Homo sapiens:
Emergence of Modern Humans
Part III:
The Middle Stone Age --
Archeology:
Rethinking the Revolution
&
MSA Fossils

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African Human Modernity Revolution?

Was it sudden at 50 Ka? A genetic leap forward?

Behavioral Modernity: Brain capacities

- Enlarged brains, 1350 cc average
- Enhanced WM and planning: The ability to show planning for future events, to have a cognitive concept of the future: i.e. to be able to communicate a sense of the future to other individuals in the context of tool production (Wynn & Coolidge)
- Enhanced theory of mind: social cohesion
- Executive functioning: prefrontal-parietal network
- Complex language
  - hyoid bone – also in Australopithecus at Dikika; Neandertal at Shanidar
  - Foxp2 gene

Upper Paleolithic: the 2 models of the development of behavioral modernity

- In 2000 McBrearty and Brooks forcefully argued, in a 110-page *J. of Evol.* article, that the components of this "Upper Paleolithic revolution" were already visible in the African MSA, tens of thousands of year earlier.

- Contested by Richard Klein, who stressed a later and punctuated emergence of "modern human behavior"

** Revolution in thinking about Human Origins

- Classical theory that emergence of MHs and Upper Paleolithic culture were causally related, virtually temporally synchronous events.

- Since 1990s, African archeological site evidence indicates that emergence of early MHs took place mainly within a Middle, not an Upper, Paleolithic, cultural context (e.g. Klasies River Mouth, Border Cave in S. Africa; Dar es-Soltan in N. Africa; Qafzeh and Skhul in Levant; Krapina A in central Europe; Middle Awash in Ethiopia).

- Only in western Europe do we find that both archaic and early MHs are associated with UP industries

Rethinking the revolution

- It does seem that the “human revolution” that made us modern never was.
- Archaeological evidence for modern behaviors arose much earlier, starting in groups that predated our own species.
- Every criterion that has historically been used to differentiate modern humans from archaic humans – culture, art, treatment of the dead, ornamentation and abstract symbolism – has much older examples.

Rethinking the revolution

- What remains to be understood, however, is the relationship between complex behaviors and hominin species from 500,000 years to 50,000 years ago when many species of hominins (not just modern humans) inhabited the African landscape.

- Gradual complex change is more difficult to interpret than revolution.

Modernity: Symbolism

- If you use standard of symbolism: artifacts of a clearly symbolic nature appear only after 100,000 years ago (Henshilwood *et al*. 2002, Henshilwood *et al*. 2004, d'Errico *et al*. 2009, Texier *et al*. 2010).

- These artifacts include: beads, ochre and ostrich eggshells with geometrically engraved patterns.

- Obvious symbolic artifacts do not occur consistently in the archaeological record until between 100,000 and 50,000 years ago and disappear periodically (Hovers & Belfar-Cohen 2006).

Symbolism

- Alternative explanations: presence or absence of various modern behavioral traits can be ascribed to
  - climatic change,
  - group size,
  - cultural exchange rates
  - taphonomic (geological disturbances) issues
- rather than a lack of capacity for modernity (Richerson *et al*. 2009; Powell *et al*. 2009).

Behavioral Modernity models

Two models, 2000:

- 1. R. G. Klein, *Archeology and the evolution of human behavior*. Evol. Anthropol. 9, 17–36 (2000).

- 2. S. Mcbrearty, A. S. Brooks, *The revolution that wasn't: A new interpretation of the origin of modern human behavior*. J. Hum. Evol. 39, 453–563 (2000):
  - One of the most-cited papers in the history of Paleolithic archaeology. This paper argued that behavioral modernity arose in Africa over a long period of time, and that it is visible very early in the MSA archaeological record. This view challenged European-centric models for human evolution that argued for a sudden appearance of behavioral modernity in Europe during the Upper Paleolithic.

Behavioral Modernity models

- Contrasting interpretations of the archeological record:

- "Human revolution" model – R. Klein: sees a rapid emergence of behavioral modernity at the transition to the Upper Paleolithic in Europe and the Later Stone Age in Africa possibly related to a genetic mutation, and consequent neural & cognitive changes, in Africa ~50 Ka

- "Revolution that wasn't" -S. McBrearty: a gradual emergence as documented by the African Middle Stone Age; cultural modernity emerged gradually in Africa starting by at least 200 Ka; without a specific biological correlate; triggered by factors such as environmental changes or demographic developments

The fortuitous mutation?

Stanford archeologist Richard Klein: Ultimate reason for the emergence of symbolism — a fortuitous genetic mutation that reorganized brain structure and function thus giving *Homo sapiens* a cognitive advantage over other archaic hominid forms.

Psychologist Frederick Coolidge and archeologist Timothy Wynn: extended Klein's hypothesis -- most likely target of this mutation would have been an enhancement of working memory capacity. In this context, working memory capacity refers to the ability to hold information in mind, especially information about behavioral procedures and intended goals, in spite of interfering stimuli or response competition

MH behavioral modernity: R. Klein

- "The Leap", 1995, Richard Klein:
- The Later Upper Paleolithic Model: modern human behavior arose through cognitive, genetic mutation abruptly around ~50,000 years ago:
- Stressed a punctuated emergence of "modern human behavior" via a neural mutation thought to have promoted the final development of the modern human brain.
- Not by an increase in brain size but by a sudden increase in brain quality/reorganization that created ability to innovate and language ability; lead to expansion out of Africa
- Critique: No evidence for genetic change; humans left Africa many times before 50 Ka; untestable hypothesis

Klein on archeology pre and post 50 Ka

- Before 50-60 ka, anatomically modern humans were confined to Africa.
- About 50 ka, behavior changed in Africa and “modern” Africans then spread rapidly to Eurasia.
- Klein’s evidence: Until 50 ka, people everywhere:
  - manufactured a relatively small range of artifact types.
  - made few if any formal (standardized) artifacts in bone, ivory, or shell.
  - produced artifact assemblages that varied little over long-time intervals and vast areas.
  - left no indisputable ruins or evidence for spatial organization within sites.
  - buried their dead without indications of ritual or ceremony.
  - rarely, if ever produced art (evidence of modern human mind)
  - didn’t fish, and they hunted relatively ineffectively.

R. Klein: evidence of behaviorally modern MH

- If you have a site that's older than 50,000 years that was located on the coast, there are no fish bones in it. You can predict that in advance. After 50,000 years, fish will dominate at coastal sites.

- The artifacts: they didn't have the technology for fishing. That only appeared after 50,000 years ago.

- More protein results in an increase in your population density

- So something very important happened 50,000 years ago. Klein believes we crossed a kind of Rubicon, a threshold.

Klein: The 50 Ka Rubicon

- Klein: “We are effectively the hardware that allows the running of a vast range of different software programs. I think what happened 50,000 years ago was the change in the operating system. I think it was a point mutation that effected the brain. It may have been something that allowed languages as we understand it today, rapidly produced, articulate speech.”

