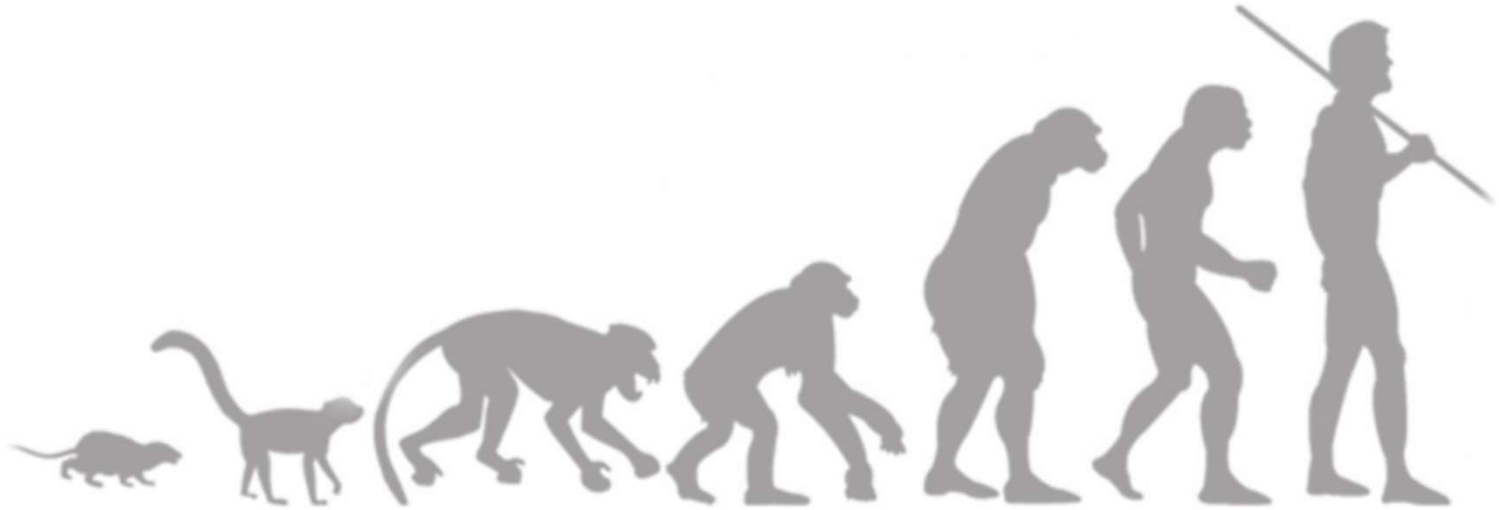
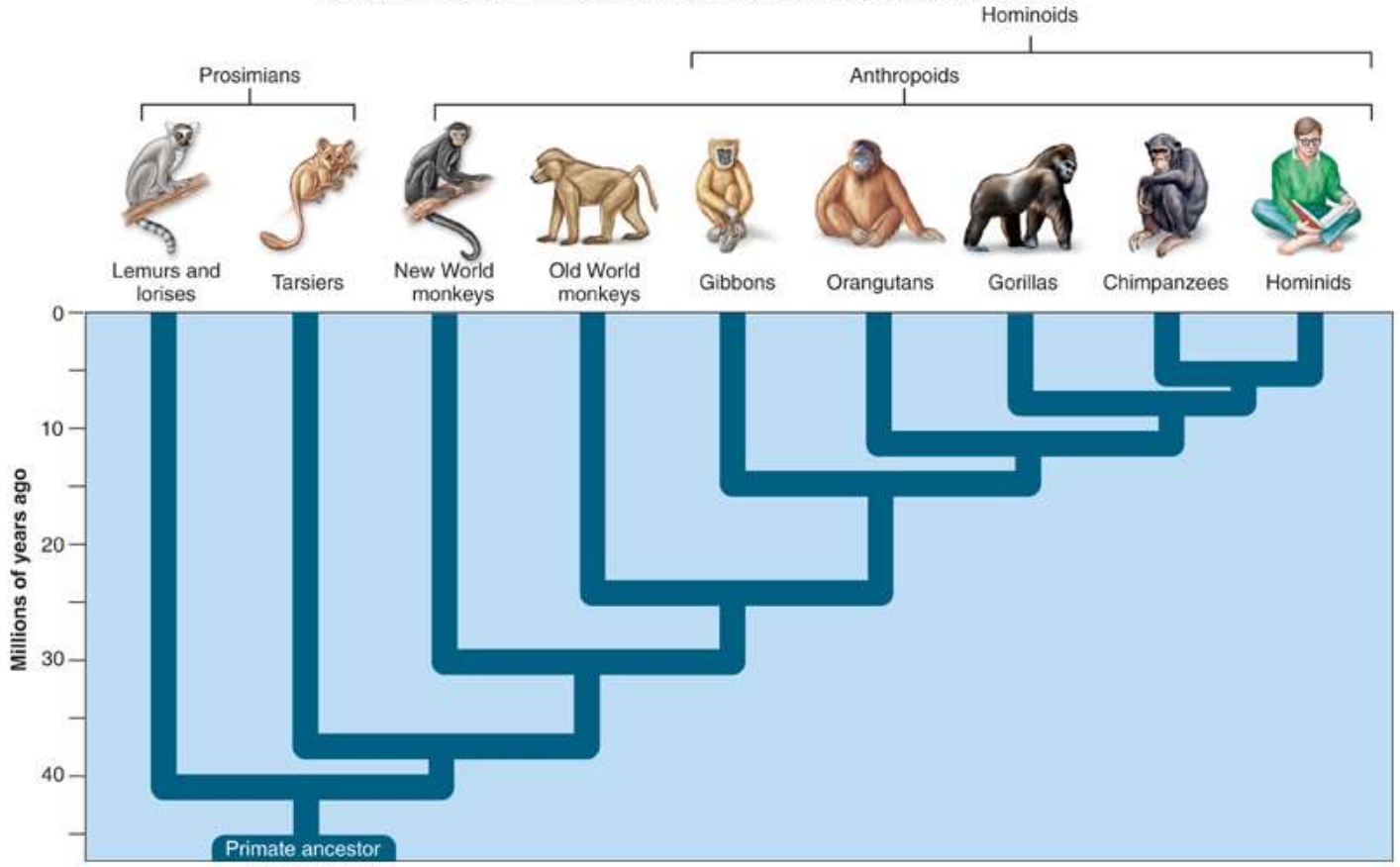
ZOOGEOGRAPHY

