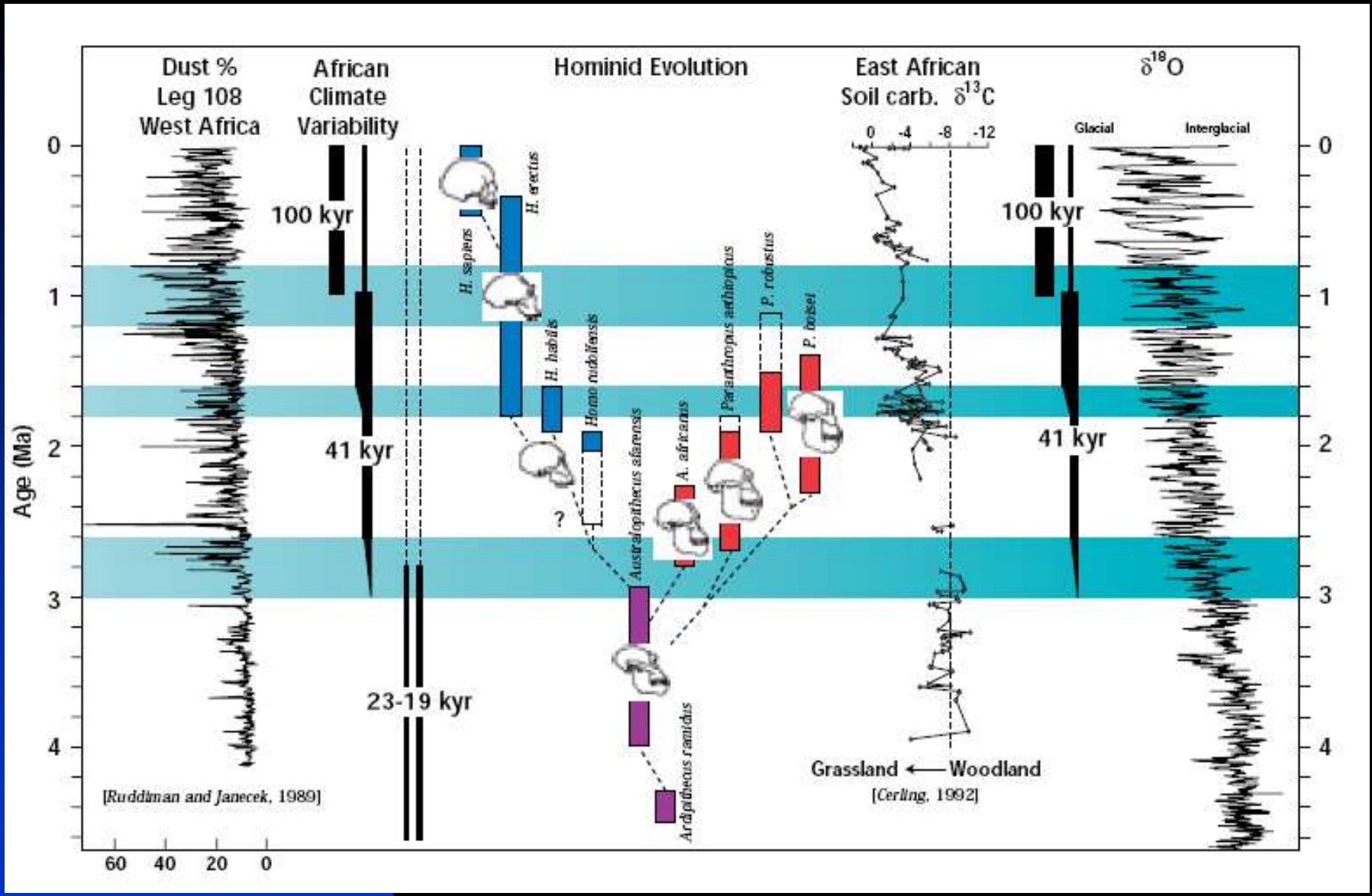
Mammals	General Learning
Primates	Social Intelligence
Great Apes	Theory of Mind
Mankind	Language

Working computational model

Extended to theory of mind

Applied to language

Did increasing African aridity drive Pliocene radiations?



P. deMenorcal

Foraging change
Dietary change
Technology?

Increased body & brain size

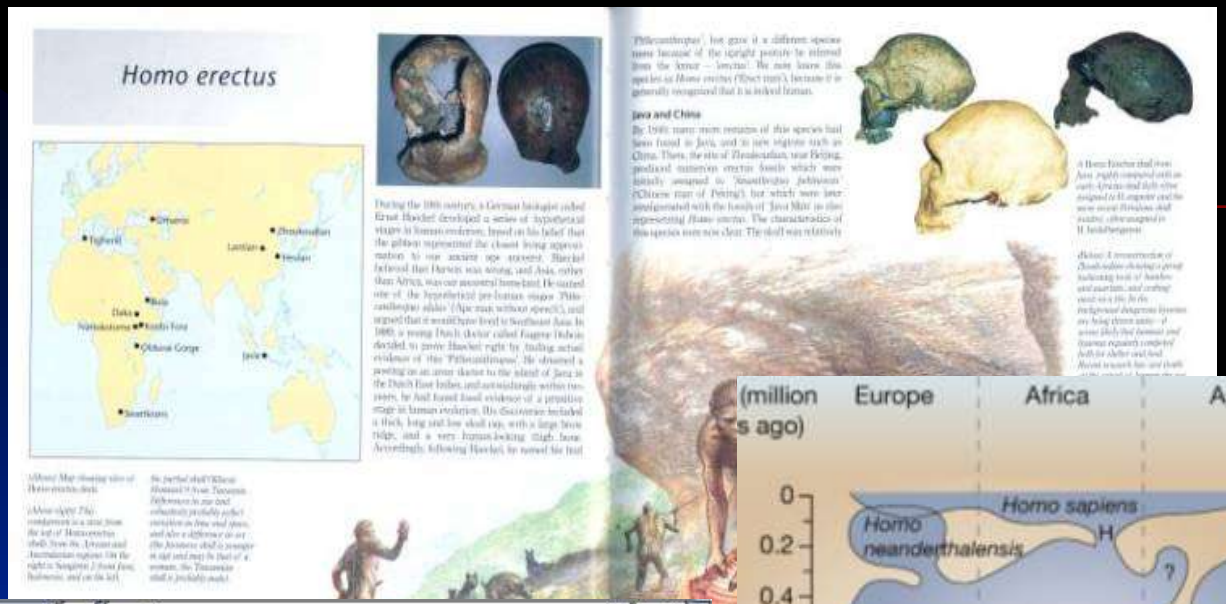
Ecological change

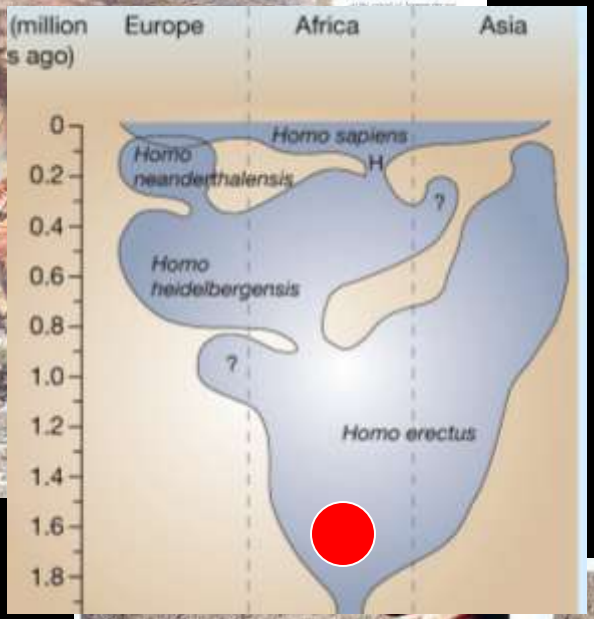
Increased range/ dispersal potential

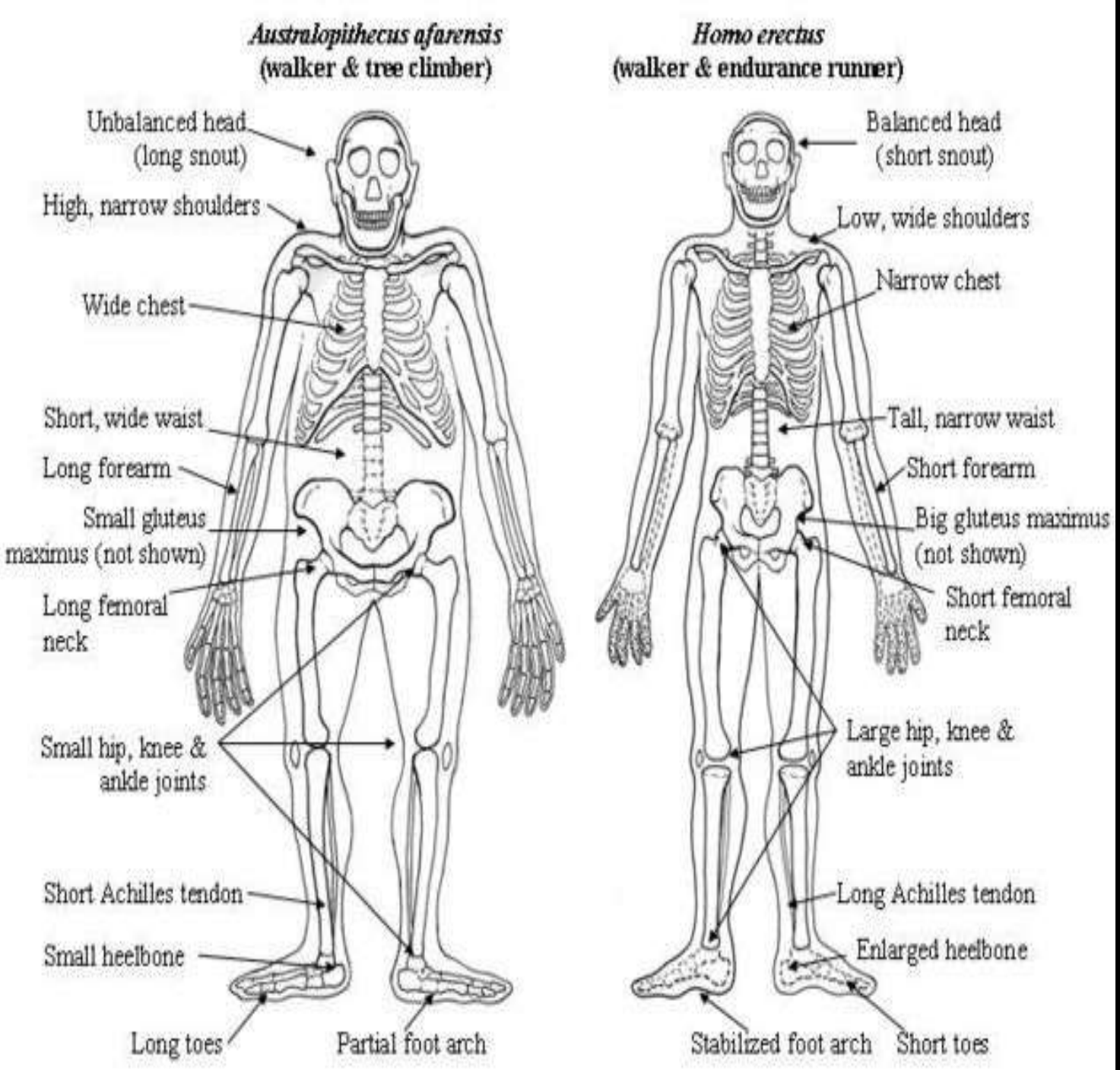
Declining 1^{o} productivity
Changing resource distribution

