

Homo but not quite us

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- As we saw last time, the first species of the genus *Homo* appeared about 1.8 mya
 - different from the other, earlier hominins in that it had
 - “slow, long, large” life history strategy
 - slower juvenile development
 - longer lifespan
 - larger body size
 - reduced sexual dimorphism
 - suggesting reduced male-male competition
 - maybe long-term pair bonding
 - Boyd and Silk argued that this could have been due to the complex extractive foraging strategy adopted by the Oldowan toolmakers around 2.5 mya
 - whatever species they were
- This first species of the genus *Homo* was *Homo ergaster*
 - 1.8 – 0.6 mya
 - appeared right at the beginning of the Pleistocene, a period of cold and variable climate
 - probably hunted game (more on this later)
 - probably controlled fire (more on this later)
 - began to make more well-planned, intentional stone tools
 - but initially did NOT have a much larger brain relative to body size than earlier hominins
- Some features of *Homo ergaster*
 - Still had some ancestral traits (inherited from possibly australopithecine ancestors)
 - low forehead
 - cranium pinches in behind the eyes
 - New, derived traits that resemble humans
 - more vertical face
 - smaller, more lightly built face
 - smaller teeth overall
 - indicates less emphasis on plant foods that require grinding, like seeds
 - and smaller molars relative to other teeth
 - shifting from back-tooth grinding towards more tearing and pulling with front teeth
 - which might indicate eating more meat (maybe)
 - projecting, human-like nose
 - New, derived traits that do not resemble humans
 - occipital torus (also called nuchal torus)
 - thickening of bone in an arc around the lower back of the cranium
 - strengthens the back of the cranium where major neck muscles attach
 - gives the lower back of the cranium a “pointed” look from the side
 - were strong neck muscles needed to pull on something held in the mouth?
 - as in eating meat?

- huge browridges
 - apparently strengthen face
 - related to pulling or tearing with front teeth?
 - as in eating meat?
- larger brain in absolute size: early *H. ergaster* around 800 cc
 - compare to most australopithecines, in the 450 cc range
 - compare to the one brainier australopithecine, *A. rudolfensis*, around 775 cc
- but body size is also larger than earlier hominins, like modern humans
 - so relative to body size, *H. ergaster* brain is not much larger than most australopithecines
 - maybe even smaller than the brainy *A. rudolfensis*, relative to body size
- But *H. ergaster* brains got larger over time, eventually reaching around 1000 cc
- Hint that *H. ergaster* may not have been able to speak as modern humans do
 - modern humans have a larger diameter opening in the cervical (neck) vertebrae for the spinal cord, narrowing considerably further down
 - the nerves that fill this additional space mostly go to the chest cavity
 - may have to do with fine control of breathing needed for modern speech
 - *H. ergaster* lacked the wider space for these extra nerves, so it presumably could not control its breathing as well
 - so maybe it could not make controlled speech sounds the way modern humans do
- *H. ergaster* was fully committed to being a biped on the ground, unlike the earlier hominins that retained features for living in trees
 - no longer had the long arms of the earlier hominins
 - long arms are good for moving in trees, but are not needed by a biped
 - instead, had long legs relative to torso and arms
 - long legs make for a much more efficient terrestrial biped
 - because longer strides waste less energy per mile
 - but long legs make a quadrupedal stance almost impossible
 - so good bipeds give up the ability to walk quadrupedally on branches
 - narrow shoulders compared to earlier hominins and other apes
 - like modern humans
 - again, reducing a feature that helps with moving through trees
 - narrow hips relative to new, taller stature
 - narrow hips make for more efficient bipedalism
 - less energy expended tensing abductor muscles to hold pelvis horizontal, because the hip joint is closer to the centerline – better leverage
 - less energy expended accelerating the body to one side, then the other, to move weight more over the hip joint
 - *H. ergaster* may have been the first hominin able to run (or jog) long distances
 - allowing them to chase a wounded animal for days, as modern low-tech hunters do
 - an inefficient biped would lose a lot of these potential kills
- Overall, fully modern body size
 - WT 15000 was 5' 4" tall as a 12-year-old
 - estimated to have been heading for about 6' tall as an adult