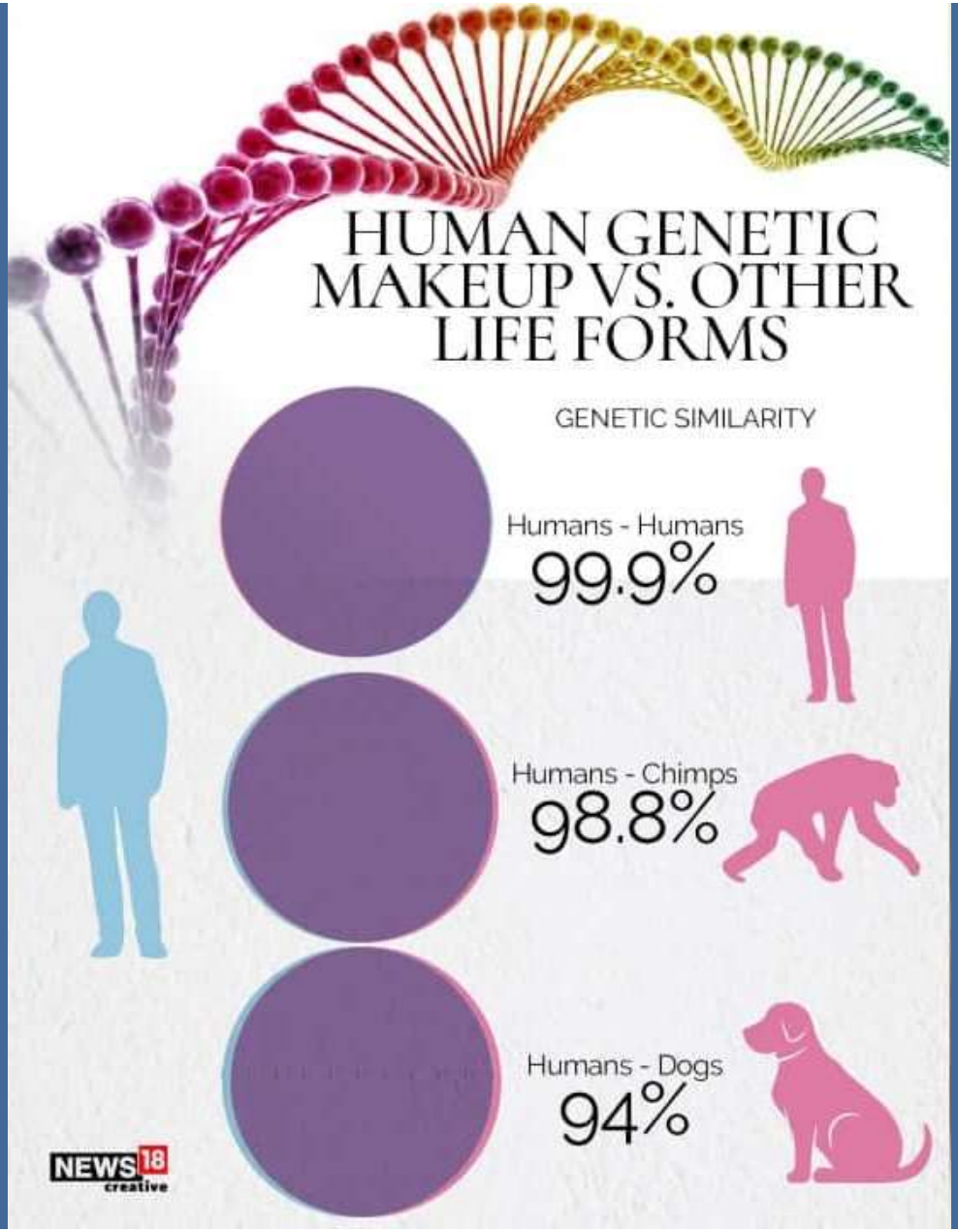


LESSON 19



THE PRIMATES OF THE NEW WORLD AND THE OLD WORLD BECAME SEPARATED FROM EACH OTHER SOME 40 MILLION YEARS AGO (MYA)

the genetic similarity between humans and chimpanzees; almost 99% of human genetic makeup is shared with the chimpanzee, so their evolutionary divergence must have been relatively recent in geological terms.



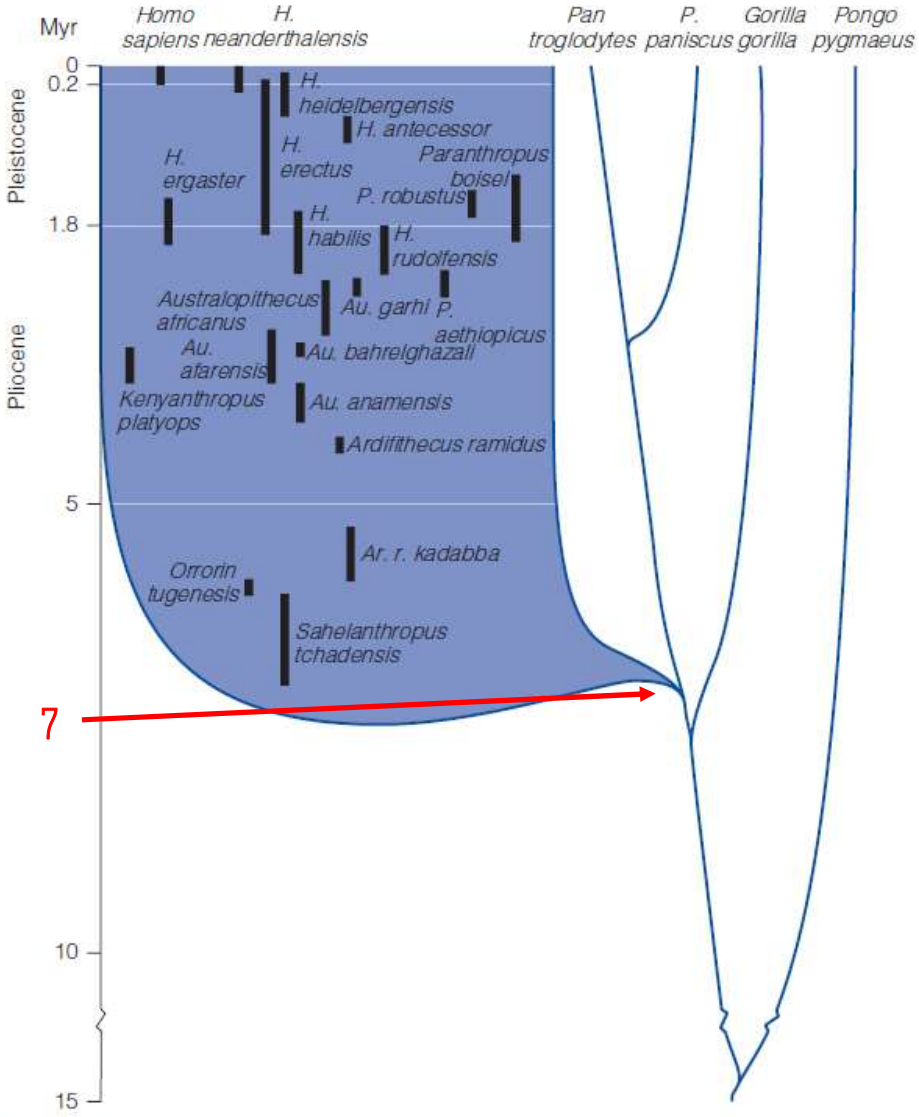


Figure 13.1 The relationships between the hominins and the great apes. From Carroll [4].

The separation of the human ancestral branch (the **hominins**) from the great apes (the two groups are known jointly as **hominids**) is thought to have taken place about 7 mya