- First evidence for tailored clothing after 50,000 years ago:
  - soil traces of clothing around graves that date to 35,000 to 40,000 years ago; indications of clothing (arctic fox, wolf): ability to live in arctic environments.

Behavioral modernity “outcomes” a la Richard Klein

- Not isolated traits but related outcomes of the innovative burst behind the OoA expansion: part of a package that enhanced fitness
- Sharp increase in the diversity and standardization of artifact types. Specific tools, for specific purposes unlike the Neanderthals
- Rapid increase in the rate of tool type change through time and in the degree of artifact diversity through space
- First routine shaping of bone, ivory, shell, and related materials into formal artifacts (“points,” “awls,” “needles, pins, etc.).
- First population densities approaching those of historic hunter-gatherers in comparable environments

R. Klein: Evidence

- Earliest appearance of incontrovertible art and personal ornamentation.
- Earliest secure evidence for ceremony or ritual, expressed both in art and in relatively elaborate graves.
- Oldest undeniable evidence for spatial organization of camp floors, including elaborate hearths and the oldest indisputable structural “ruins.“
- Oldest evidence for the transport of large quantities of highly desirable stone raw material over scores or even hundreds of kilometers.

MH behavioral modernity: McBrearty & Brooks

- 2000, Sally McBrearty and Alison S. Brooks:

- Proponents of gradualism, forcefully arguing that the components of this "Upper Paleolithic revolution" were already visible in the African MSA, beginning at 100 Ka or before.

- They suggested a gradual assembling of a package of modern human behavior in Africa, which was later exported to other regions of the Old World.

The roots of modern human behavior

- Many complex technologies and signs of symbolic behavior, such as sophisticated Middle Stone Age (MSA) tools and pigment use. Appeared first in Africa and then in fits and starts around the world.

- Dating of MSA: 300-50 Ka

- 320 Ka: Olorgesailie in Kenya -- Oldest securely dated MSA tools, use of red and black pigment, long-distance MSA tools, transport of obsidian.

- 300 Ka: Jebel Irhoud, Morocco -- Oldest fossils of early *Homo sapiens.* MSA tools.

- 190 Ka: Omo Kibish, Ethiopia -- "first" modern H. sapiens, MSA tools.

The roots of modern human behavior

- 164 Ka: Pinnacle Point, South Africa -- Shellfish harvests, use of red ochre pigment.

- 105 Ka: Skhul Cave in Israel -- Creation of perforated shell beads

- 50-30 Ka: Africa. Asia, and Europe -- Shaped bone & ivory tools, notation systems, stunning figurative art.

“The revolution that wasn't: a new interpretation of the origin of modern human behavior” - 2000: McBrearty & Brooks

- Abstract: “Proponents of the “human revolution” model claim that modern human behaviors arose suddenly, and nearly simultaneously, throughout the Old World ca. 40–50 ka. This fundamental behavioral shift is purported to signal a cognitive advance, a possible reorganization of the brain, and the origin of language.
- Because the earliest modern human fossils, *Homo sapiens sensu stricto*, are found in Africa and the adjacent region of the Levant at >100 ka, the “human revolution” model creates a time lag between the appearance of anatomical modernity and perceived behavioral modernity, and creates the impression that the earliest modern Africans were behaviorally primitive.“

The revolution that wasn't: a new interpretation of the origin of modern human behavior - : McBrearty & Brooks

- This view of events stems from a profound Eurocentric bias and a failure to appreciate the depth and breadth of the African archaeological record.
- In fact, many of the components of the “human revolution” claimed to appear at 40–50 ka are found in the African Middle Stone Age tens of thousands of years earlier.
- These features include: blade and microlithic technology, bone tools, increased geographic range, specialized hunting, the use of aquatic resources, long distance trade, systematic processing and use of pigment, and art and decoration.

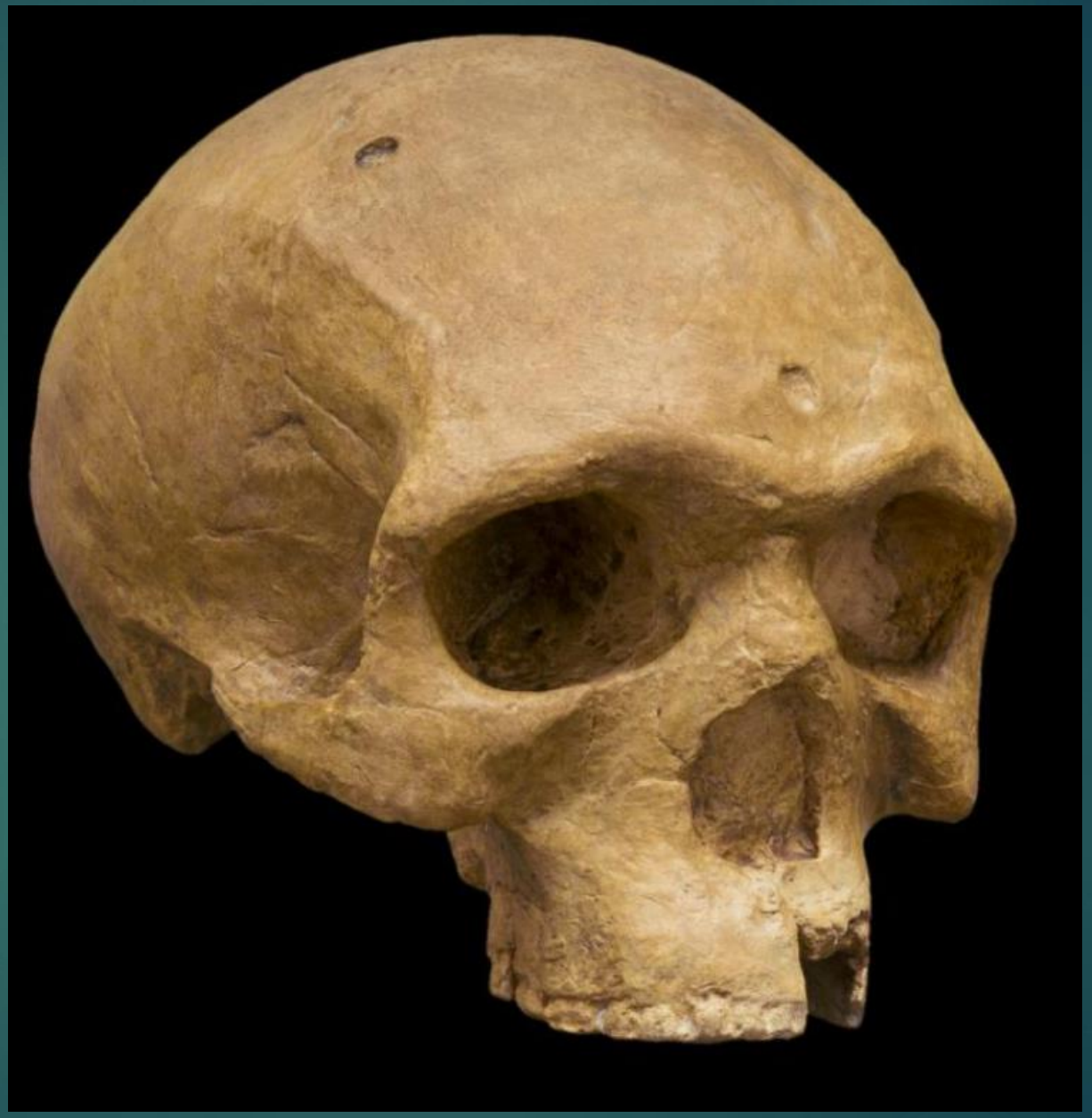
The revolution that wasn't:

- These items do not occur suddenly together as predicted by the “human revolution” model, but at sites that are widely separated in space and time. This suggests a gradual assembling of the package of modern human behaviors in Africa, and its later export to other regions of the Old World.
- The African Middle and early Late Pleistocene hominin fossil record is fairly continuous and in it can be recognized in a number of probably distinct species that provide plausible ancestors for *H. sapiens*.
- The appearance of Middle Stone Age technology and the first signs of modern behavior coincide with *H. helmei* (Florisbad Skull, 1400 cc), with MSA tools**)**. The origin of our species is linked with the appearance of Middle Stone Age technology at 300-250 Ka.

Florisbad,
Zambia, 1400 cc

Early MSA,
259 Ka

Early
Homo sapiens
or *Homo helmei*
or *Homo heidelbergensis*



The revolution that wasn't

- McBrearty believes that the model of the “human revolution” is fatally flawed.
- Model based on European UP: a proposed picture of Europe conquered by invaders with superior technology.
- Models derived from the unique record of European prehistory do not explain events in Africa where the origin of modern people actually occurred.
- *Homo* originated in Africa. Modern humans were in Africa by 300 Ka and in Australia by 65 Ka. The earliest modern Europeans were Africans and arrived circa 47 Ka.
- Hominin populations in Africa, while probably widely dispersed, appear to have been consistently larger.

The revolution that wasn't

- As early as the 1920s it was clear that the African archaeological record could not be accommodated within the European Paleolithic model.

- A separate scheme of Earlier, Middle and Later Stone Ages (ESA, MSA, and LSA) was devised for Stone Age Africa to emphasize its distinctiveness from European Paleolithic.

- The ESA, MSA and LSA were first defined on stone tool technology on the basis of material from South Africa.

- The MSA, at <60 Ka was considered the temporal equivalent of the Upper Paleolithic of Europe.

The revolution that wasn't

- The fully developed signature of modern human behavior, including planning, sophisticated technology and resource use, and symbolic behavior in the form of decorative art, is clearly present in the African LSA.

- There was no “human revolution” in Africa.

- McBrearty presents data from the human fossil and archaeological records to show that novel features accrued stepwise.

- Evidence described from the African MSA to support the contention that both human anatomy and human behavior were intermittently transformed from an archaic to a more modern pattern over a period of more than 200,000 years.

The revolution that wasn't

- The most conspicuous behavioral event in the late Middle Pleistocene archaeological record of Africa is the disappearance of the Acheulian industry before 200 ka, and its replacement by diverse MSA traditions.

- Origin of *H. sapiens* has been conflated with the origin of the Upper Paleolithic.
- The Acheulian contains large bifaces, while most MSA industries are characterized by smaller flake tools.
- The abandonment of handaxes and cleavers for smaller flake tools represents the replacement of handheld by hafted implements and signals a profound technological reorganization.

The revolution that wasn't

- Early members of *H. sapiens* are associated with MSA technology.
- Thus, it appears that the major adaptive shift represented by the Acheulian-MSA boundary ca. 250–300 ka corresponds with a speciation event.
- There is no evidence for hominin morphological change during the MSA–LSA transition, which is the product of culture change. *H. sapiens* and MSA technology would be seen to appear simultaneously in the record between 250 ka and 300 ka.
- Suggest that modern behaviors developed gradually over a substantial period of time and sporadically in different parts of the continent.

The revolution that wasn't

- The “human revolution” is synonymous with the origin of “fully syntactical” language

- Africa is vast, researchers are few, and research history is short.

- The high degree of variability in Middle Pleistocene industries makes it difficult to identify the earliest MSA, and perhaps lends support to the idea of multiple contemporary hominin lineages.

The revolution that wasn't

- McBrearty argues that modern human behavior is characterized by: Abstract thinking, Planning depth, Behavioral, economic and technological innovativeness, Symbolic behavior, the ability to represent objects, people, and abstract concepts with arbitrary symbols,
- **Increased geographic range:** This trend is seen in the African MSA. Sites of the MSA Aterian industry do indicate widespread habitation of the Sahara between ca. 90 ka and 40 ka. MSA occupations, in contrast to those of the Acheulian, are not restricted to sites near water sources.
- **Technology - Blades**
- The earliest true Upper Paleolithic industry, the Aurignacian, appears in Europe at approximately the same time as the first traces of *H. sapiens* ca. 40–45 ka. it seems increasingly likely that Upper Paleolithic technology was introduced into Europe by African *H. sapiens* migrants

The revolution that wasn't

- European Upper Paleolithic technology is dominated by blades, and thus blade production has been considered a key ingredient of the "human revolution". But in Africa, blade production has great antiquity.
- **MSA points:** The presence of stone points has been considered a defining characteristic of the MSA. Pointed flakes and flake-blades are among some of the earliest MSA artefacts at 235 ka
- Hafting was probably routine in most MSA contexts. MSA points are often deliberately modified to facilitate hafting.
- **Social organization -** Regional variety in MSA points at different sites reflect regional traditions. There is not a high degree of variability in the MP of Europe, where pointed forms are rare