- extremely robust bones and strong muscles
- *H. ergaster* was only slightly more sexually dimorphic than modern humans are
 - suggesting greatly reduced male-male competition
- *H. ergaster* apparently had longer juvenile development than earlier hominins
 - growth rings in tooth enamel suggest a rate of juvenile development about half-way between that of australopithecines and modern humans
 - the birth canal opening in the pelvis is small relative to the adult head size
 - this allows for narrow hips and more efficient bipedalism
 - but infants must have been born very immature, with heads small enough to pass through the opening
 - requiring a longer period of juvenile development
- *H. ergaster* was the first hominin to spread out of Africa
 - numerous individuals found at Dmanisi, Georgia
 - at 1.7 mya, only 0.1 mya after the earliest *H. ergaster* known in Africa
- earlier hominins made “mode 1” Oldowan tools
 - basically, just cobbles with some flakes broken off in no obviously intended shape
 - and the resulting flakes
 - the earliest *H. ergaster* (1.8 mya) apparently also made only “mode 1” tools
- but quickly, by 1.6 mya, *H. ergaster* began making “mode 2” stone tools: the Acheulean style
 - Acheulean tools are “mode 2” tools
 - they are bifaces, that is, they have had flakes removed from both sides of the cutting edge in order to shape the edge as desired
 - they are larger than Oldowan tools
 - average about 6” long, up to about 2 feet long
 - just a few, standardized shapes
 - handaxe: teardrop-shaped flattish form, sharpish edge all around
 - cleaver: similar, but broken across the narrow end and shaped to have a fairly straight edge crosswise to the long axis of the tool
 - pick: similar to a handaxe, but narrower and longer
 - plus the flakes from them
 - often retouched to adjust shape or re-sharpen after some use
 - these mode 2 tools have more cutting edge per pound of rock than Oldowan tools do
 - presumably an improvement if you have to carry them around
 - they are made in specific shapes, with a preconceived plan in mind
 - *H. ergaster* had the mental ability to visualize the shape, plan how to make it, and do so
 - but the plan was very rigid, with only a few variants (other than variable size)
 - and these plans were used with almost no change for over 1.3 million years!
 - if making these tools was a learned skill, that is an incredible duration for a cultural trait
 - consider that modern people developed countless ways to farm over about 10,000 years
 - this single tool type was made for 100 times longer than people have been farming!
 - this extreme stability might suggest that *H. ergaster*’s toolmaking behavior was not completely learned or “cultural” in the modern sense

- *H. ergaster*'s brain and thinking may have been limited and inflexible in some way
- Oldowan tools are still made by modern humans; they are just the result of making some simple, handy stone flakes
- but Acheulean tools went out of use around 0.3 mya
 - modern humans generally do not make or use tools like these
 - so figuring out what they were used for or what they imply about their users is difficult
 - their minds were apparently different from ours...
- What were the Acheulean tools for?
 - Butchering animals?
 - Throwing weapons for hunting?
 - Stripping bark to get edible cambium?
 - Digging (for tubers, burrowing animal prey, or water)?
 - Maybe they weren't tools at all, but rather flake dispensers (cores)
 - this would imply a very rigid, standardized way of making flakes
 - Evidence favors their use for butchering animals
 - experiments suggest that Acheulean tools are most useful for butchering
 - although these experiments may not be fair, since we don't have the experience or strength of an *H. ergaster* tool user
 - use-wear studies also suggest that both the Acheulean tools and the flakes from them were used to butcher animals
 - both are found at sites with animal bones, like the elephant butchery site at Olorgesailie
- Did *H. ergaster* hunt game?
 - one dramatic case of an *H. ergaster* female that died from hypervitaminosis A
 - diagnosed from abnormal secondary growth of bone tissue that it causes
 - probably from eating an uncooked carnivore liver
 - does that mean *H. ergaster* hunted carnivores?
 - or that they had carnivore carcasses so rarely that they did not learn to avoid raw livers?
 - Olorgesailie again: *H. ergaster* butchered an elephant there
 - lack of carnivore toothmarks on the elephant bones suggests that they hunted it
 - Acheulean tools work well for butchery
 - maybe implying that they had to do a lot of it, because they hunted
 - *H. ergaster* back teeth are small
 - implies reduced selection for being able to chew tough, hard plant foods
 - yet the climate was increasingly seasonal, so there would be more times when only poor, tough plant foods were available
 - was *H. ergaster* substituting more meat, instead?
 - *H. ergaster* lived in a very cold climate at Dmanisi, Georgia
 - what could they have eaten in the snowy winter when few plant foods were available?
 - maybe hunted meat?
- Did *H. ergaster* control fire?
 - At Koobi Fora, Acheulean tools were found with a patch of burned soil
 - experiments suggest that the soil was burned at temperatures higher than those caused by wildfires, burning tree trunks, etc.