Anton, Leonard and Robertson (2002)

Early humans 1.5-1.8 Ma: Out of Africa 1

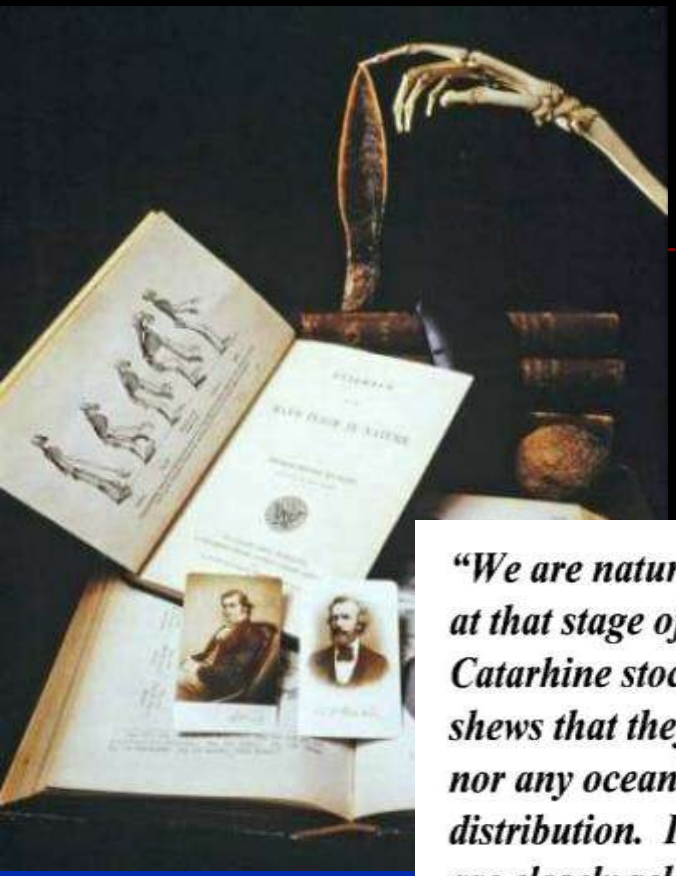


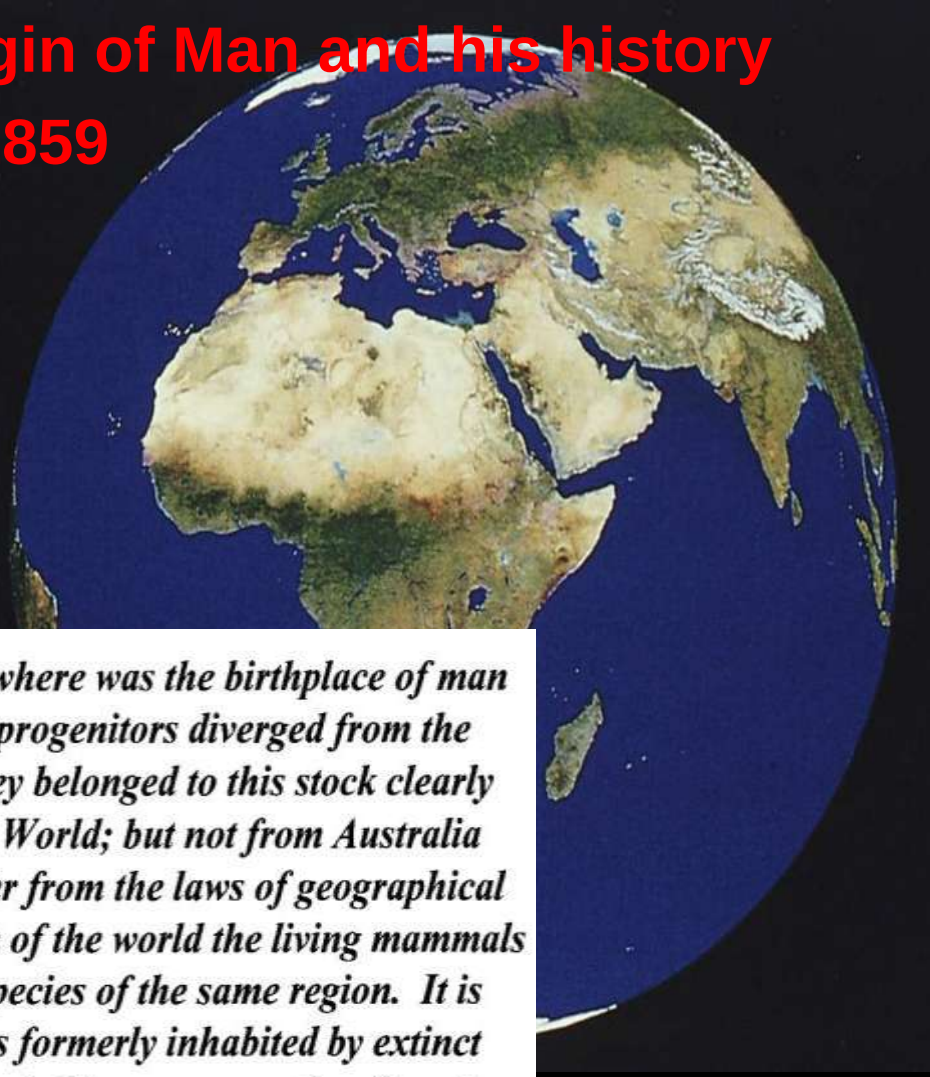



Australopithecus afarensis
(walker & tree climber)
Unbalanced head (long snout)
High, narrow shoulders
Wide chest
Short, wide waist
Long forearm
Small gluteus maximus (not shown)
Long femoral neck
Small hip, knee & ankle joints
Short Achilles tendon
Small heelbone
Long toes
Partial foot arch
Homo erectus
(walker & endurance runner)
Balanced head (short snout)
Low, wide shoulders
Narrow chest
Tall, narrow waist
Short forearm
Big gluteus maximus (not shown)
Short femoral neck
Large hip, knee & ankle joints
Long Achilles tendon
Enlarged heelbone
Stabilized foot arch
Short toes

Light will be thrown on the origin of Man and his history

Darwin 1859

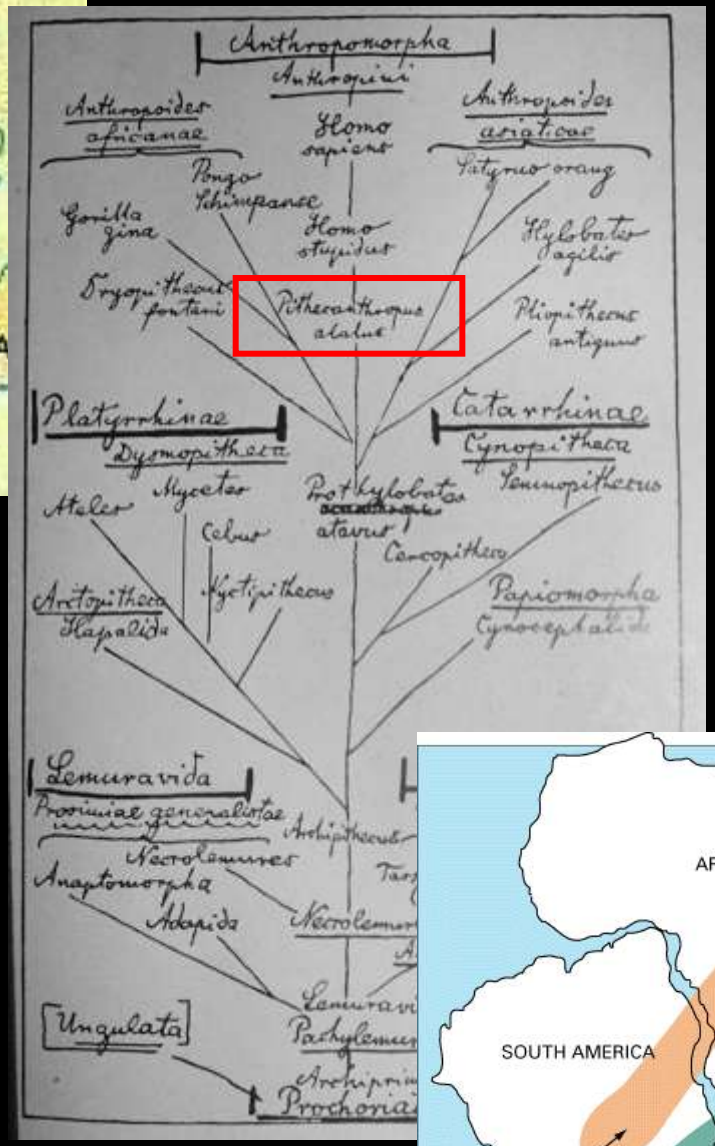


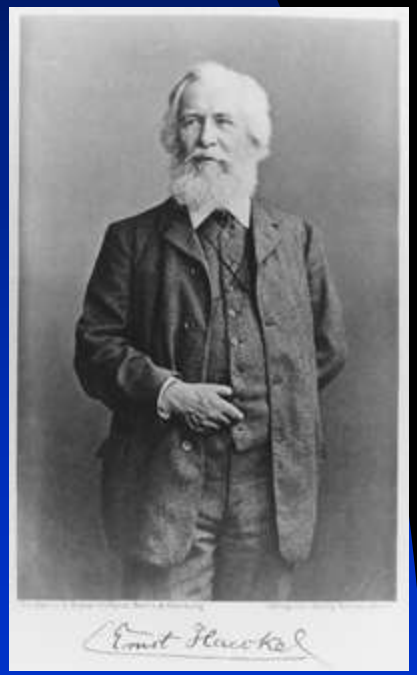


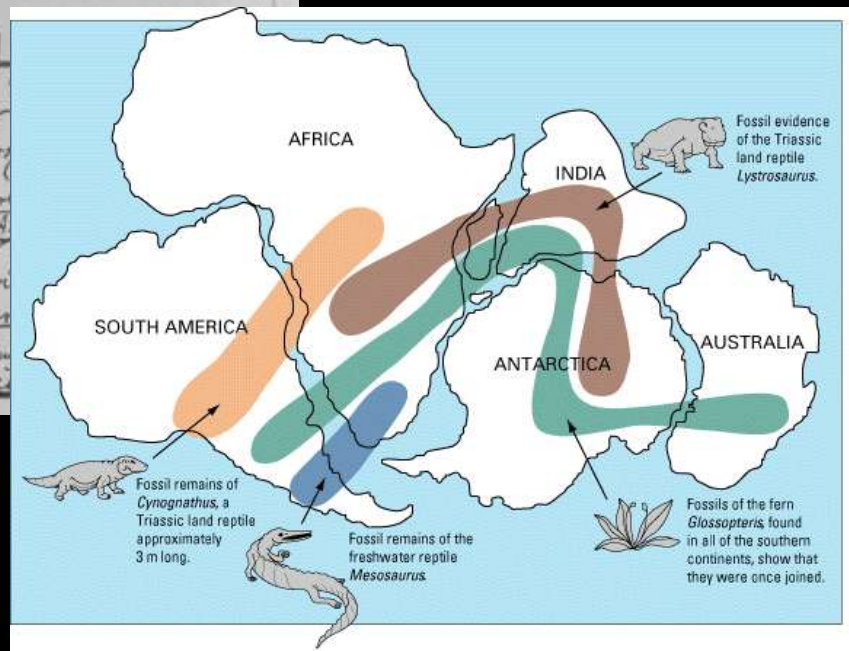
"We are naturally led to enquire where was the birthplace of man at that stage of descent when our progenitors diverged from the Catarhine stock. The fact that they belonged to this stock clearly shews that they inhabited the Old World; but not from Australia nor any oceanic island, as we infer from the laws of geographical distribution. In each great region of the world the living mammals are closely related to the extinct species of the same region. It is therefore probable that Africa was formerly inhabited by extinct apes closely allied to the gorilla and chimpanzee; and as these two species are now man's nearest allies, it is somewhat more probable that our early progenitors lived on the African continent then elsewhere. "

Descent of Man 1871 p. 199.