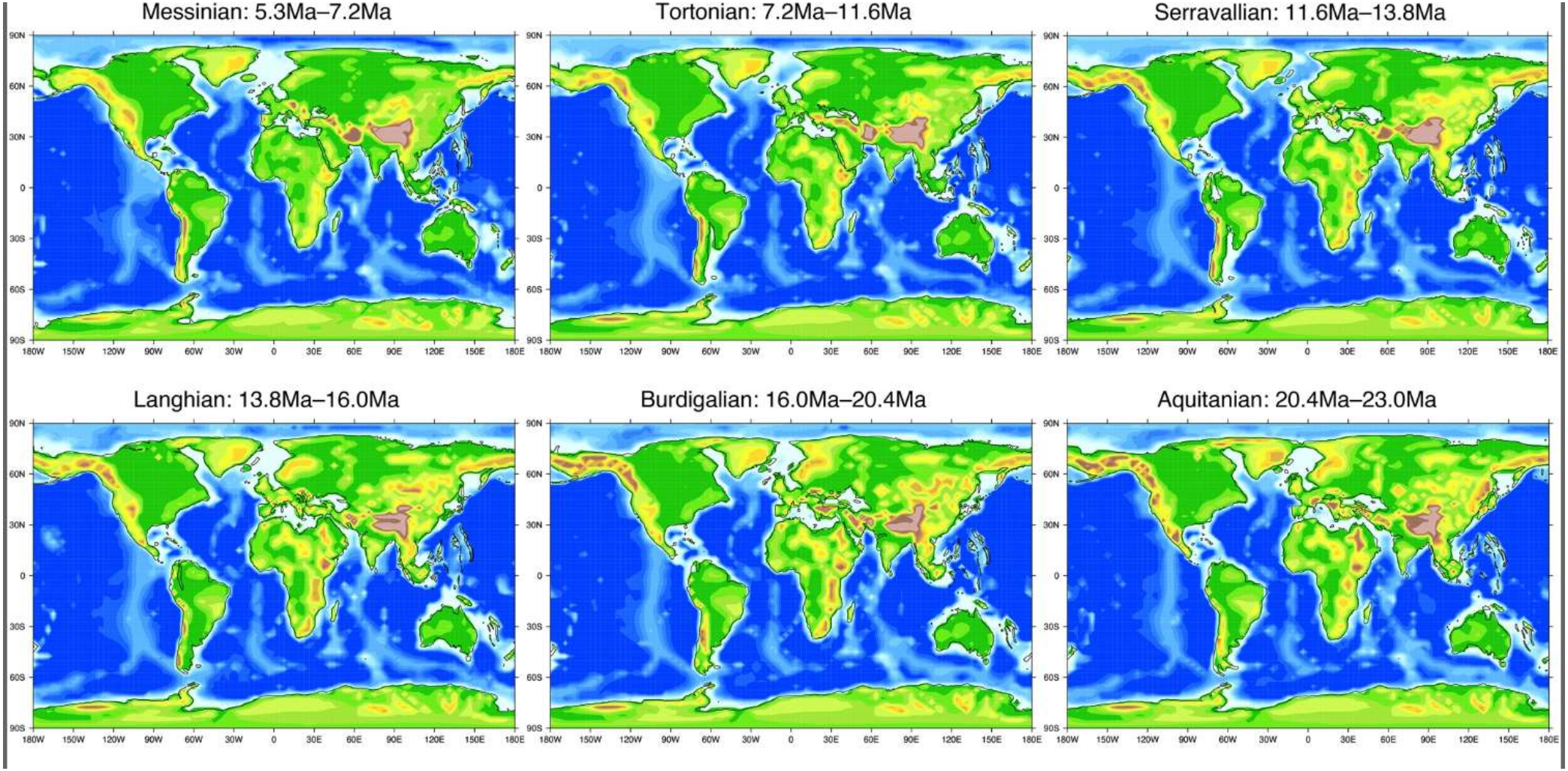
BIOGEOGRAPHY OF THE EARLY HOMINIDS

LACK OF FOSSILS

Trying to establish the biogeography of the early hominids, which lived during the Miocene over 5 mya, is extremely difficult because of the lack of fossils.

TO STUDY THE EVOLUTION OF ASSOCIATED ANIMALS

we can instead study the fossil record of other, larger and more common mammal groups, such as the hyaenids (hyenas) and the proboscideans (mammoths and elephants), which are often associated with hominids.


Messinian: 5.3Ma–7.2Ma
Tortonian: 7.2Ma–11.6Ma
Serravallian: 11.6Ma–13.8Ma
Langhian: 13.8Ma–16.0Ma
Burdigalian: 16.0Ma–20.4Ma
Aquitanian: 20.4Ma–23.0Ma
90N
60N
30N
0
30S
60S
90S
180W
150W
120W
90W
60W
30W
0
30E
60E
90E
120E
150E
180E

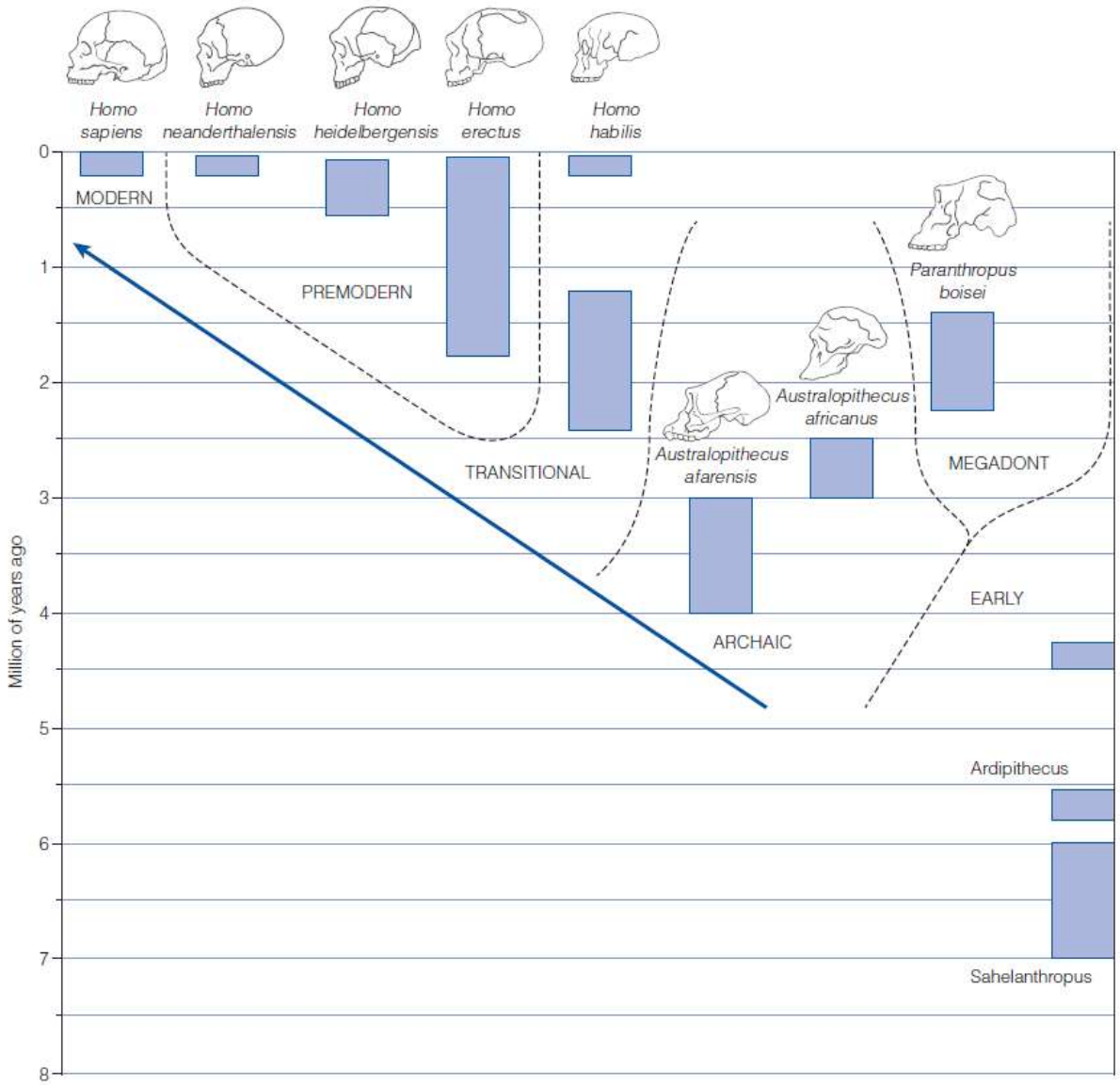


Figure 13.2 A scheme showing the possible interrelationships between hominins over the last 7 million years. Adapted from Wood and Lonergan [7].

A recent practical: six informal 'grades' rather than try to establish the detailed relationship of the different species.

- early,
- archaic,
- megadont ('large-toothed').
- transitional hominins,
- pre-modern *Homo,* and
- modern *Homo*

- In 2002, Michel B
  some lower jaws)