African MSA points

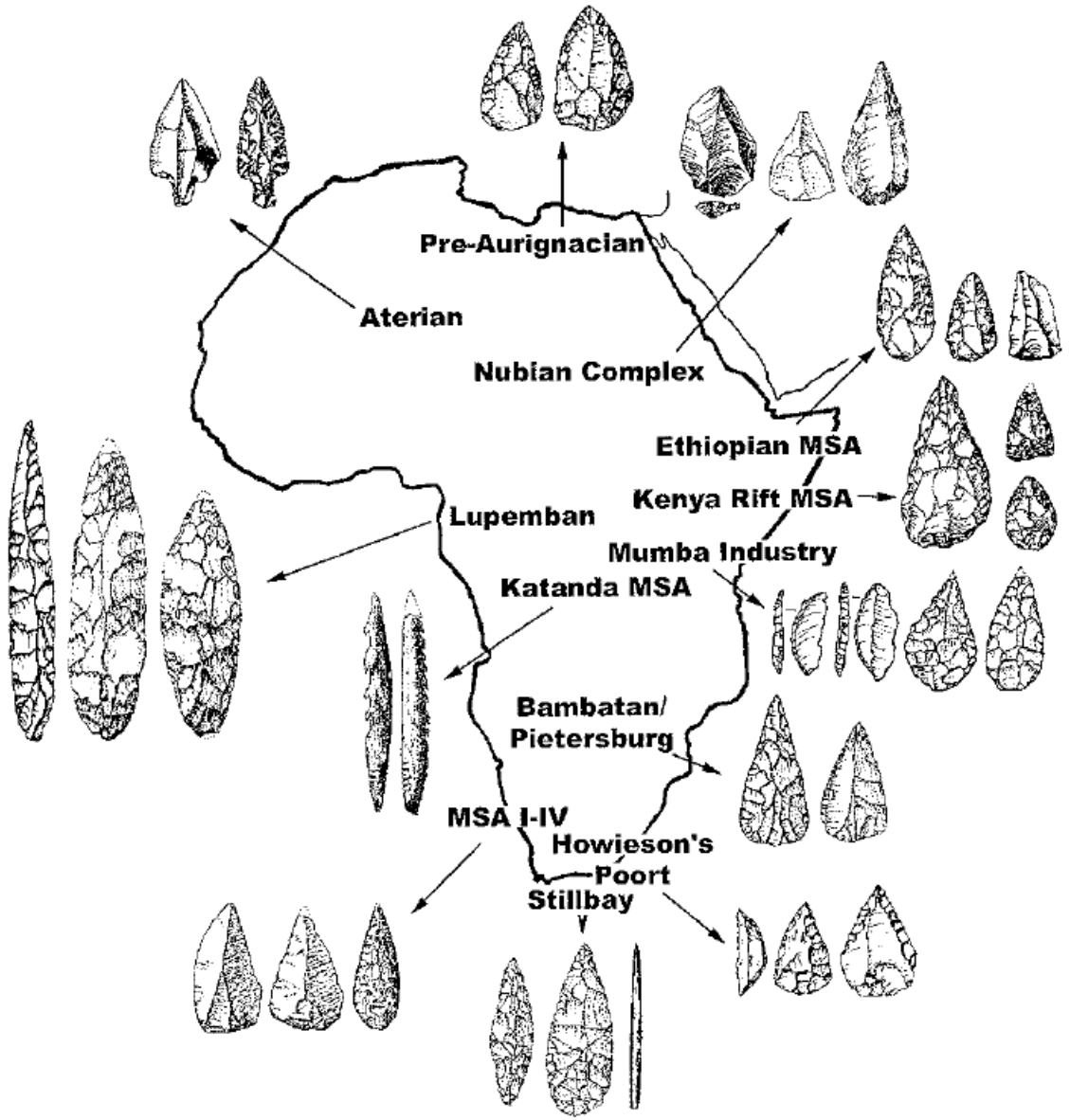


Figure 5. Map of distribution of point styles in the African MSA (after Clark, 1993, Figure 1). © Sally McBrearty & Alison S. Brooks.

Bone points of the African MSA. (a) Katanda 16 and Katanda 9

The revolution that wasn't

- **Technology - Geometric macroliths and microliths** do not become common or widespread in Europe until after 20 ka
- In Africa, geometric microliths are the hallmark of the LSA. The Mumba and Howiesons Poort microliths support the presence of composite projectiles in Africa by 65 ka, about 30,000 years earlier than they are found in Europe.
- **Bone tools:** The shaping of bone and other organic materials into points, awls, and other tools has been a hallmark of the Upper Paleolithic. The bone artefacts from Blombos and Katanda together firmly document bone working in the Middle Stone Age.

The revolution that wasn't

- **Economy - Hunting**
- MSA people have been portrayed as scavengers, or as less effective hunters than their LSA successors.
- Klein infers that MSA hunters were unable to take the more dangerous animals regularly and were forced to concentrate upon the more tractable eland. He concludes that MSA hunters were deficient not only technologically, but also cognitively and socially. These arguments can be questioned on both empirical and theoretical grounds.
- Refute three assertions about hunting behavior in the MSA: (1) that hunting was not practiced at all; (2) that dangerous species were not hunted on a regular basis; (3) that hunters did not focus upon prime age adults.
- The taking of large prey species and prime age adults are regarded as signs of fully competent hunting ability. There is good evidence that MSA hunters did not confine themselves to docile prey species or to juvenile targets

The revolution that wasn't

- **Aquatic and small-scale resource use:**

- Deliberate fishing in the MSA has long been debated.
- In MSA levels at Blombos Cave, South Africa, faunal remains include not only marine mollusks and small fish but also large deepwater fish. Finds establish the competence of MSA people at marine coastal fishing, if not the presence of watercraft.

- By at least 75 ka, African hominins exploited large catfish caught in rivers; exclusively at the beginning of the rainy season when they spawn nearshore. This suggests that exploitation took place as part of a specialized seasonal strategy,

The revolution that wasn't

- Clearly MSA people were competent hunters and fishers who planned their settlement choices around the seasonal availability of game and fish.

- Availability of Omega-3 and lipids in fish for brain growth. Crawford *et al*. (1999) argue that access to marine foods was essential to the development of the modern human brain, and that the evolution of *H. sapiens* took place at the land-water interface.

- Shellfish found at In South Africa, shellfish remains are found at Klasies River and other locales. Snails and tortoises as well.

- Intensive processing of plant foods is revealed by the general presence of grindstones at many MSA sites,

The revolution that wasn't

- Klein has repeatedly asserted that the greater intellectual abilities and technological sophistication of LSA people resulted in an increase in the human population. LSA sites greatly outnumber MSA sites on the African landscape

- McBrearty: there is no intellectual difference in the abilities of MSA and LSA hominins.

- Rather, a long-term trend in population growth led to residual crowding and a diminished resource base . In addition, crowding probably led to greater residential stability in the LSA, which in turn may contribute to higher archaeological visibility for small food items.

The revolution that wasn't

- **Lithic resource procurement**
- The exchange of goods and the development of trade: In Upper Paleolithic Europe, raw materials such as elk teeth, mammoth ivory, amber, marine shells, and fossils were obtained from distant sources and transformed into decorative objects
- Maximum transport distances in the eastern European early Upper Paleolithic are as great as 300–420 km.

- But local raw materials continue to dominate Upper Paleolithic assemblages. For example, at nearly all the German Gravettian sites, more than 95% of the lithic artefacts were made from raw material obtained from within a radius of 25 km.

- Increased interaction and exchange among human groups can explain the distribution of obsidian over the MSA landscape.