John Reader

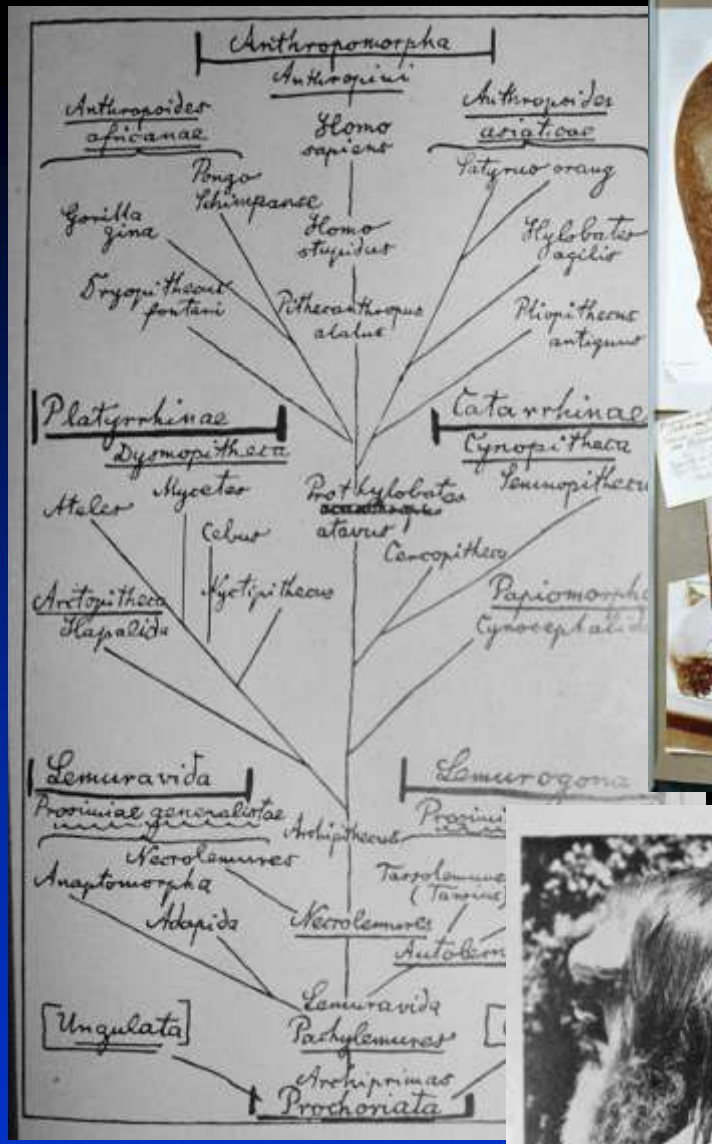


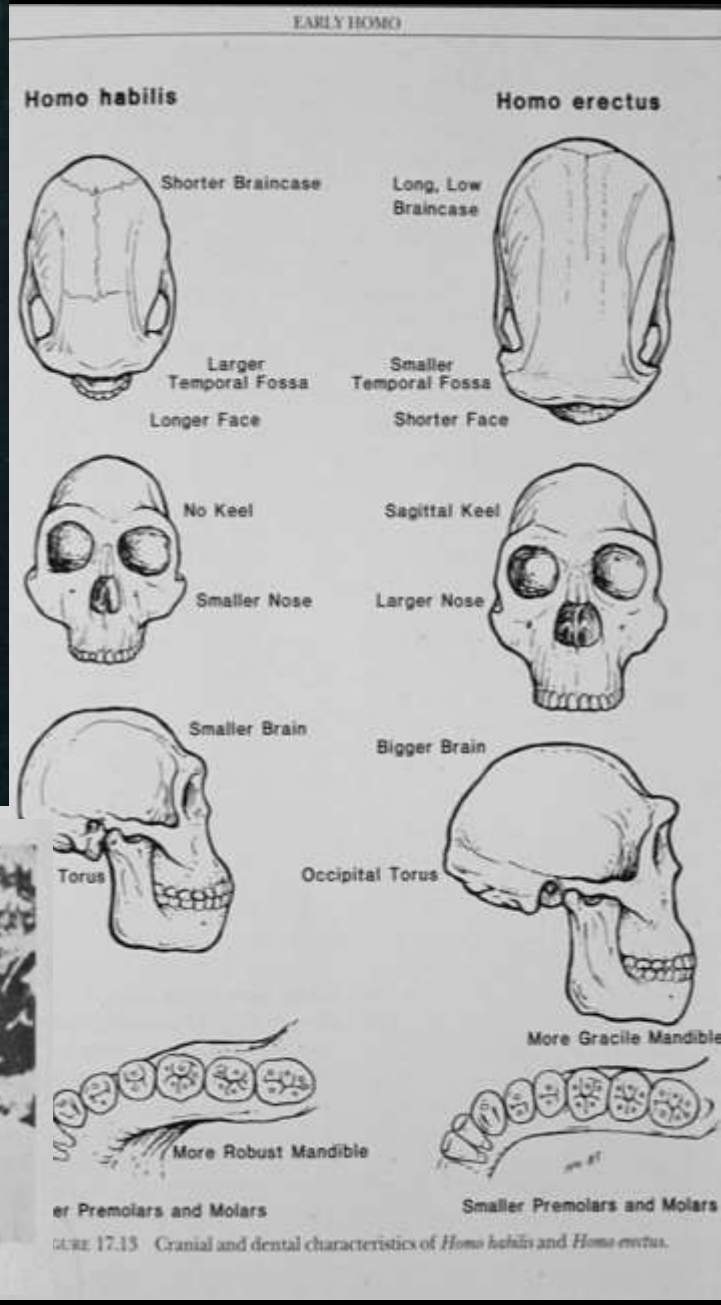




Ernst Haeckel (1834-1819)

Homo erectus

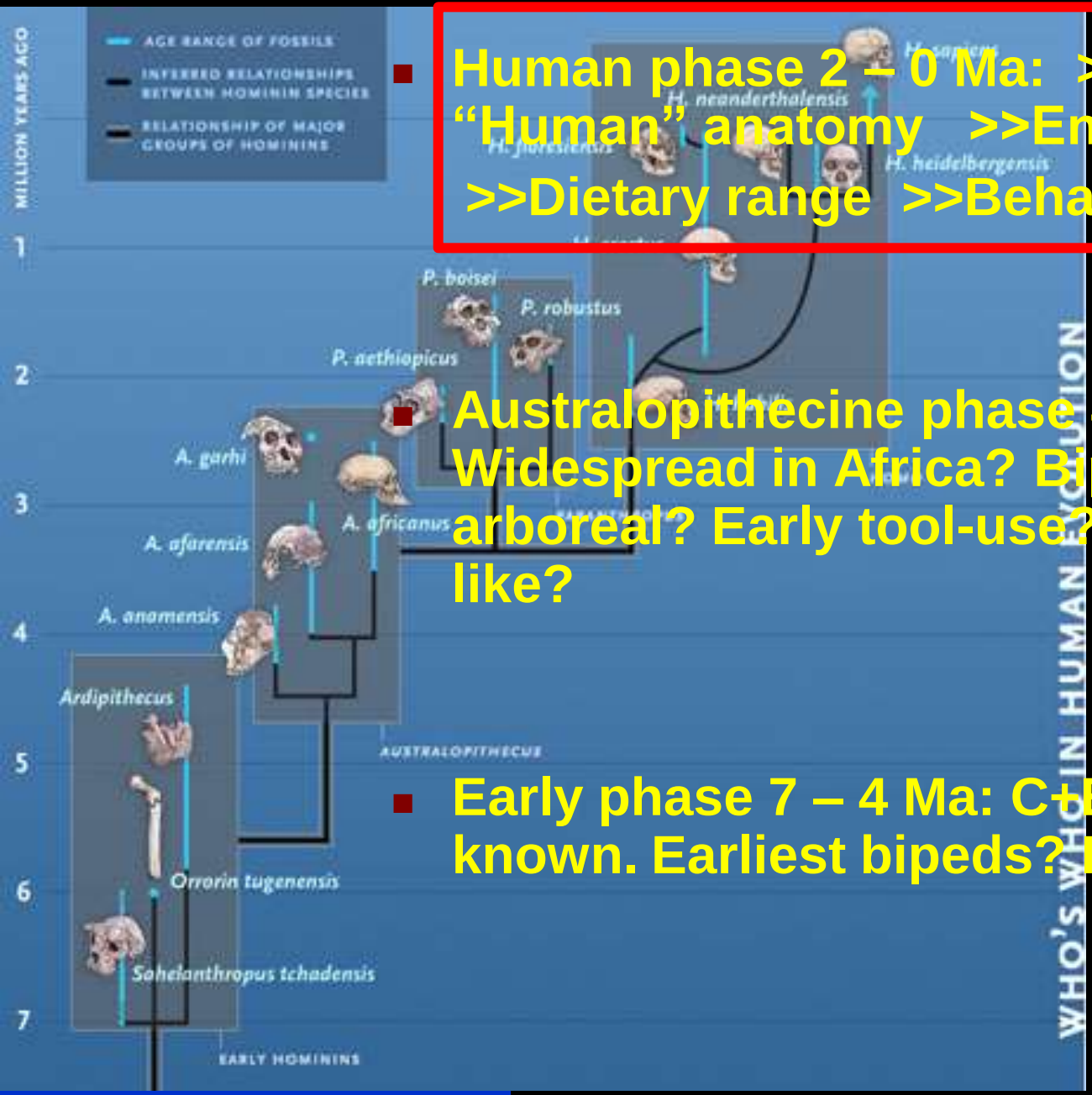




CRANIAL HAIR AND BROWRIDGES Grover S. Krantz

URE 17.13 Cranial and dental characteristics of *Homo habilis* and *Homo erectus*.

“Phases” of human evolution



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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.