  Until then, most f
  Africa

  this set of fossils
  Chad, south of th

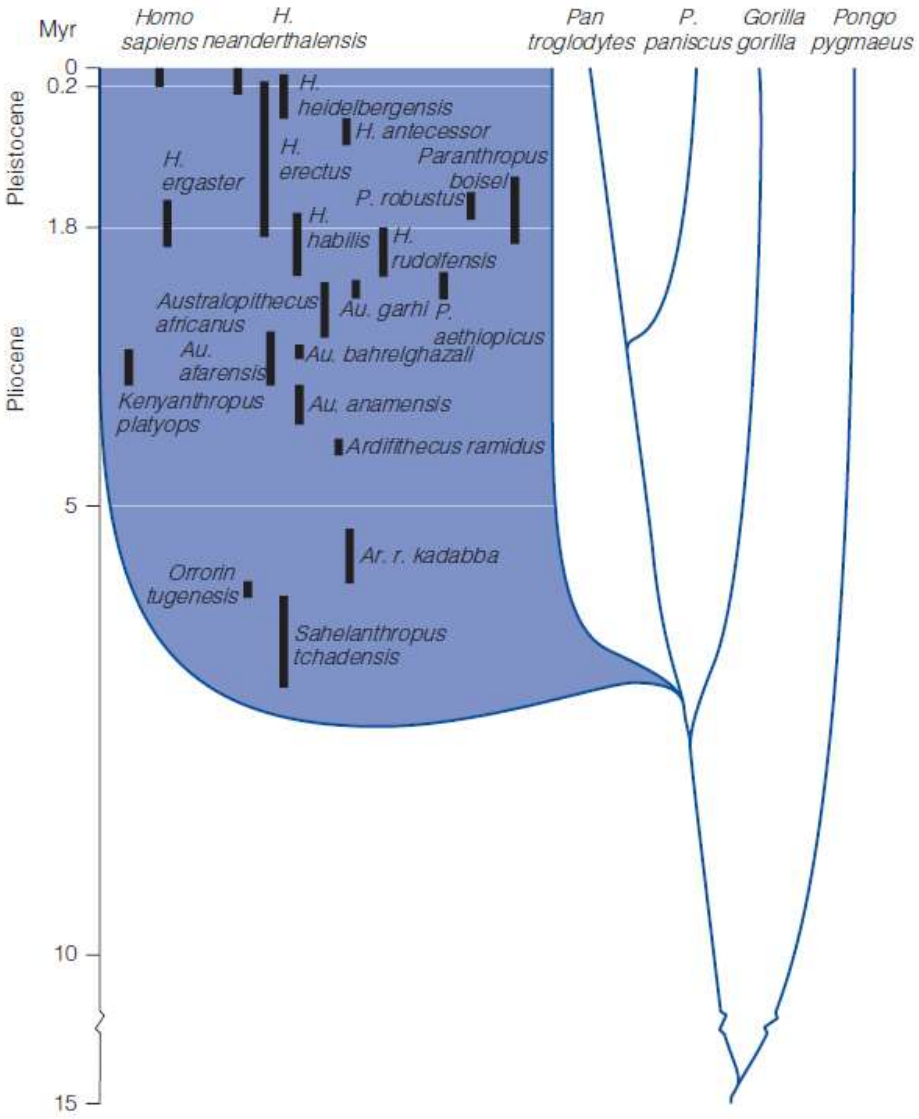


Figure 13.1 The relationships between the hominins and the great apes. From Carroll [4].

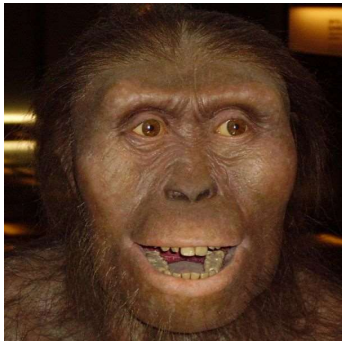
s

il bones (a cranium and

en discovered in East

ARCHAIC HOMININS

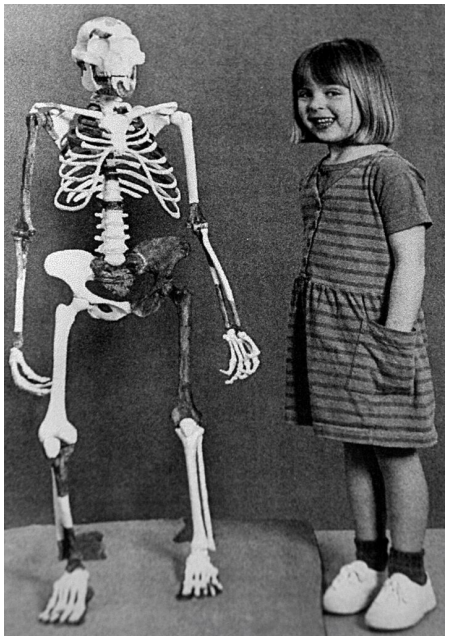
Australopithecus afarensis



- The fossil remains that succeeded *Sahelanthropus* are widely recorded from eastern and southern Africa; the earliest dated from around 4 mya.

The discovery of bipedal fossil human footprints in volcanic ash from Tanzania shows that they walked upright, on their hind legs, though their short legs suggest that they were not adapted to running.

The habitat in which they lived was open woodland and savanna, but very little is known of their precise way of life and the ecological niche they occupied.



MEGADONT HOMININS

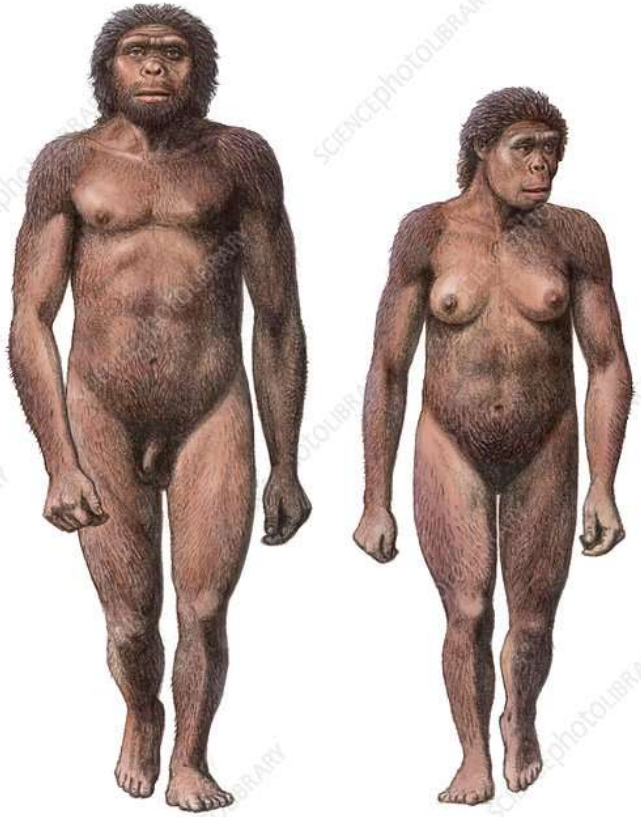
Paranthropus (ex Zinjanthropus)

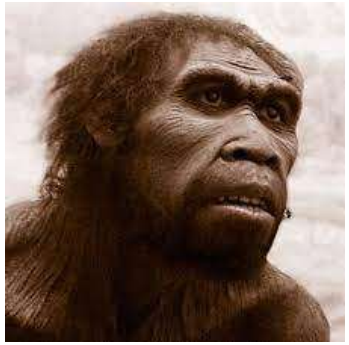
- A short-lived side-line of hominin evolution lived in East Africa 2.3–1.4 mya.
- Characterized by heavy, strong jaws and large molar teeth with a thick coating of enamel.
- The males of this genus were much larger than the females.
- They were adapted to feeding on large seeds, nuts and C4 grasses and sedges.

TRANSITIONAL HOMININS

Homo habilis

- This group includes *Homo habilis* (nearly 2 mya), it differs from *Australopithecus* for the upright posture and larger brain.
- However, the structure of its arms and hands suggests it was still quite adept at climbing, and its ankle has australopithecine characteristics.
- It belongs to the genus Homo, because it could make stone tools and, at the time at which it was discovered, it was assumed that this ability was confined to our own genus





PRE-MODERN HOMO

Homo ergaster, H. erectus

- *Homo ergaster* (1.9 mya) → direct descendent of *H. abilis*.
- H. erectus first species of our genus to be found far beyond Africa (1.7 mya, and had spread into eastern Asia by 100 000 years later)
- Some excavations in Java indicate that *H. erectus* may have survived in South-East Asia as late as the last Ice Age (50 000 years ago), in which case it would have overlapped with our own species in that area.

- By 1.5 mya, *H. erectus* had developed much more sophisticated stone tools, such as hand axes.
- The use of fire (as an aid in hunting).

Both the fauna and the flora of the grasslands must have been altered by this new phenomenon in the environment.

- between 600 000 and 100 000 years ago

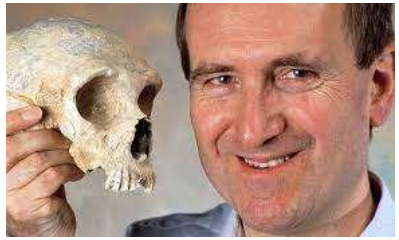
Homo heidelbergensis

Way of life: the discovery of hunting spears, buried in compressed peat deposits in north Germany 400k

hunting and butchering of animals using tools

H. heidelbergensis also reached Britain by about 500 000 years ago, although stone tools dating to about 900 000 years ago show that other hominins had reached the island even earlier.