The revolution that wasn't

- **Site structure and modification**
- The designation of different areas of a habitation site for different activities is considered by many to indicate sophisticated cognitive functions.

- The deliberate modification of the occupation area is thought to be unique to *H. sapiens*, and is a feature that consistently distinguishes European Upper Paleolithic from Middle Paleolithic sites.

- In the MSA levels at Mumbwa, Zambia, is clear evidence for deliberately constructed stone-lined hearths.

The revolution that wasn't

- **Symbolic behavior - Special treatment of the dead:** Burial and other special treatments of the dead are a consistent feature of the symbolic life of modern human societies
- The earliest evidence for burial among *H. sapiens* is found in the Levant at the site of Qafzeh, dated ca. 90–120 ka.
- In Africa, deliberate burials of Middle Pleistocene hominins are absent.
- The cutmarks on the temporal bone of the Bodo cranium (600 Ka), however, indicate defleshing with a stone tool, and suggest either cannibalism or a postmortem ritualized treatment of the skull. Also at Klasies River.
- There is evidence that deliberate interment was practiced by early *H. sapiens* in Africa, but it is not uncontroversial. Modern human remains have been recovered from Border Cave, South Africa. And at the site of Taramsa, Egypt; dated to 80 ka to 50 ka. Also a child burial at 78 Ka.

The revolution that wasn't

- **Beads and ornaments:** Distribution in the European UP is uneven, and many Aurignacian sites lack pierced or decorated items altogether. Ornaments are infrequent at European MP sites.

- African tradition of body ornamentation predates that of Europe by tens of thousands of years. The perforated *Conus* shell in MSA context at Border Cave may date to before 105 ka, A number of body ornaments are now known from Aterian sites dating from at least 130 ka to ca. 40 ka.

- The manufacture and use of ostrich eggshell beads is widespread in the African LSA. The earliest LSA ostrich eggshell beads was in southern Africa. Beads have been reported from multiple MSA sites
- Evidence for considerable antiquity for the practice of personal ornamentation in Africa.

The revolution that wasn't

- **Use of pigment: S**ystematic use of pigment is one of the hallmarks of the European Upper Paleolithic. While the sophisticated cave art at some of the best known European painted caves dates to 30 ka.
- The pigments most commonly encountered in archaeological contexts are iron oxides - red hematite or yellow limonite.

- Multiple uses of ochre: Although some would identify the use of pigment in prehistory as *de facto* evidence for symbolic behavior, others are skeptical of the symbolic content of this behavior: distinguish between symbolic and domestic use, such as for hide preparation. Others have suggested possible medical uses for ochre, as a styptic or antiseptic treatment for wounds or for eradicating internal or external parasites.

The revolution that wasn't

- The use of red ochre is widespread in modern sub-Saharan Africa. It is clear that hematite and limonite were almost universally used as coloring agents in late Pleistocene and Holocene Africa.

- Countless fragments of pigment with unambiguous evidence of grinding, as well as grindstones with traces of ochre, have been recovered from LSA sites. Undoubted art objects with traces of applied ochre are also often found in LSA contexts, and painted stones are frequently encountered in LSA graves

- Rock art is present in MSA.

The revolution that wasn't

- **Pigment acquisition and processing:**

- Evidence is accumulating for the widespread, controlled and systematic acquisition, processing and use of pigment in the MSA.

- Large scale mining for hematite in the MSA is reported from Lion Cavern in the Ngwenya Range, Swaziland.

- Hematite pencils are reported throughout the entire MSA sequence at Border Cave, South Africa; the age of the base of the sequence has been estimated at >100 ka

The revolution that wasn't: Summary

- Early members of *H. sapiens* are associated with MSA technology, and thus it is clear that the main behavioral shift leading to modernity lies at the Acheulian–MSA boundary about 250–300 ka, not at the MSA–LSA boundary at 50–40 ka as many assume.

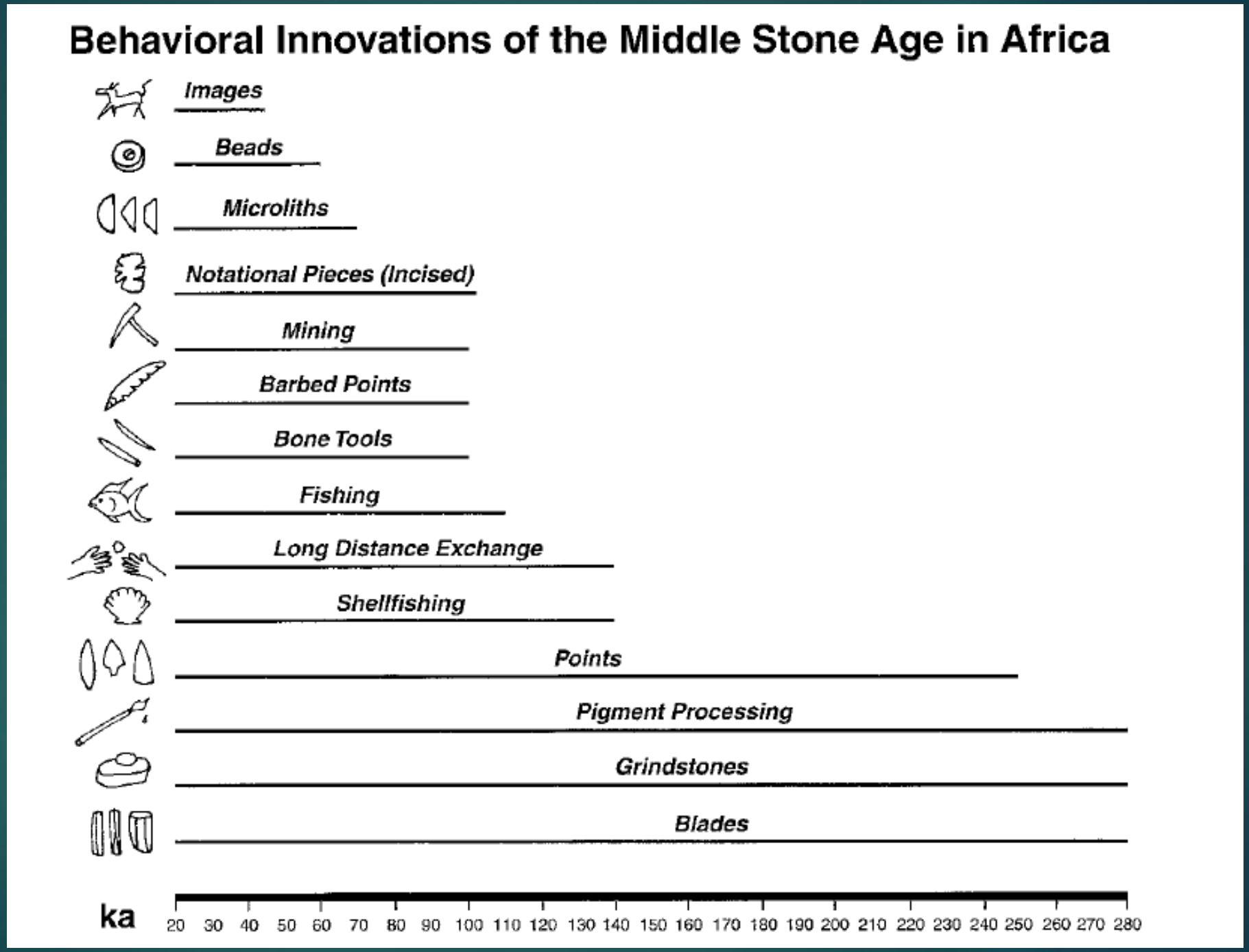
- There were many sophisticated behaviors present in the MSA. This implies increased cognitive abilities.