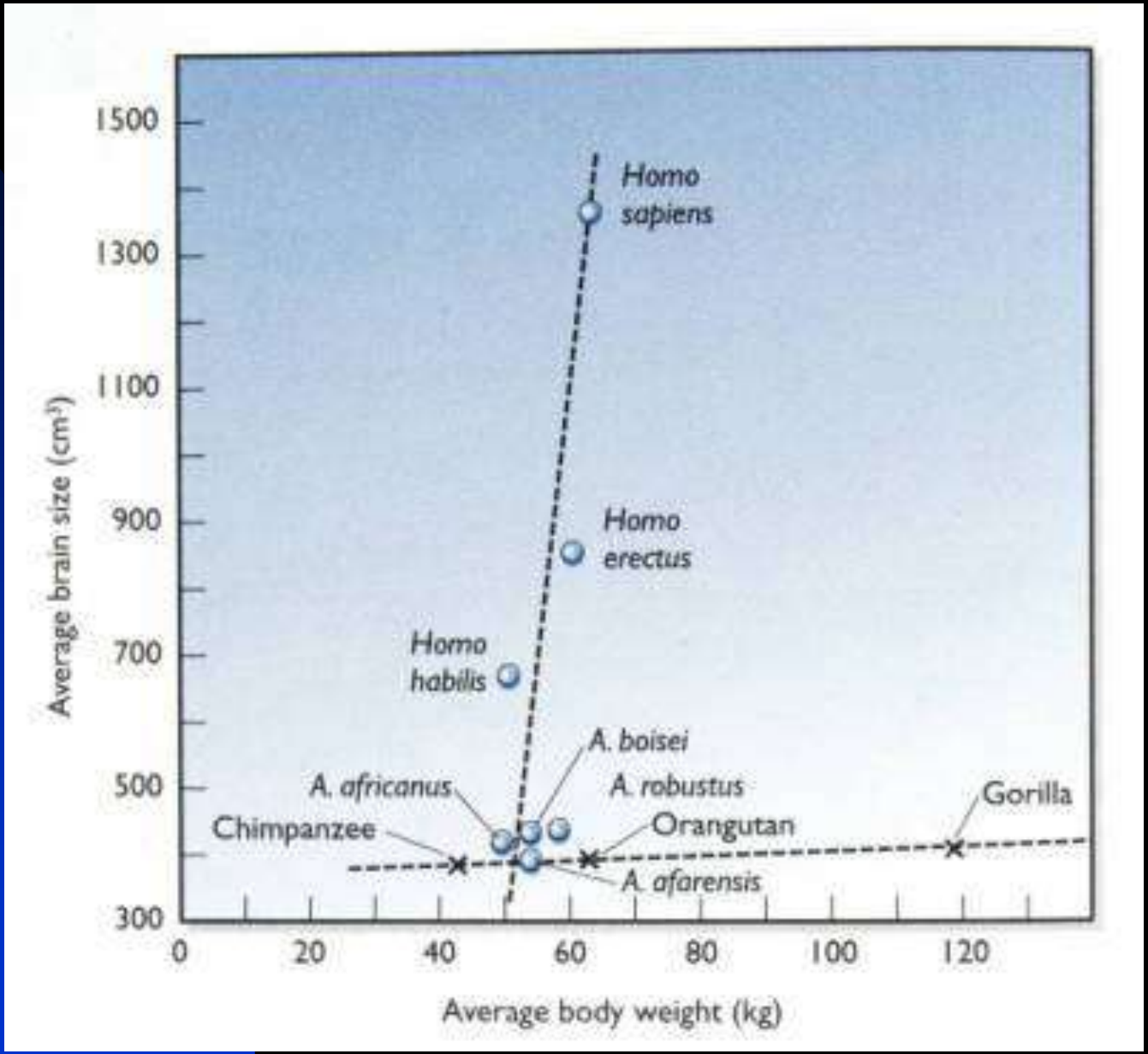
Dmanisi, Georgia ~1.8 Ma

The emigrants

Humans weren't the only creatures leaving Africa 1.75 million years ago: Hundreds of animal bones have been unearthed at Dmanisi (other 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.

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

Brain size increase



Lewin

Debate about the earliest human dispersals from Africa

An Asian perspective on early human dispersal from Africa

Robin Dennell & Wil Roebroeks 2005

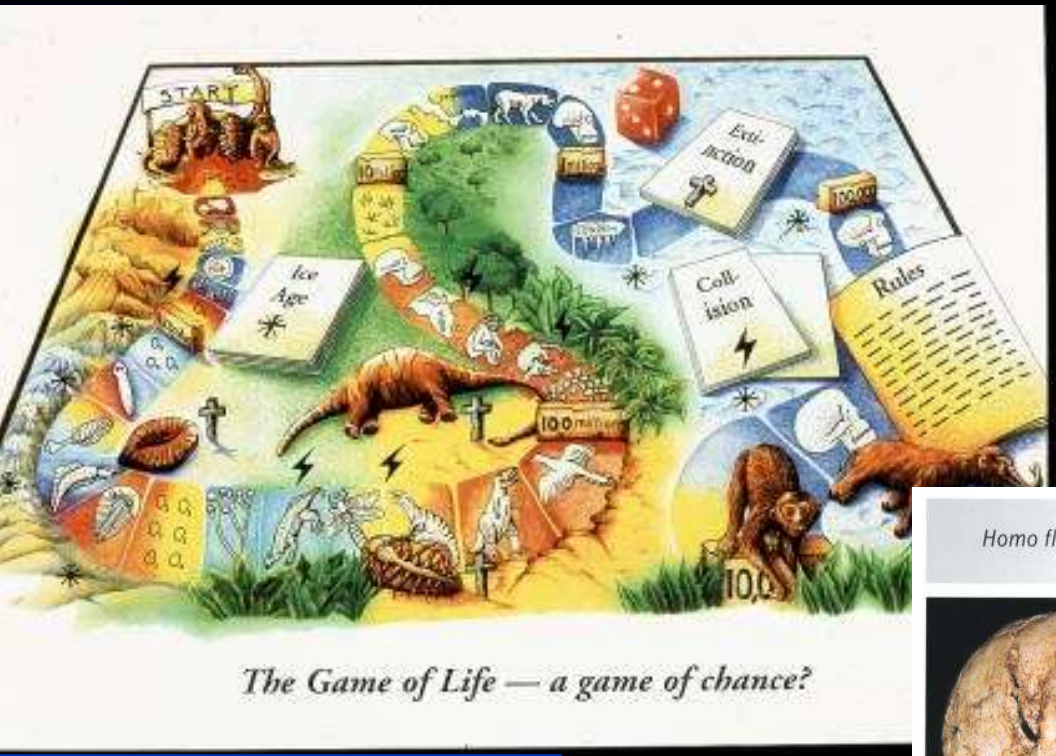
Nature **438**: 1099-1104

…it is time to develop alternatives to one of palaeoanthropology's most basic paradigms: 'Out of Africa 1'.

Flores

Dmanisi

Contingency (chance events)



The Game of Life — a game of chance?

Homo floresiensis

The skull of *Homo floresiensis*, believed to be a female specimen.

It is usually assumed that only one species of early human – *Homo erectus* – lived in Southeast Asia before modern people arrived there. Furthermore, up to now, *Homo erectus* fossils have only been identified in the region from the island of Java, in Indonesia. East of Java, towards New Guinea and Australia, it was thought that deep water had kept people from venturing any further until the ancestors of Australian Aborigines used boats to hop across the intervening chain of islands, some 60,000 years ago. This simple picture was challenged when it was reported a few years ago that 800,000 year-old stone tools had been found on the island of Flores, some 200 miles east of Java, but most experts wanted more evidence to back up the claim that ancient humans had migrated that far.

That evidence has now turned up in an extraordinary discovery from Flores. The skeleton (including a well-preserved skull of a metre tall 'human' with a brain size of about 380 ml (about the same as that of a chimpanzee) has been excavated from the Liang Bua cave, together with stone tools, and remains of a pygmy form of an extinct elephant called *Stegodon*. There are also bones of smaller animals, some of which have been burnt. Remarkably, the level in which the skeleton was found has been dated to only about 18,000 years ago, so modern people must have actually encountered this strange creature. What was it, what was it doing on Flores, and what happened to it?

Naming the new species

The Flores find is so unexpected that deciding what kind of creature it represents is not easy. The possibility that it was a single abnormal individual can be discounted because other similar remains have already been found in the cave. Although the legs and hipbone suggest that it walked upright in a fundamentally human manner, in details of shape as well as size, the hipbone resembles those of the prehuman australopithecines, who lived in Africa over 2 million years ago. Together with the very small brain size, this might suggest that this is actually some kind of australopithecine that migrated out of Africa long before the spread of *Homo erectus*. Yet details of the skull, the shape of the face, the small teeth, the evidence of tool making and, perhaps, hunting all suggest that the creature was fundamentally human. Thus the describers of the skeleton have named a new human species *Homo floresiensis* ('Man from Flores'), after its island home. They suggest it might be a descendant of *Homo erectus* that arrived early on Flores, perhaps using boats, and under completely isolated conditions evolved a very small size – a phenomenon known from other mammals, called island dwarfing. Alternatively, the dwarfing process could have occurred along the route to Flores, on one of the islands nearer to Java, such as Lombok or Sumbawa. As the skeletal remains are hardly fossilized, there is the possibility that DNA can be extracted from them, which could provide valuable insights into our relationship with both *Homo floresiensis* and its presumed ancestor *Homo erectus*.

It is also possible that DNA might be recovered from the cave sediments, preserved droppings and, if it survives, ancient hair.

Questions for future research

This remarkable discovery raises many questions for future research. One of these is how *Homo floresiensis* got to Flores. Could its ancestors really have made watercraft (perhaps of bamboo) to reach the island? This would certainly be surprising, because such behaviour is thought to be exclusive to *Homo sapiens*. But the alternatives – a short-lived land bridge that allowed very few species to cross it, or accidental transport on natural rafts of vegetation – seem even more unlikely.

A second question concerns the behavioural evidence from the Liang Bua cave. Some of the excavated stone tools are small and sophisticated, and there is evidence of the use of fire, and possible predation on young *Stegodon*. Was *Homo floresiensis*, with its ape-sized brain, really capable of such behaviours? The answer to that question may only come from further excavations to exclude the possibility that early modern humans were also using caves on Flores, at least after 60,000 years ago, and could be responsible for some of the archaeological evidence left behind.

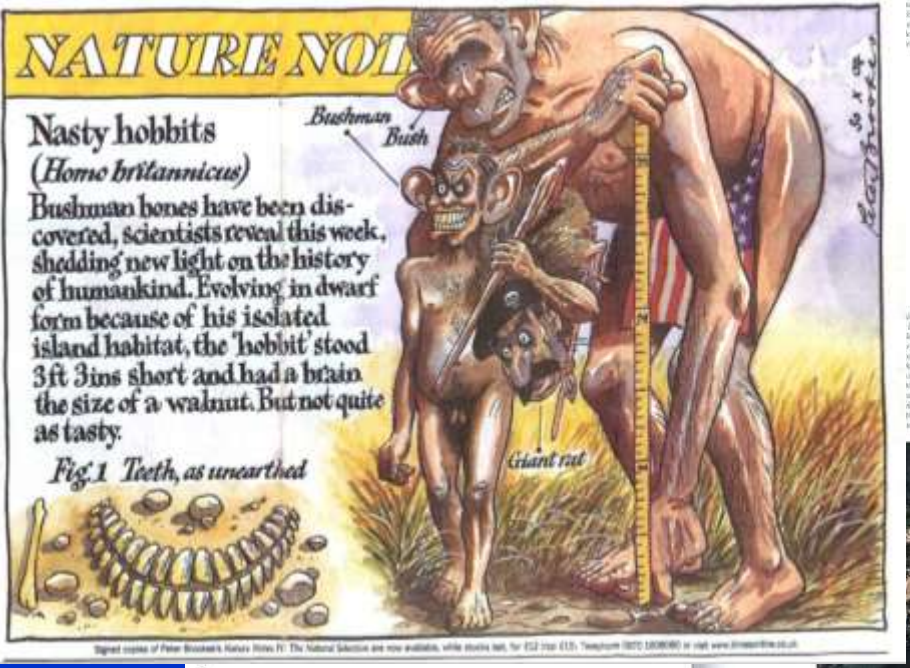
A third and especially intriguing question is what happened to *Homo floresiensis*. Climatic changes at the end of the Pleistocene may have affected its habitat, or modern humans could have killed it off directly, or by outcompeting the resources on which it lived. There is also evidence of a massive volcanic eruption which devastated Flores about 12,000 years ago. However, there is the fascinating possibility that it (or species like it) lingered on, and form a source of the widespread legends of 'wild men' living in the jungles of Southeast Asia. Whatever the truth, its very existence shows how little we still really know about human evolution in Asia.