POSSIBLE HYPOTHESIS BY BRITISH PALAEONTOLOGIST CHRIS STRINGER



Homo heidelbergensis

↓

Evolutionary split between 400 000 and 300 000 years ago

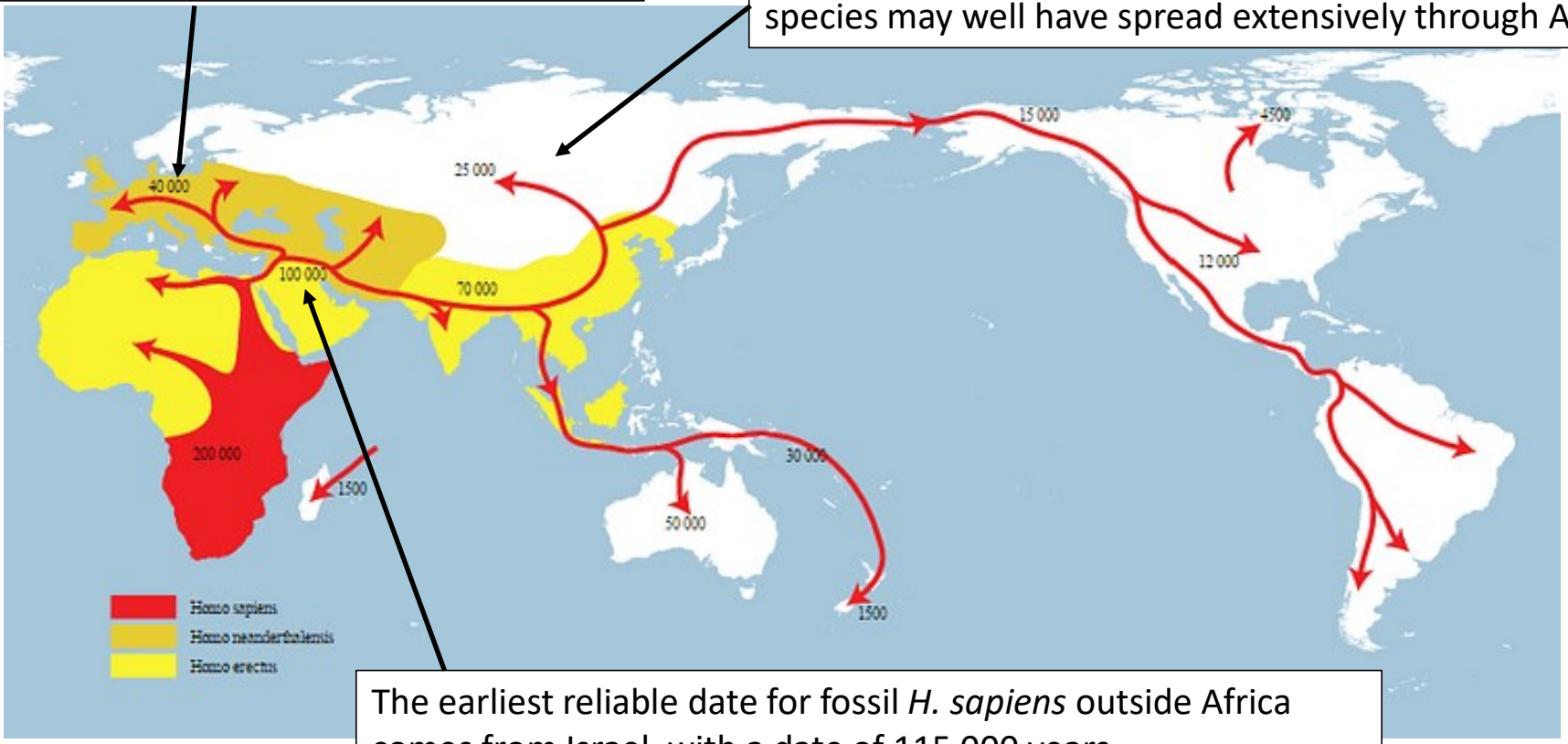
First evidence: *Homo neanderthalensis* about 200 000 years ago

Second evidence: *Homo sapiens* appearing later, (160 000-year-old) from Ethiopia

HUMAN MIGRATIONS

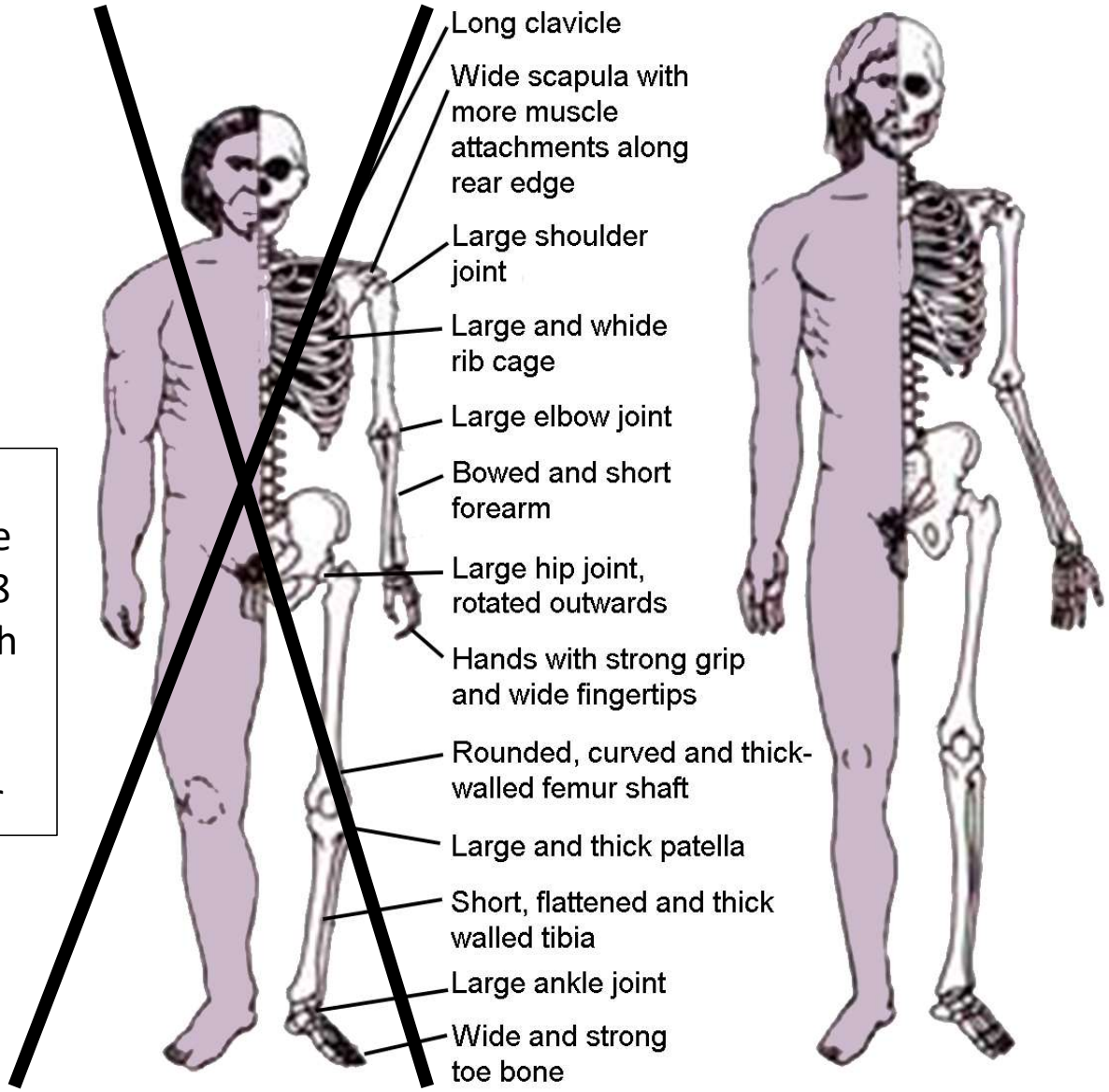
Neanderthals were the first of these two species to enter Europe, about 45 000 years ago

DNA from bones dating 38 000 years ago from Uzbekistan in Central Asia has Neanderthal affinities, suggesting that the species may well have spread extensively through Asia



The earliest reliable date for fossil *H. sapiens* outside Africa comes from Israel, with a date of 115 000 years.