- the burned soil was in a bowl-shaped form, typical of artificial camp fires
 - so maybe they made fires for warmth, light, keeping away animals, or even cooking?
 - many animal bones from the Acheulean levels at Swartkrans (a cave site in South Africa) were burned at high temperatures
 - experiments suggest these temperatures were higher than usually occur in natural fires
 - more typical of concentrated campfires
 - Again, *H. ergaster* lived in a very cold climate at Dmanisi
 - could it have survived the winters without fire?
 - seems likely that *H. ergaster* did control fire, but the evidence is still not conclusive
- Another early member of our genus: *Homo erectus*
 - 1.6 mya to 0.03 mya (that is just 30,000 years ago)
 - similar to *H. ergaster*, but not identical
 - probably an early branch from the same lineage
 - I'll spare you the many interesting similarities and differences
 - only found in Asia
 - appeared in Asia very quickly after *H. ergaster* appeared in Europe
 - presumably part of the same process of expansion out of Africa
 - *H. erectus* probably descended from early *H. ergaster* that left Africa
 - *H. erectus* survived as a species until very recently
 - went extinct much more recently than *H. ergaster* did
 - but changed very little over all that time
 - unlike *H. ergaster*, cranial capacity did not gradually increase
 - nor did they change the kinds of tools they made
 - (at least the stone ones, which are all we can see)
 - this does not mean the *H. erectus* was inferior in some way
 - on the contrary, it suggests that *H. erectus* was a successful, well-adapted creature whose average individual was reproducing just fine
 - Did *Homo erectus* make Acheulean tools?
 - *Homo erectus* is usually found with Oldowan-like mode 1 tools
 - so maybe it was not capable of making mode 2 tools
 - if so, maybe the lineage of *H. erectus* split from early *H. ergaster* before that species had made whatever mental leap allowed them to make mode 2 tools
 - if so, that would imply that the ability to make mode 2 tools involved a fairly distinct step up in cognitive abilities, which only happened in the lineage of *H. ergaster*
 - but maybe *H. erectus* could make stone mode 2 tools, but just did not need to
 - they had plenty of bamboo, which easily splits into good, lightweight cutting tools
 - Exception: mode 2 handaxes were recently found in the Bose basin of southern China
 - around 0.8 mya, a large meteor strike burned the forests off the region and exposed good toolmaking stone that would have previously been covered by soil and vegetation
 - Acheulean-like mode 2 tools appear only in this region and at this time
 - maybe made by *H. erectus*
 - when faced with the need (scarcity of bamboo?)
 - and the opportunity (availability of appropriate stone)

- or maybe made by bigger-brained *H. heidelbergensis*,
 - which had just appeared in Africa and Europe at this time,
 - and we know was present in Asia later
- *Homo erectus* could handle cold
 - Zhoukoudian cave, northern China, near Beijing
 - occupied 0.5 to 0.25 mya
 - snow-covered winters today, and even more so then, during the Pleistocene ice ages
 - does the ability to live at Zhoukoudian imply that *H. erectus* controlled fire?
 - many layers of charcoal, burnt bones, and ash
 - but whether these represent artificial fires is still being debated
 - still, it is hard to believe *H. erectus* could have survived the frigid winters without fire
 - does Zhoukoudian imply that *H. erectus* hunted game?
 - in winter, game may have been the only food available, suggesting that they hunted
 - the cave is full of bones, mostly from just two species of deer
 - clearly hunted by something: maybe *H. erectus*?
 - would any hunters other than hominins have been so selective?
 - but the cave also contains hyena bones and hyena feces
 - and the *H. erectus* crania found there are badly damaged, with their faces and the bases of the crania often broken off
 - so did *H. erectus* hunt the deer and the hyenas?
 - or did the hyenas hunt the deer and the *H. erectus*?
 - if the cave was a hyena den, then the burned layers could not have been artificial fires
- *Homo ergaster* was clearly our ancestor; *H. erectus* was evidently not
- *Homo ergaster* apparently evolved into *Homo heidelbergensis*
 - appearing somewhere between 0.8 and 0.5 mya (800,000 – 500,000 years ago)
 - and persisting until about 0.2 mya
 - until recently, often just called “archaic *Homo sapiens*”
- Some features of *Homo heidelbergensis*
 - Derived features that resemble modern humans
 - bigger brains, around 1200-1300 cc
 - modern humans range from about 1000 to 2000 cc, averaging around 1400
 - so we are getting into the range in which raw brain size does not tell us much about the differences between these creatures and us
 - higher, rounder braincase than *H. ergaster*
 - Ancestral features
 - still have thick cranial bones
 - cranial shape still longer and lower than modern humans
 - massive browridges
 - heavy, projecting, relatively prognathic face compared to us
 - no chin (that is, receding chin)
 - very robust bodies
- Geographic distribution: *H. heidelbergensis* initially in both Africa and Europe