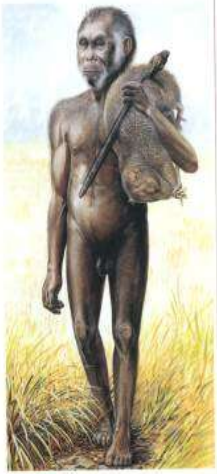
(Above) Work in progress in the Liang Bua cave. The little skeleton of Homo floresiensis *was found in the deep excavation area on the far right against the cave wall. Excavations have reached a depth of 11 m (36 ft), which means that safety shoring, multiple platforms at different depths and hard hats had to be used.*

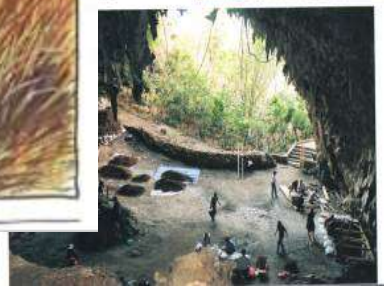
(Right) Homo floresiensis returning from the hunt. The second trapped over his shoulder is the Flores game rat (Papagomys armandvillei), which still lives on the island, but, as it is also hunted by modern Homo sapiens, it is vulnerable to extinction.

(Opposite) The co-directors of the archaeological excavation at Liang Bua, R. P. Soejono (left) and Mike Morwood (middle) discuss survey results with technical officer Yet Wanda.

The "Hobbit": *Homo floresiensis*

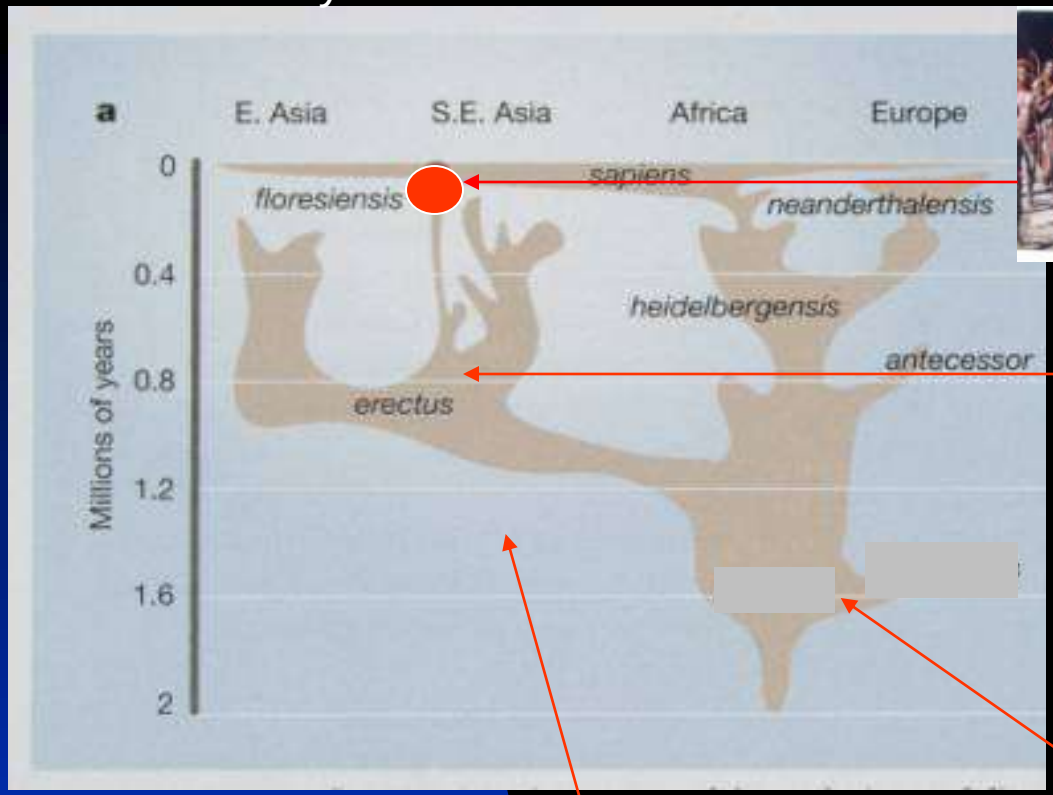


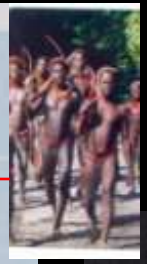




Origins and evolution?

Lahr & Foley



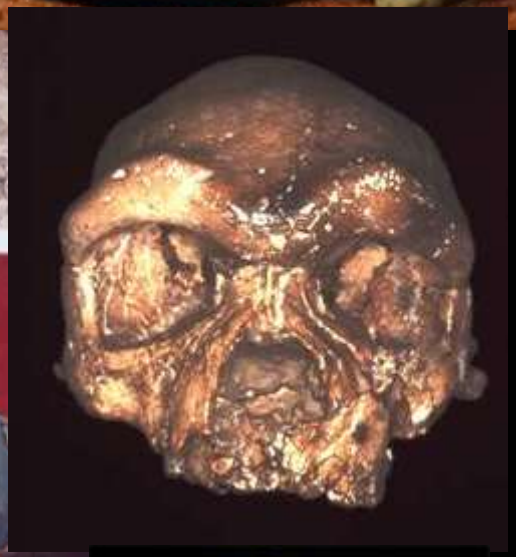


Brown

Reader

Dmanisi.org

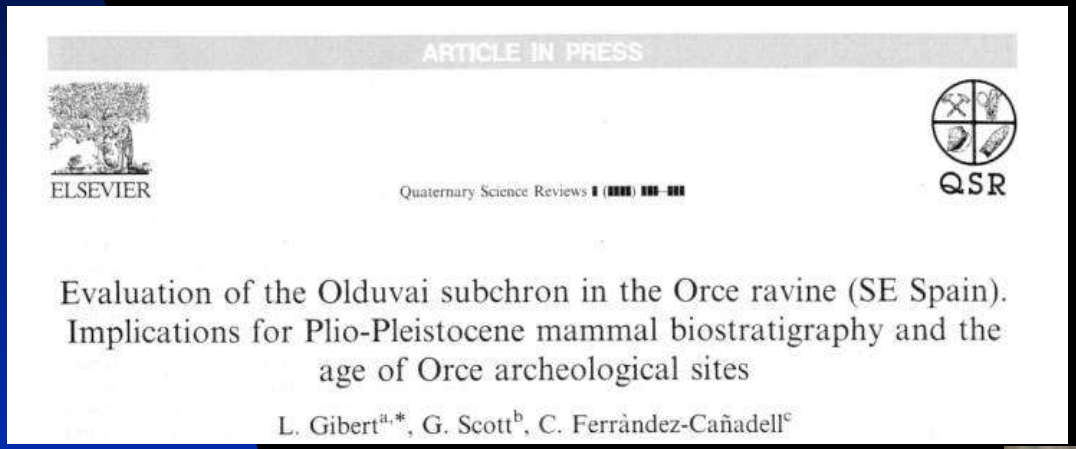
The Asian story…



Getting to Europe…

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?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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

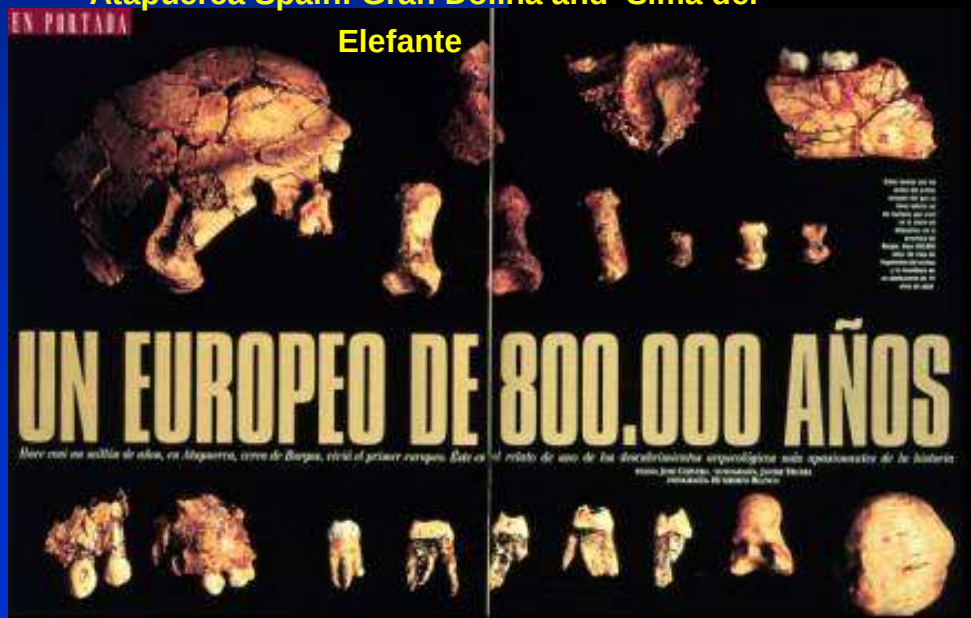
L. Gibert[a,*], G. Scott[b], C. Ferrández-Cañadell[c]

1.4 Ma?

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

Homo antecessor 0.8Ma and possibly 1.2Ma?