- *Homo sapiens* has a time depth of ca. 250–300 ka, and its origin coincides with the appearance of MSA technology. However, we are not seeking simply to move the "human revolution" back to the Acheulian–MSA boundary.

The revolution that wasn't: Not punctuated event

- Use of the term "revolution" implies not only profound, but also rapid change.
- Popular treatments of these issues borrow the vocabulary of punctuated equilibria from paleobiology (Eldredge & Gould, 1972), but even in paleontology, punctuated events are notoriously difficult to document, and there is no agreement about how rapid a change must be to qualify.
- There is no logical reason to expect a single sudden event to represent what is essentially a cultural, not a neurological, process
- The record shows that the new behaviors do not appear suddenly together, but rather are found at points separated by sometimes great geographical and temporal distances.
- It seems inappropriate to label changes accumulating over a period of 200,000 years either a revolution or a punctuated event.

Modern behaviors and their time depths in Africa.
Sally McBrearty & Alison S. Brooks.



The revolution that wasn't

- MSA artefacts were habitually hafted, and some of them were used as projectiles, perhaps in some cases propelled by the bow.
- The presence of exotic obsidians at some East African sites indicates that the distances involved in some tropical Africa MSA exchange networks exceeded 300 km.
- There is good faunal evidence to show that MSA people were competent hunters who brought down a variety of dangerous game animals.
- Use of both marine and freshwater fish and shellfish

The revolution that wasn't

- Sophisticated bone tools were used in seasonally scheduled fishing
- General presence of grindstones in the MSA indicates that plant food processing was routine
- Notching and incising not only of ochre, but also of bone and ostrich eggshell, most likely as part of a symbolic or notational system.
- Despite the relatively small number of excavated MSA sites, the quantity and quality of evidence for symbolic behavior that has been reviewed here far exceeds that known for the European Middle Paleolithic where the site sample is more than ten times greater.

The revolution that wasn't

- Pigment processing and bead production, in particular, are comparable in kind to that seen in the Africa LSA and European Upper Paleolithic,

- As a whole, the African archaeological record shows that the transition to fully modern human behavior was not the result of a biological or cultural revolution, but the fitful expansion of a shared body of knowledge, and the application of novel solutions on an "as needed" basis. The complex content of human cultures has been built incrementally, with cognitive equipment present since at least 250 ka, in a process that continues today

- MHs in Australia possessed the means to cross large bodies of water at least 10,000 years before the usual dates invoked for the "human revolution".

The revolution that wasn't

- **Population growth and the MSA–LSA transition**

- The cultural intensification visible at the MSA–LSA transition after about 50 ka is in part the result of simple population growth coupled with environmental deterioration.

- What might have accounted for dramatic population growth in Africa early in the Late Pleistocene?

- Factors that would have acted to increase infant survivorship and decrease overall mortality rates. Two of the most important of these are new technologies and risk-management strategies involving long-distance exchange.

The revolution that wasn't

- New projectile technologies reduced the need to grapple at close range with large game animals, and would have increased hunting productivity. Fishing technology allowed humans to exploit a vast new resource

- It was the desire to believe that brain expansion preceded bipedalism that fostered the acceptance of Piltdown and the rejection of *Australopithecus* for many decades.
- By continuing to insist upon revolutions, researchers, perhaps unwittingly, create a gulf separating humans from the rest of the biological world. By stressing human uniqueness, proponents of the "human revolution" effectively remove the origin of *H. sapiens* from the realm of normal scientific inquiry.

The revolution that wasn't

- All species are by definition unique.

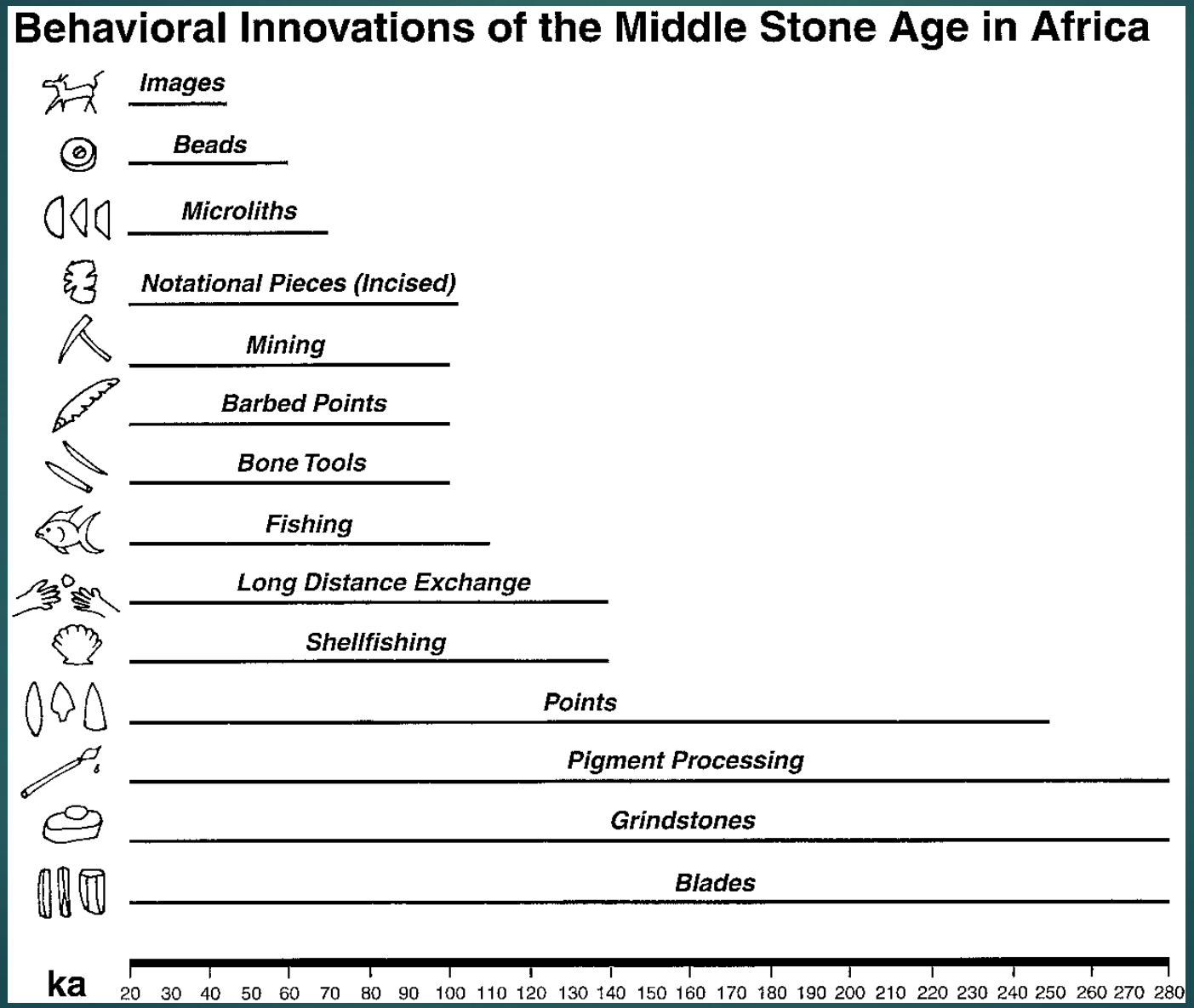
- There is a profound Eurocentric bias in Old World archaeology that is partly a result of research history and partly a product of the richness of the European material itself.