- *H. heidelbergensis* culture
 - continued making mode 2 Acheulean tools at first
 - but near the end of its span as a species, started making mode 3 tools
 - more on this below
 - finally, we have good evidence of hunting
 - on the island of Jersey, off France
 - many mammoth and rhino bones at the foot of a cliff
 - these are animals too big to have been killed by other predators
 - they were cut up with stone tools
 - many of the body parts were stacked up by type
 - probably the animals were driven off the cliff, butchered, and eaten
 - 3 wooden spears from a coal mine near Schönigen, Germany
 - 0.4 mya
 - very similar to modern throwing spears
 - found with lots of horse bones with cutmarks from butchering
 - late *H. heidelbergensis* began making mode 3 tools
 - starting about 0.3 mya
 - unlike mode 2 tools, this approach is still used by recent and modern humans
 - most famous style of mode 2 tools is the Levallois style
 - the method
 - step 1: shape the core by flaking it, preparing a specific spot to strike a flake off of
 - step 2: strike off a flake
 - the shape of the core determines the shape of the flake
 - the flake is the desired tool
 - step 3: reshape the same surface of the core, in preparation for making the next flake
 - step 4: strike off another flake tool ... etc.
 - this method of preparing the core in order to make a desired type of flake requires more planning and complex thinking than mode 1 Oldowan or mode 2 Acheulean tools do
 - advantages
 - you get many more good, usable flakes per pound of stone
 - that is, more cutting edge per pound
 - good control of the shape of the resulting flake tool
 - wear patterns show that many flakes made this way were hafted (mounted in handles)
 - as projectile points (on spears, arrows, harpoons, etc.)
 - knives, etc.
- Late *H. heidelbergensis* appeared in Asia by 0.2 mya
 - overlapping with late *H. erectus*
 - although we don't know if they coexisted in the same places at the same time...
 - they might have interbred, or competed, or hunted or fought each other
 - Asian *H. heidelbergensis* might be descendents of immigrants from western populations
 - or they might have developed locally from *H. erectus*
 - just happening to look similar due to parallel evolution

- if so, they would be on a separate branch from the western ones, and should have a different species name
- Asian *H. heidelbergensis* continued to make mode 1 Oldowan-like tools, as *H. erectus* did
- And now for something completely different: *Homo floresiensis*
 - just discovered in 2003, first publication in 2004
 - very recent: 35,000-14,000 ya (0.035 –0.014 mya)
 - only known from a single cave on the island of Flores, Indonesia
 - one pretty intact cranium
 - fragments of six other similar individuals
 - tiny bodies and heads
 - about 3 feet tall
 - have been called “hobbits”
 - cranial capacity about 380 cc
 - even smaller than australopithecines!
 - even relative to body size, this brain is much smaller than *H. erectus* or any other *Homo*
 - yet found with sophisticated mode 4 stone blade tools
 - we’ll get to this tool technology next time
 - some doubt that a hominin with such a small brain could make these tools
 - a debate is raging about whether these individuals are a new species, or a group of *H. sapiens* with a congenital disorder like microcephaly or Laron Syndrome
 - Laron Syndrome is a simple recessive disorder that is common in several small, inbred southeast Asian island populations
 - a 2007 study suggests that the bones of Laron Syndrome sufferers are very similar to the remains from Flores
 - in that case, the small individuals were just born with the disorder, and the tools were made by healthy normal humans, whose remains were not left in the cave
 - Boyd and Silk go with calling these individuals a new species
 - personally, I find the genetic disorder view more plausible, but the jury is still out
 - if they are really a separate species, they illustrate two interesting ideas
 - 1. hominins were still undergoing major evolutionary changes very recently
 - 2. hominins experienced the same process of “insular dwarfism” as has been documented for numerous other island species
 - such as pygmy mammoths (on Santa Rosa Island, off Santa Barbara, and several islands off Alaska), dwarf elephants, dwarf deer, and other examples
 - on isolated islands, predators may go extinct
 - without the predators, the remaining animals experience little selection for large size
 - and islands often have limited food supplies
 - which creates strong selection for smaller bodies that need less food to survive
 - maybe this process could have created *Homo floresiensis*
- in any case, the Flores island population is an interesting sideline, not directly related to the evolution of modern humans
 - we will pick up that story next time