Atapuerca Spain: Gran Dolina and Sima del Elefante



Neanderthals and “Hobbit” extinct
Homo sapiens Out of Africa 2
Homo sapiens in Africa

Early Neanderthals in Europe

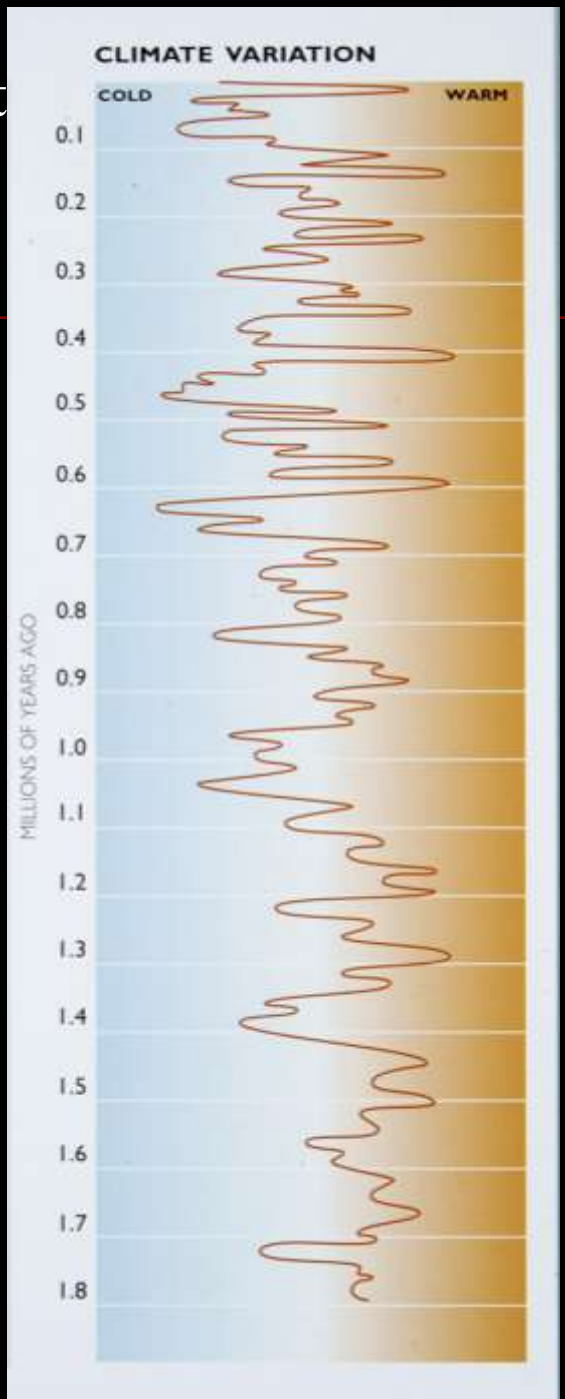
Changes in glacial intensity

First humans in N. Europe/Britain?

Some “recent” events in human evolution

First humans in S. Europe?

First humans in Far East?
Out of Africa 1?



How and when did people first get to Britain?

Shelters?

Better hunting?

Clothing?

Better technology?

Fire?

National Museum of Wales

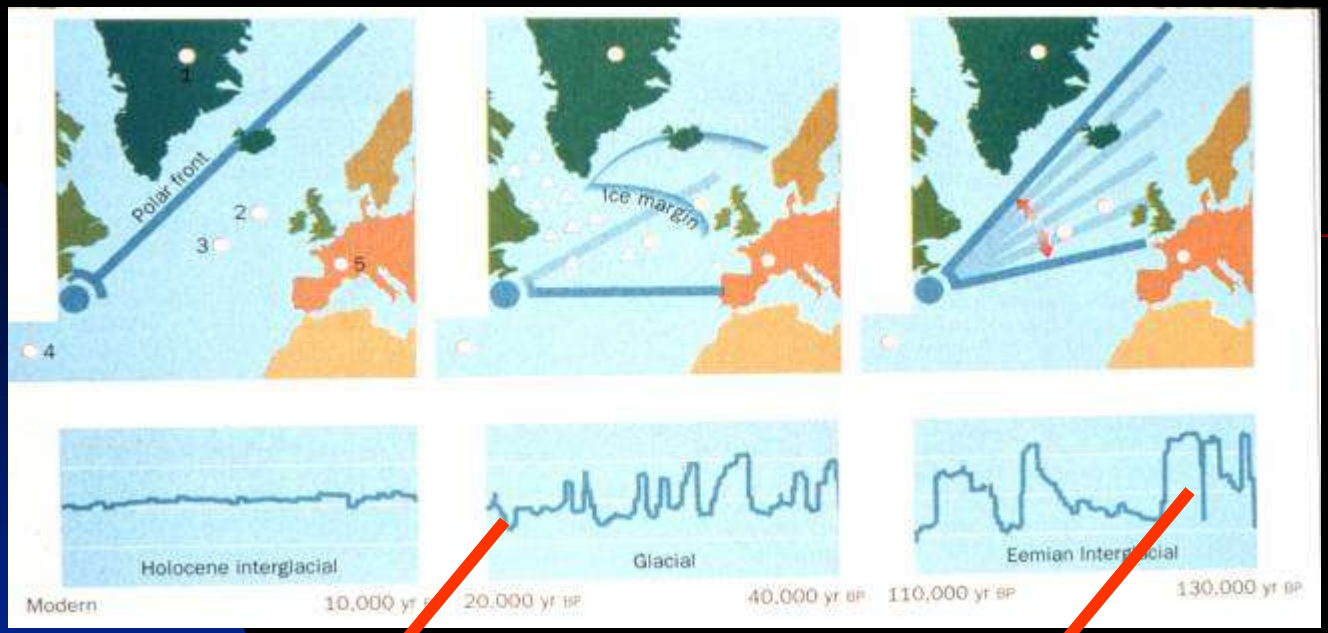
The Ancient Human Occupation of Britain

http://www.ahobproject.org

- When did people first arrive?
- Who were they?
- How did they get to Britain?
- What environments did they occupy?
- Was occupation continuous?
- When did our real ancestors arrive?
- When did Britain become an island?

An example of severe climate change in Britain: Three Cliffs Bay, Gower, S. Wales

The marginal position and extreme climates of Britain help us to distinguish and sequence events..



Happisburgh, Norfolk

Ostend Channel

Site 4

Site 5 → offshore

Site 2

Site 3 ~840/950ka?

Hill House River sediments

Site 1

theguardian

July 8th 2010

Meet the Norfolk relatives

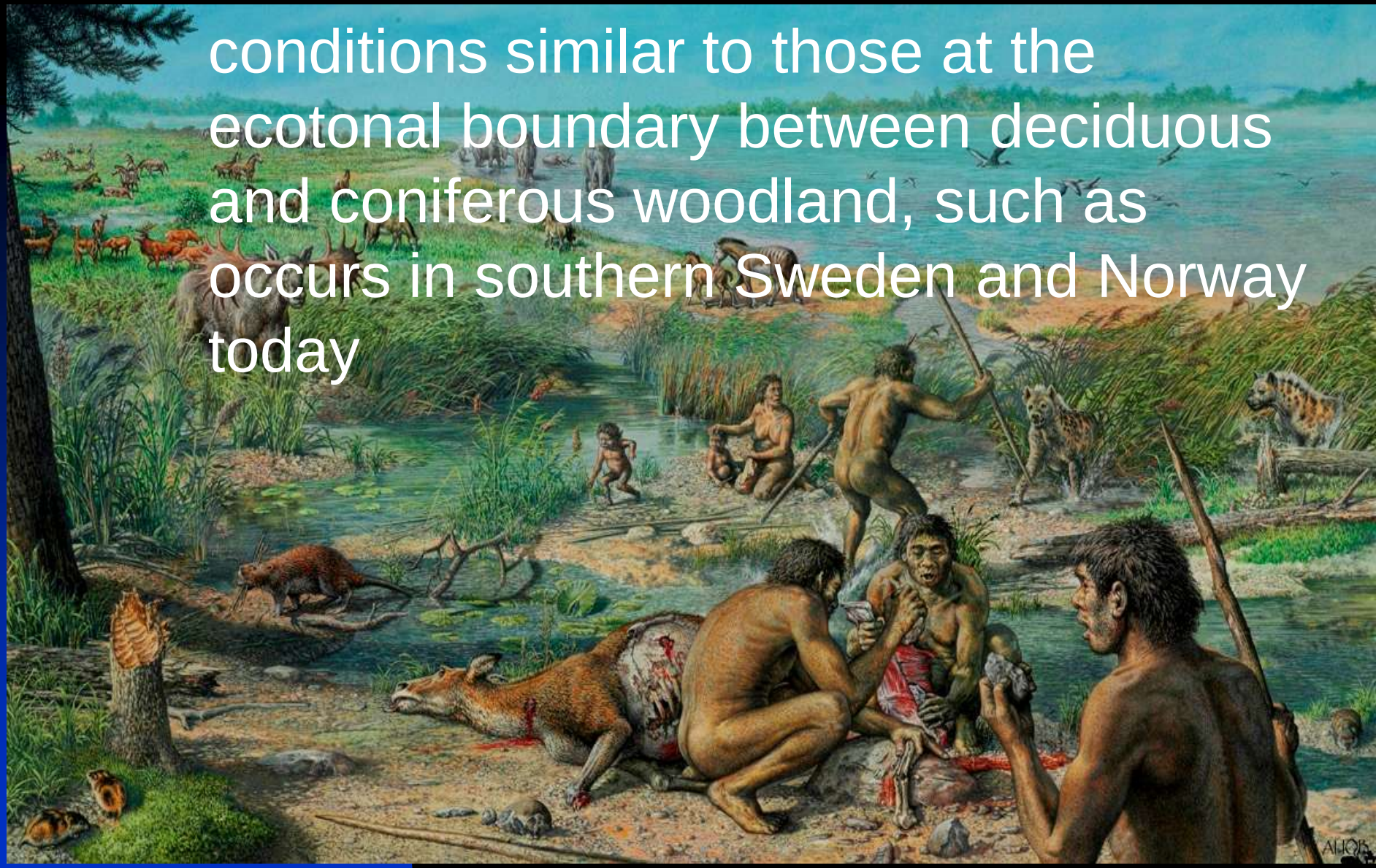
Judges: gay refugees must get asylum

Alan Travis and Afua Hirsch

Supreme court judges yesterday predicted that "more and more" gay and lesbian refugees are likely to seek protection in Britain after a landmark legal ruling recognised the rights of asylum seekers.