Neanderthals disappeared from the fossil record about 28 000 years ago, though some would claim survival to 24 000 years ago in Gibraltar



NEANDERTHALS DISAPPEREANCE
(ROUGHLY 30K YRS AGO)

- Neanderthals disappeared coincides with a major expansion in global ice volume. This climatic change may have placed an additional strain on Neanderthal survival.

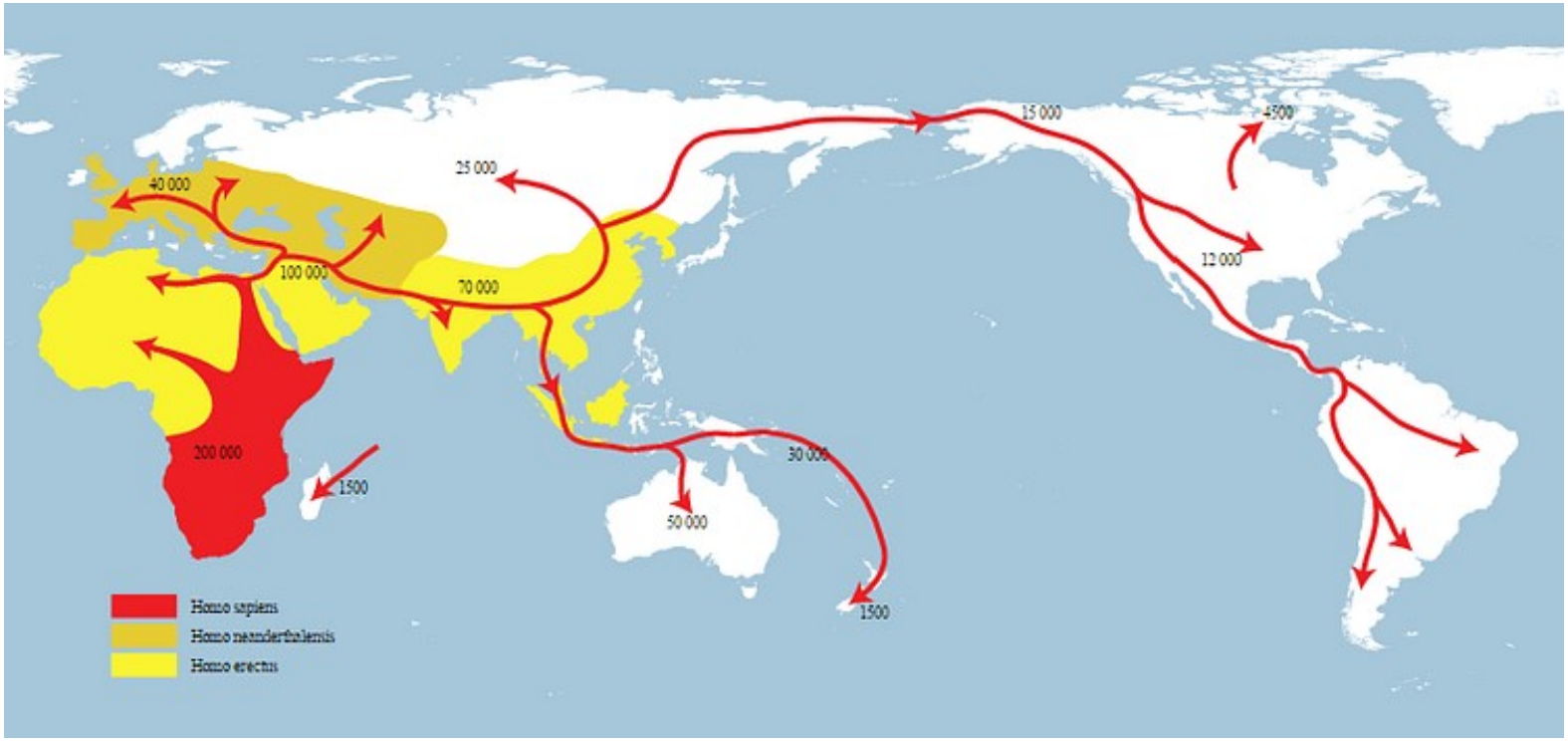
- However, only *Homo sapiens* remained in Europe at the beginning of the Holocene.

in 2003: a skeleton of an adult hominin only about 1 m tall was unearthed during the excavation of cave sediments dating back only 18 000 years on the island of Flores, Indonesia

Homo floresiensis

dwarf form of its genus, like many other examples of animals or reduced size living in islands, with their limited supplies of nourishment

MODERN HOMO



- Australia became populated by about 50 000 years ago
- Northern Europe and eastern Asia around 20 000 years ago (by the time the glaciation was at its peak)
- Only the Americas remained empty of our species

- Studies on human languages suggest that the colonization of the New World must have taken place before the major advance of the last glaciation about 22 000 years ago.