- The privileging of the European record is so entrenched in the field of archaeology that it is not even perceived by its practitioners.

McBrearty & Brooks (2000) The revolution that wasn't

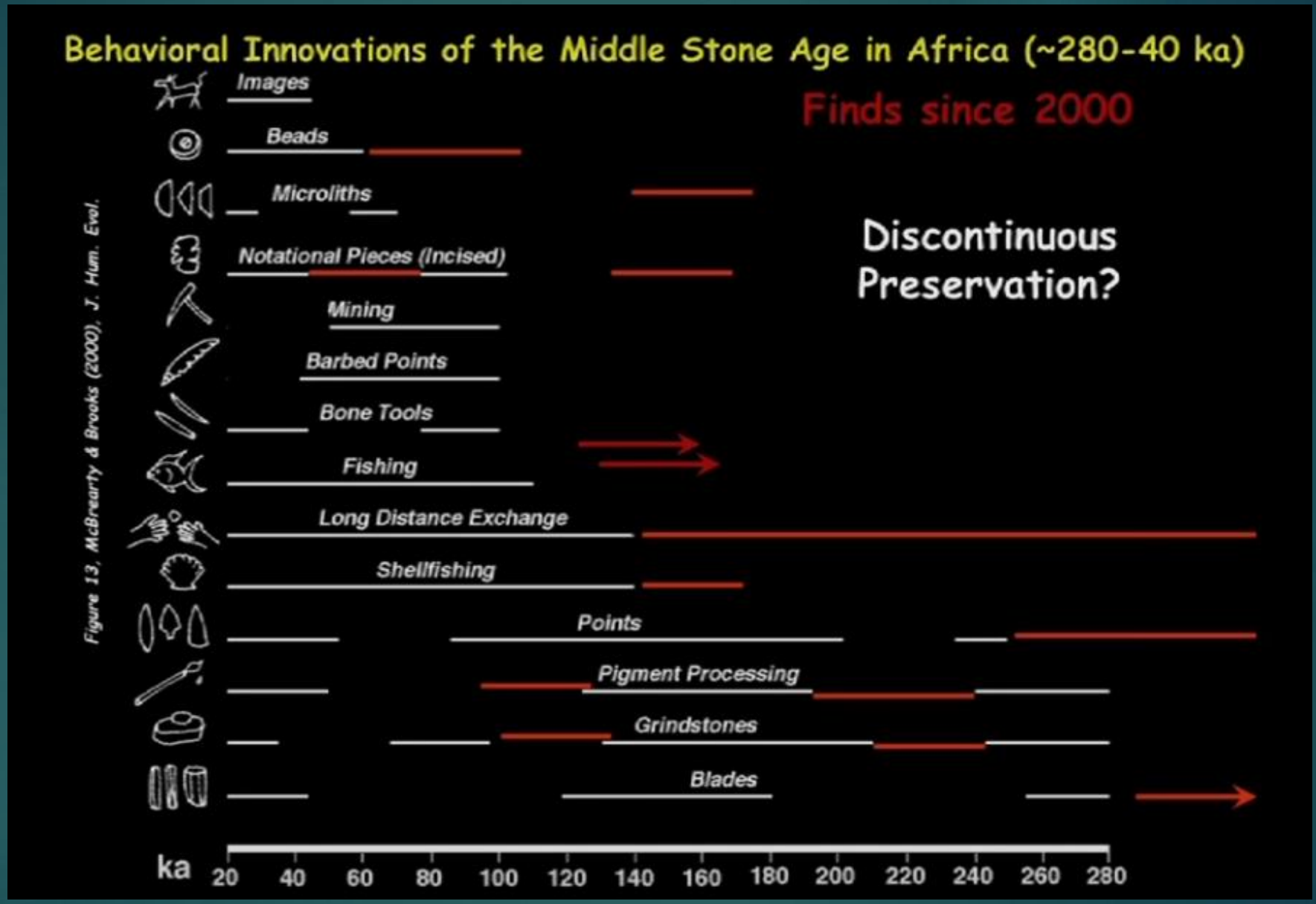
280 to 20 Ka
In Africa

Painting
Images not
until 40 ka,
same as in
Europe



- Increasing innovation rates, no abrupt change:
- Bladelets are old;
- Balls of ochre, under a tuff dated to 340 K in Kenya;
- Hafted points, 260-235 Ka, long before found in European Mousterian;
- Long distance exchange has old antiquity in Africa;
- Exotic stone all over place after 500-400 K, not there in Acheulean;
- No moment of sudden revolution