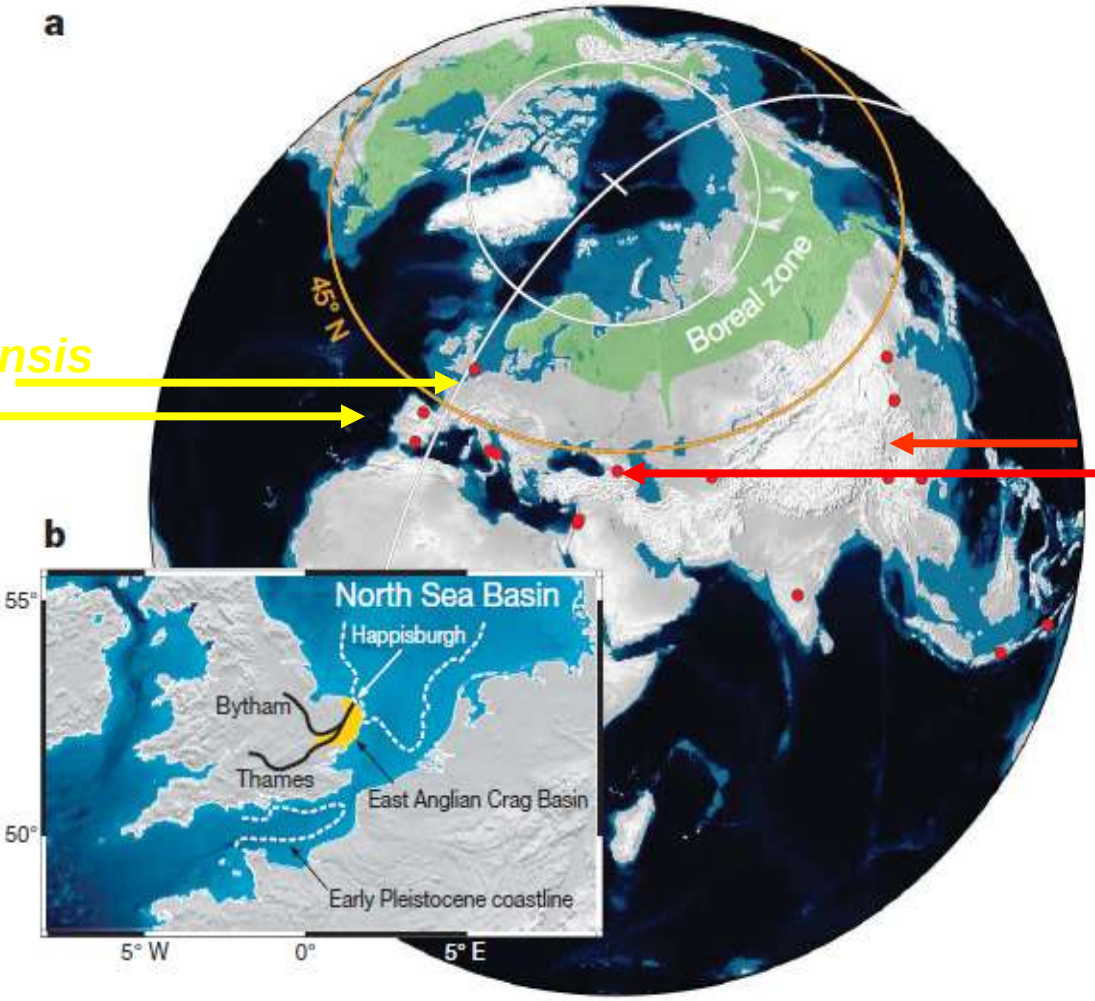
Five supreme court justices said gay and lesbian asylum seekers should not be expected to "exercise discretion" in their home countries to avoid persecution. Their ruling met with cheers and applause from campaigners.

But the Home Office moved to dampen claims from anti-immigration groups that the ruling could lead to a massive exodus



John Sibbick/AHOB

Homo heidelbergensis
Homo antecessor



Homo erectus

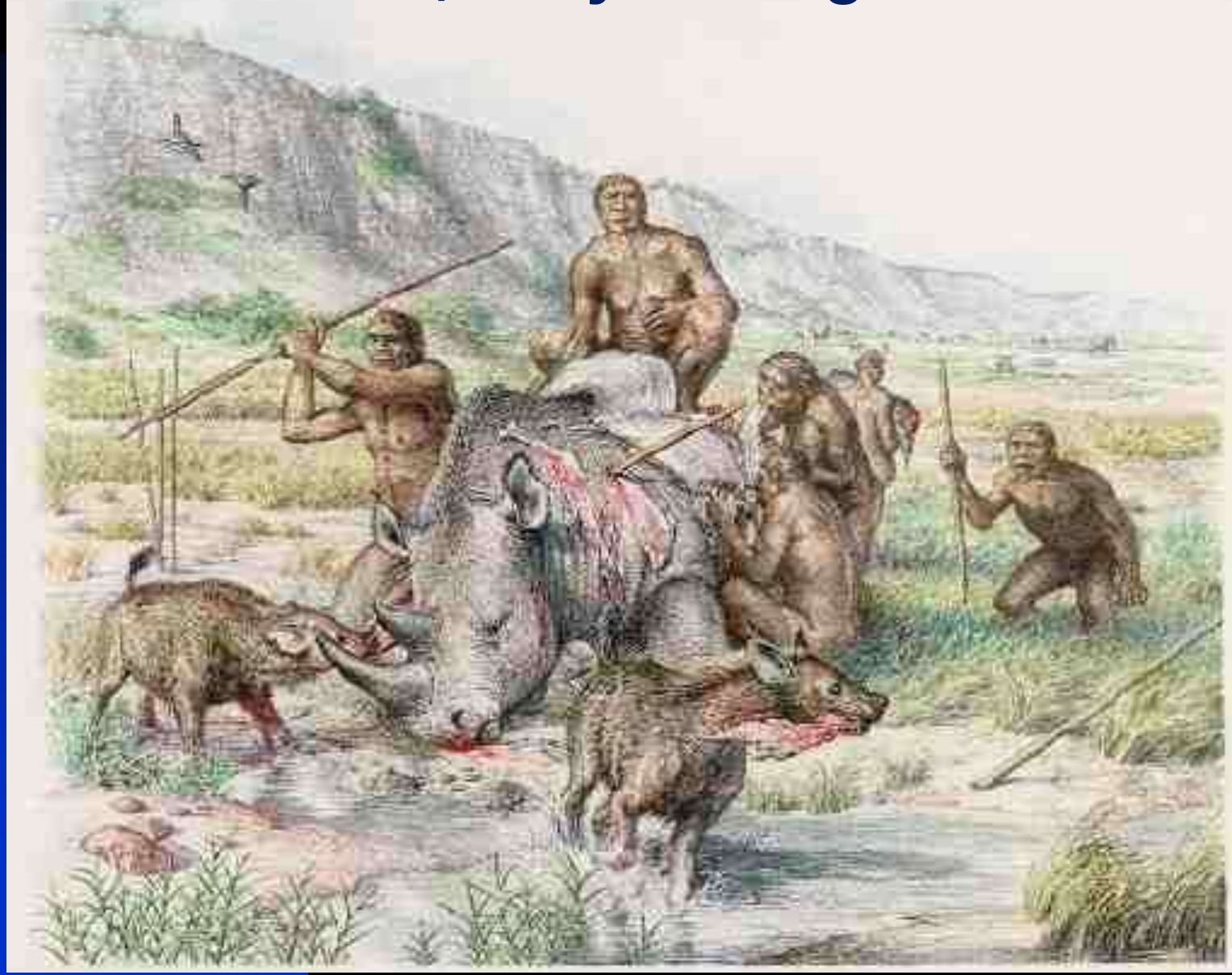
Figure 1 | Location of Happisburgh and other Early Pleistocene archaeological sites in Eurasia. a, Key Early Pleistocene archaeological sites (red dots) in relation to 45° N and the present-day boreal zone. **b**, Reconstruction of the palaeogeography of northwest Europe at the time of the human occupation at Happisburgh, showing the Thames draining into the North Sea ~150 km to the north of its present-day estuary.

Homo heidelbergensis Mauer ~600ka?

A common ancestor at 500 ka?

The Boxgrove Quarry

Sussex 500,000 years ago



Boxgrove ~500ka

Homo heidelbergensis

The Boxgrove Project

Why does *heidelbergensis* brain size reach the modern range?

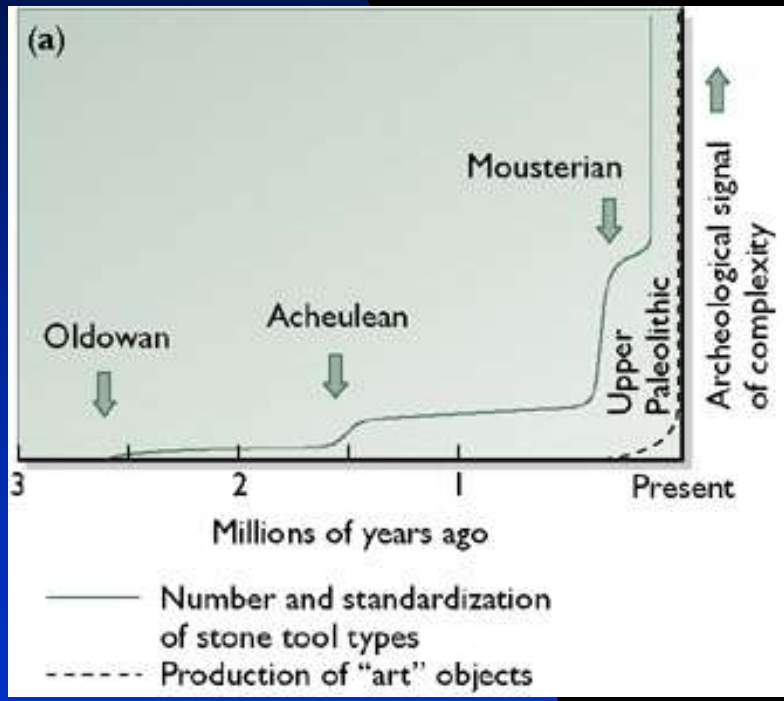
H. erectus (Sangiran)

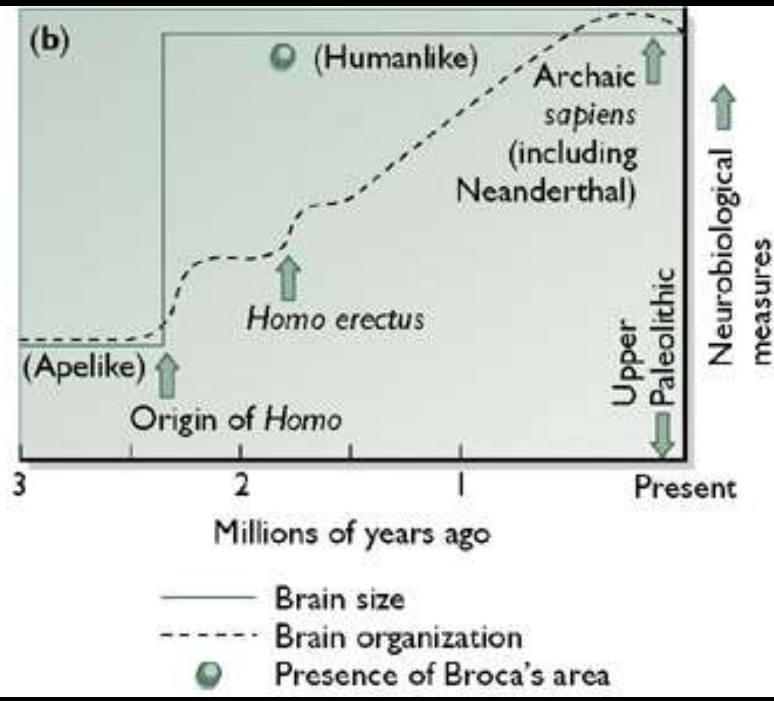
H. heidelbergensis (Broken Hill)

Technology and brain evolution

Archaeology suggests a late “explosion” in behavioural complexity…

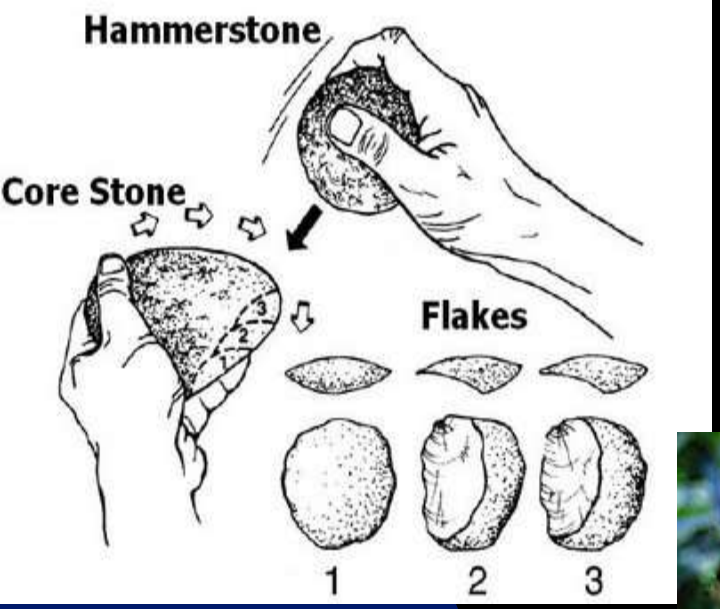
…however, brain size shows a steadier increase