- three distinct groups of Native American languages

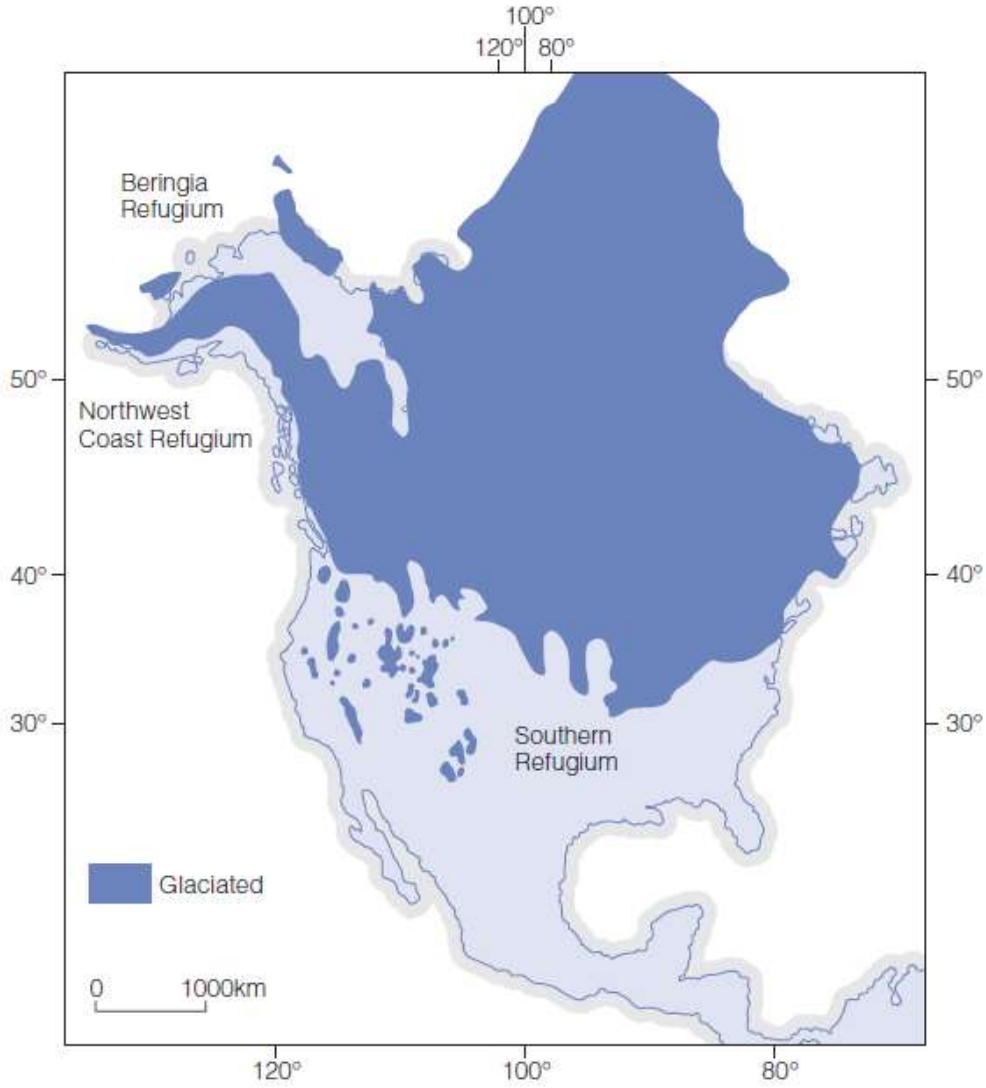
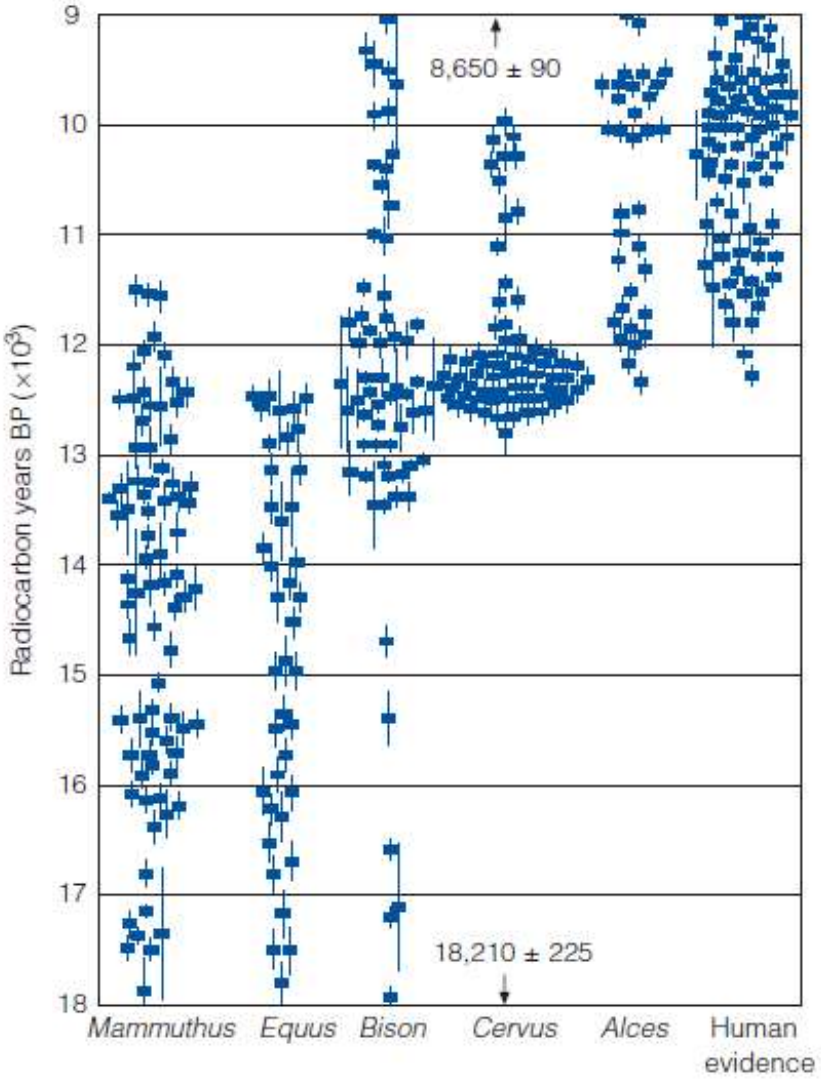


Figure 13.4 Maximum extent of the last (Wisconsin) glacial in North America, showing the three ice-free areas (refugia) which correspond to the language groups of Native Americans. From Rogers *et al.* [30].

MODERN HUMANS AND THE MEGAFAUNAL EXTINCTIONS

first in Australia, then in Eurasia and finally in North America.

- Hyp 1: extintion of megafauna (large mammal spp) caused by climatic changes.
- Hyp 2: Humans play somehow a role in the megafauna extintion events (by American anthropologist Paul Martin).



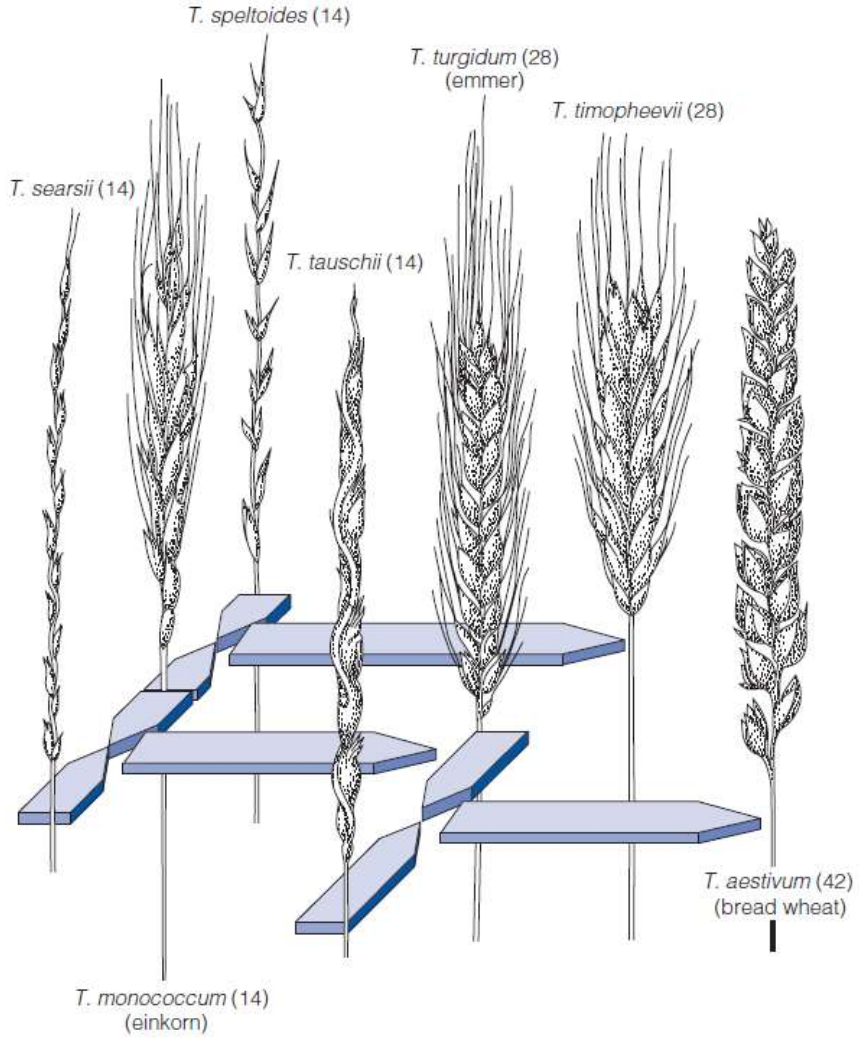


Figure 13.6 The evolution of modern bread wheat. This reconstruction is tentative, but it represents the probable course of crossings among the wild wheat species that led to the early domesticated forms of the genus *Triticum*, and the subsequent crossings of domesticated wheats with wild species and chromosome doubling that led to bread wheat. Figures in parentheses after names represent chromosome numbers.

ıESTICATION
ŘICULTURE

ans readily turned to alternative sources of

human groups in South Africa had resorted to marine
, harvesting shellfish and other intertidal organisms.

od, people living in Palestine and Syria were
lies: using annual grasses with edible seeds, the

Recognizing the value of these plants, successive generations of people must have encouraged the growth of such useful plants by removing shade-casting trees and shrubs, and disturbing soils so that their seeds germinated more effectively.

Figure 13.7 Are

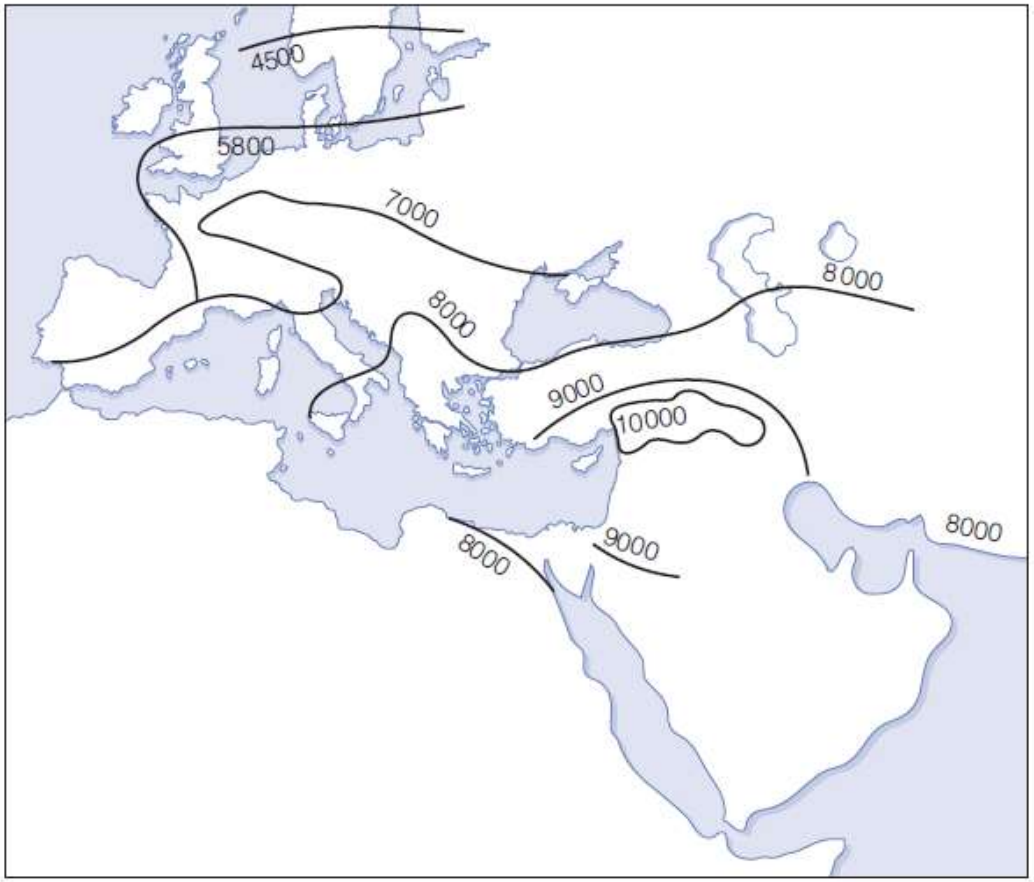


Figure 13.8 Map of Europe showing the spread of agriculture from the area of the Fertile Crescent. Dates are in radiocarbon years before present. Radiocarbon timescales diverge increasingly from calendar or solar timescales as one moves further into the past. A radiocarbon date of 10 000 years ago is approximately equivalent to 11 500 calendar years ago (9500 BC). The pattern is greatly simplified here, and there are problems concerning the precise time and direction of agricultural spread in such regions as the Balkans. From Willis and Bennett [51].

- agricul e continent of Europe during
- accom heir native regions.

ANIMAL DOMESTICATION

- The domestication of some animals may have preceded that of plants.
- It is likely that wolf was of considerable use in driving and tracking game and hunting down wounded prey,
- but determining when the dog was domesticated has proved very difficult using conventional archaeological techniques.

Bones of dog/wolf associated with human settlements (found as far back as 400 000 years) could merely be a result of people eating the animal, rather than domesticating it.

- Mitochondrial DNA analyses of samples from 162 wolves and 140 dogs (representing 67 different breeds) support the idea that the dog evolved from the wolf,
- but the differences between the two groups suggest that the evolutionary separation (presumably associated with domestication and isolation of dogs from wolves) took place about 100 000 years ago,
- later work suggests it could be as little as 30 000 years ago.

As in the case of plant domestication, however, the combined processes of selection and backcrossing with wild races have probably confused the genetic record.

- The first traces of domesticated sheep come from Palestine around 8000 radiocarbon years ago.
- These may have originated from one of the three European and Asiatic sheep, or may have resulted from interbreeding among these species.
- sheep and goats, were domesticated during the Early Neolithic period and soon after the first cultivation of plants.

Ovis musimon

Ovis orientalis

i.e. The Soay sheep that has survived in Scotland almost certainly originated from the mouflon, either the European *Ovis musimon* or the Asiatic *Ovis orientalis*.

Domestication of these animals may have resulted from the adoption of young animals orphaned as a consequence of hunting activity.

Soay sheep

i.e. CATTLE DOMESTICATION

- the milking of cattle was being practiced in the Near East about 9000 years ago.

Milk evolved in mammals as a means of increasing the growth rate of the very young. Its major constituent is the **carbohydrate lactose.**

In the young mammal, this is digested by the **enzyme lactase**, but the gene controlling the production of this enzyme is normally switched off in humans as they are weaned.

European races of humans are exceptional in that lactase production continues through the life of the adult, so they can still digest milk. The same is true of many **East African** peoples, but not of those in **West Africa**.

DIVERSIFICATION OF *HOMO SAPIENS*

- As humans spread around the world and developed their own cultures and food resources, they continued to diversify in response to the new environmental pressures placed on them.

- Some modifications derived from their choice of food (i.e. the persistence of lactase production in populations that consumed milk).
- The A and B blood groups are totally absent in Native Americans, yet are relatively common among Caucasians.
- Skin colour.

THE BIOGEOGRAPHY OF HUMAN PARASITIC DISEASES

- our early African ancestors were probably already liable to such widespread infections as roundworms (Ascaris), hookworms (Necator) and amoebic dysentery (*Entamoeba histolytica*).



All of these have infective stages that are passed out with the faeces of the infected individual and then wait in the soil or water until ingested by the next individual

- As hunter-gatherers on the plains of Africa, however, our ancestors probably suffered less from such diseases than do the people who live there today in more sedentary settlements.

  Their habit of continually moving on from temporary campsites would have ensured that they did not remain for long near their own faeces, which might otherwise have acted as infective agents for the eggs or larvae of parasites

- the members of each small, independent group would have been closely related to one another, and therefore all would have had a similar amount of immunity to any viral or bacterial infections.

  A group might rapidly lead to the death of most of the individuals in a particular group, any survivors would be immune to future infections.
  Our ancestors would not have suffered from epidemics that spread from group to group.

- Studies of the distribution patterns of parasitic diseases have shown a strong **latitudinal gradient** in the frequency of the diseases associated with protozoan parasites, with higher concentrations of such diseases in the tropics.

- The distribution pattern of any parasitic disease that requires an intermediate host is naturally limited by the environmental needs of both the final host and the vector.

- The year-round warmth of the tropics and subtropics provides a genial environment for all of them, and so it is not surprising that such diseases are prevalent there.

- It is also worth noting that the tropics contain more species of bird and mammal, which therefore provide a varied reservoir of organisms that share our warm-blooded physiology and from which a transfer of host by ‘spillover’.

- In time, people changed their way of life from nomadic hunter-gathering into more permanent settlements, surrounded by the animals and plants that they had domesticated→ their new closeness to animals brought with it a greater variety of disease exposure.

i.e. 1- The tapeworm Taenia finds its intermediate host in cattle and pigs,

i.e. 2- The human diseases smallpox, tuberculosis and measles are all closely related to similar diseases of cattle.

- At the same time, the irrigation systems that early farmers constructed in the Fertile Crescent of the Middle East may, by placing water courses permanently near their villages, have made it more likely that they would be infected by diseases transmitted by mosquitoes (whose larvae live in water).

- At the same time, homes and storehouses would have provided shelter and food for rats, from which they could have caught typhus.

- the higher population densities that accompanied all these changes would have made these early human communities more vulnerable to epidemics of disease.

So there were certainly drawbacks, as well as advantages, to the development of domestication.

- The bacterium *Helicobacter pylori* is present in approximately 50% of all human stomachs, where it can cause peptic ulcers and may even be a causative agent of stomach cancer.

↓

An extensive genetic survey has shown that its genetic diversity decreases with distance from East Africa, suggesting that this was the original centre of infection and evolutionary development.