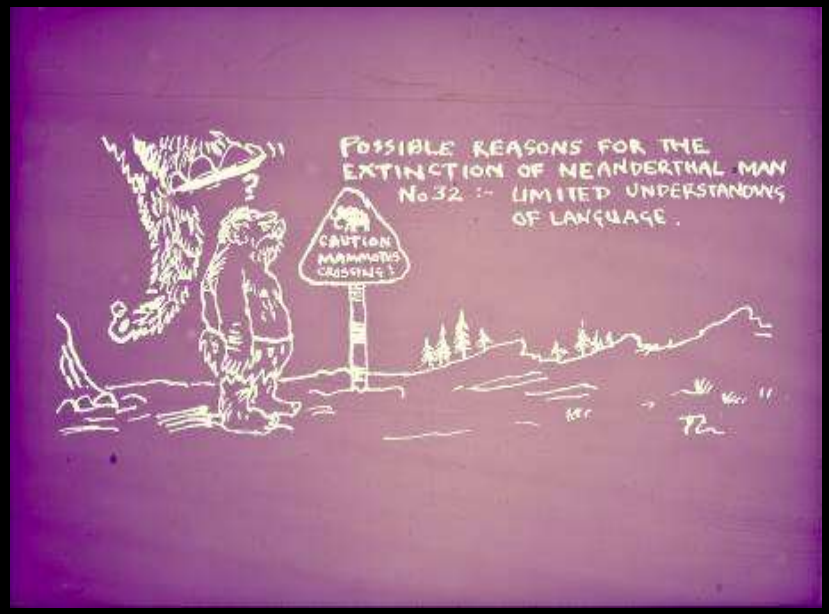


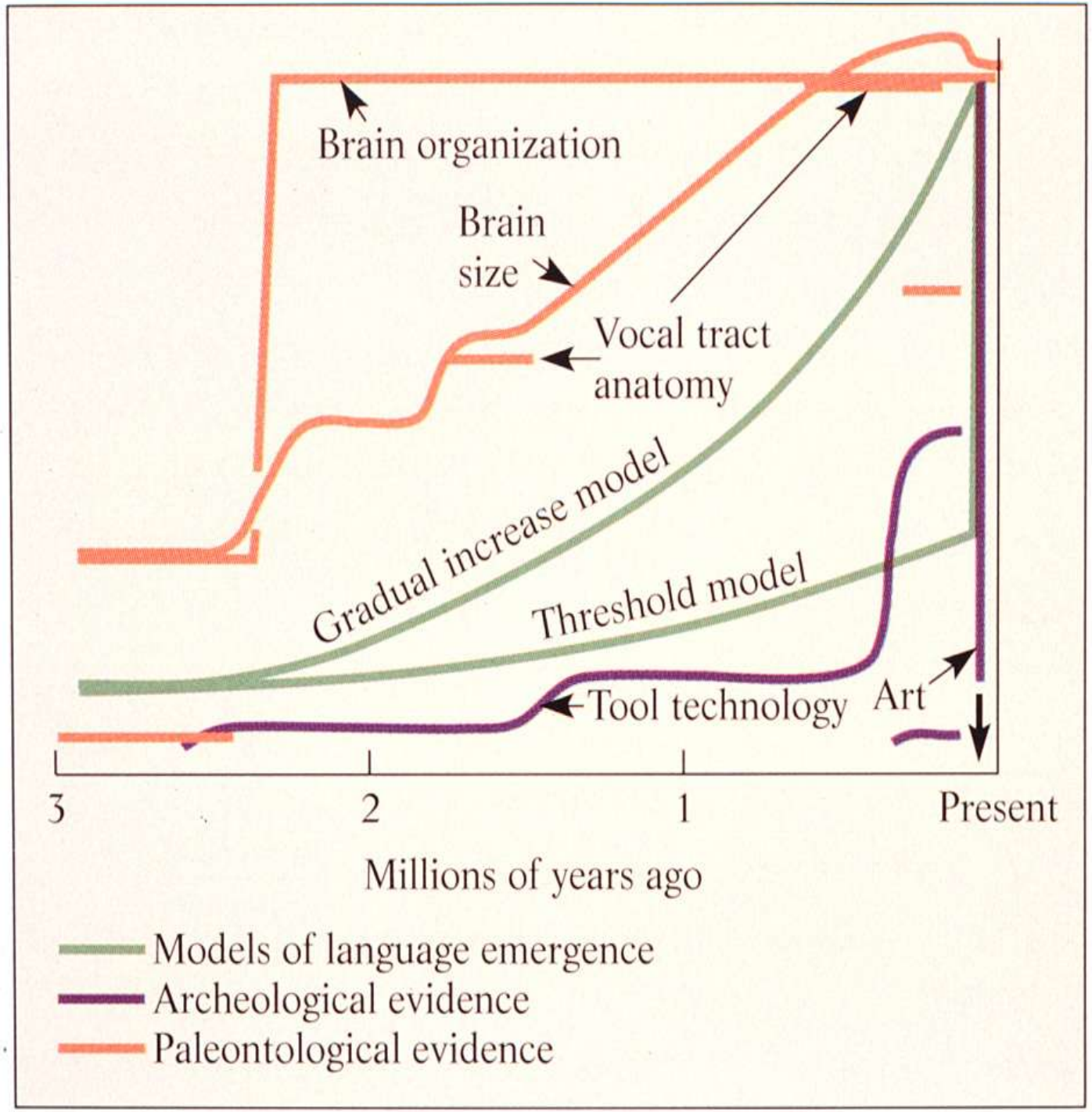


Foley & Lewin

Language?


Hammerstone
Core Stone
Flakes
1
2
3


POSSIBLE REASONS FOR THE EXTINCTION OF NEANDERTHAL MAN
No.32 :- LIMITED UNDERSTANDING OF LANGUAGE.
CAUTION MAMMOTHS CROSSING


Brain organization
Brain size
Vocal tract anatomy
Gradual increase model
Threshold model
Tool technology
Art
3
2
1
Present
Millions of years ago
Models of language emergence
Archeological evidence
Paleontological evidence

Lewin

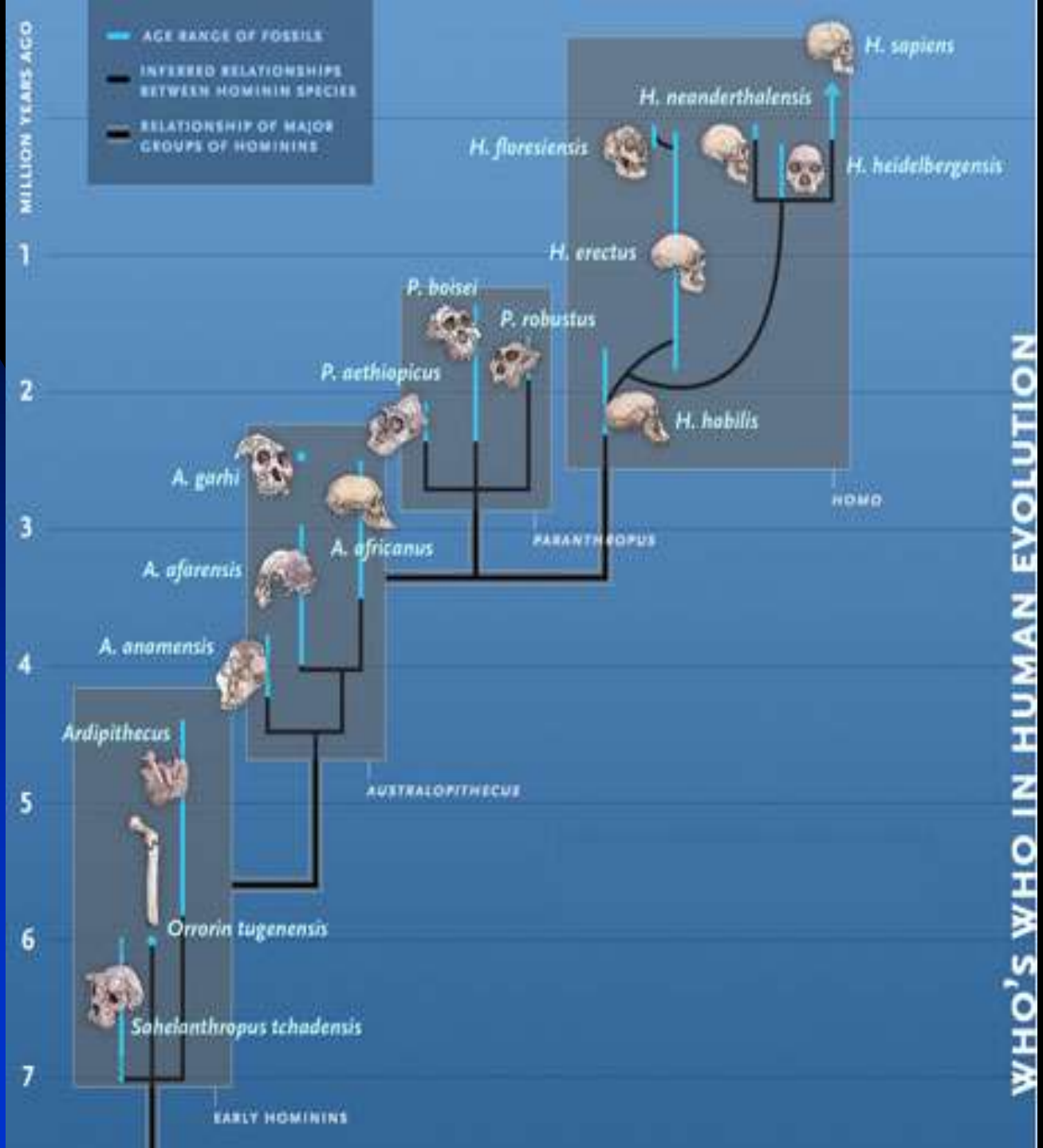
The Enigma of the Handaxe

and spears……

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

Desmond Clark

The enigma of Schöningen


AGE RANGE OF FOSSILS
INFERRED RELATIONSHIPS BETWEEN HOMININ SPECIES
RELATIONSHIP OF MAJOR GROUPS OF HOMININS
MILLION YEARS AGO
1
2
3
4
5
6
7
H. sapiens
H. neanderthalensis
H. floresiensis
H. heidelbergensis
H. erectus
P. boisei
P. robustus
P. aethiopicus
H. habilis
A. garhi
A. africanus
A. afarensis
A. anamensis
Ardipithecus
Orrorin tugenensis
Sahelanthropus tchadensis
HOMO
PARANTHROPUS
AUSTRALOPITHECUS
EARLY HOMININS
WHO'S WHO IN HUMAN EVOLUTION

Our future is partly up to us….