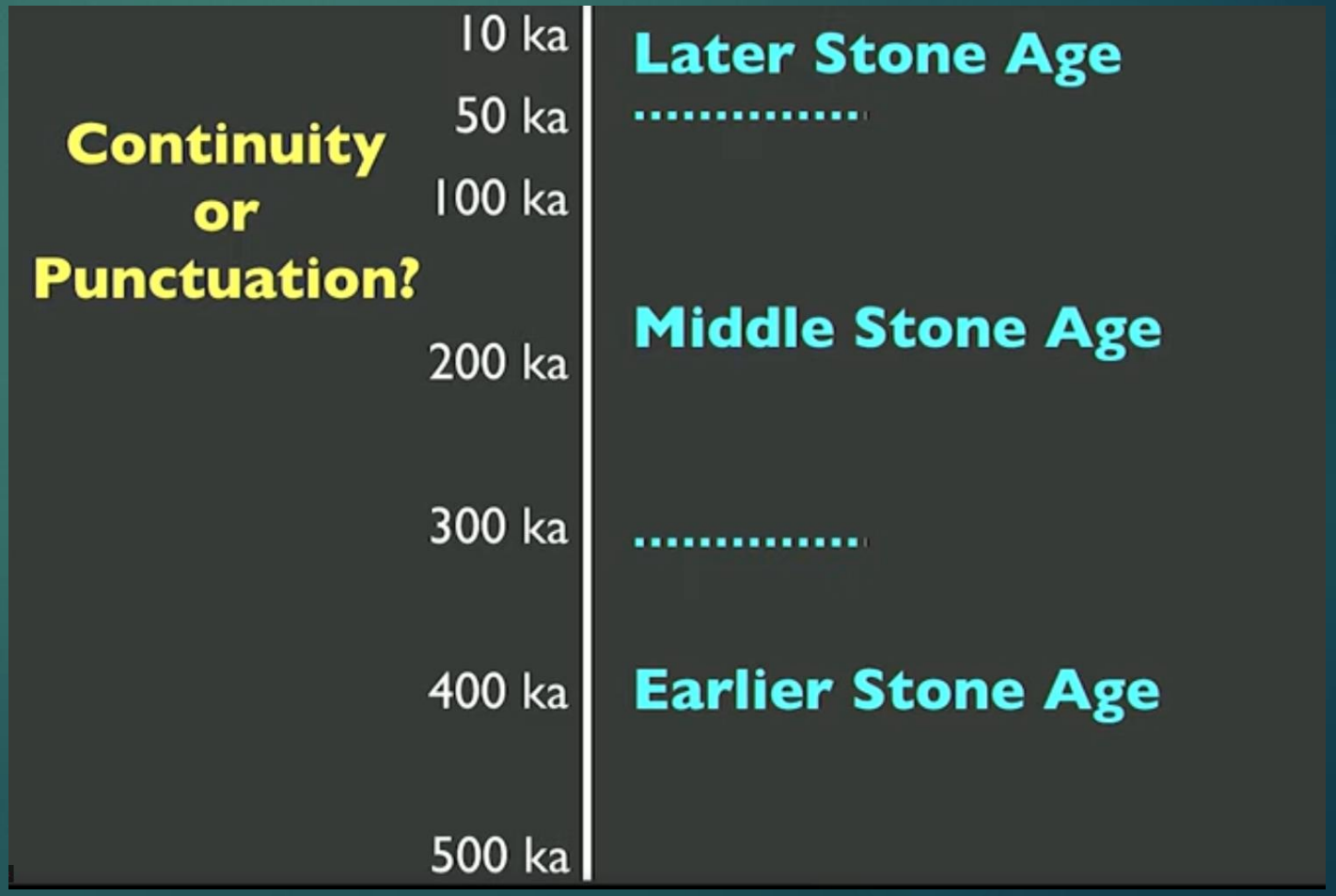
Before 2000, opinion that 280 Ka was beginning of MSA



Since 2000, evidence of much earlier findings, considerably before 280 Ka

Continuity or Punctuation in the African Archaeological Record

- Teresa Steele, Carta, 2020: evidence of complex cognition (language, symbolism, cumulative culture): continuity or punctuation, tempo of evolution

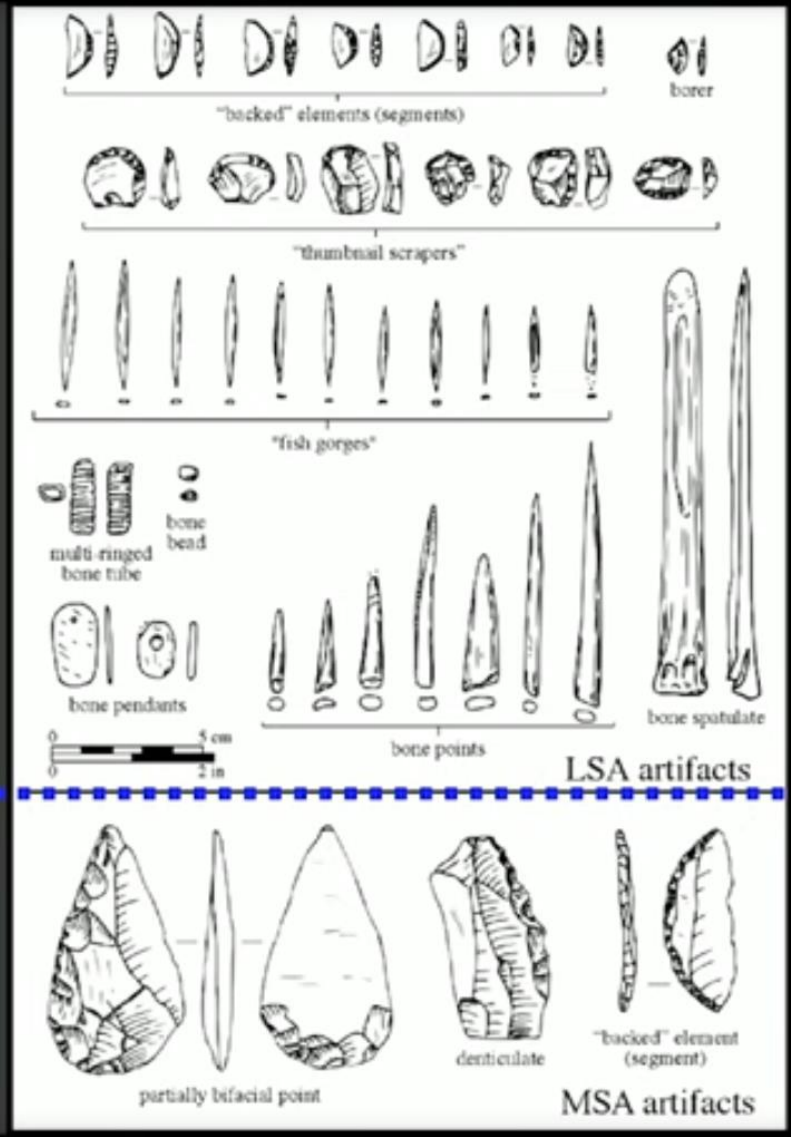


Continuity or Punctuation: MSA and LSA

tuation in the African Archaeological Record After 500000 Years Ago

Later Stone Age
(LSA)
Fully modern humans
~45 ka to recent

Middle Stone Age
(MSA)
Near or fully modern humans
~315 to ~40 ka



Klein w Edgar 2002

Klein model: 50 KA – MSA to LSA

Abrupt & Late Model

~ 50 ka

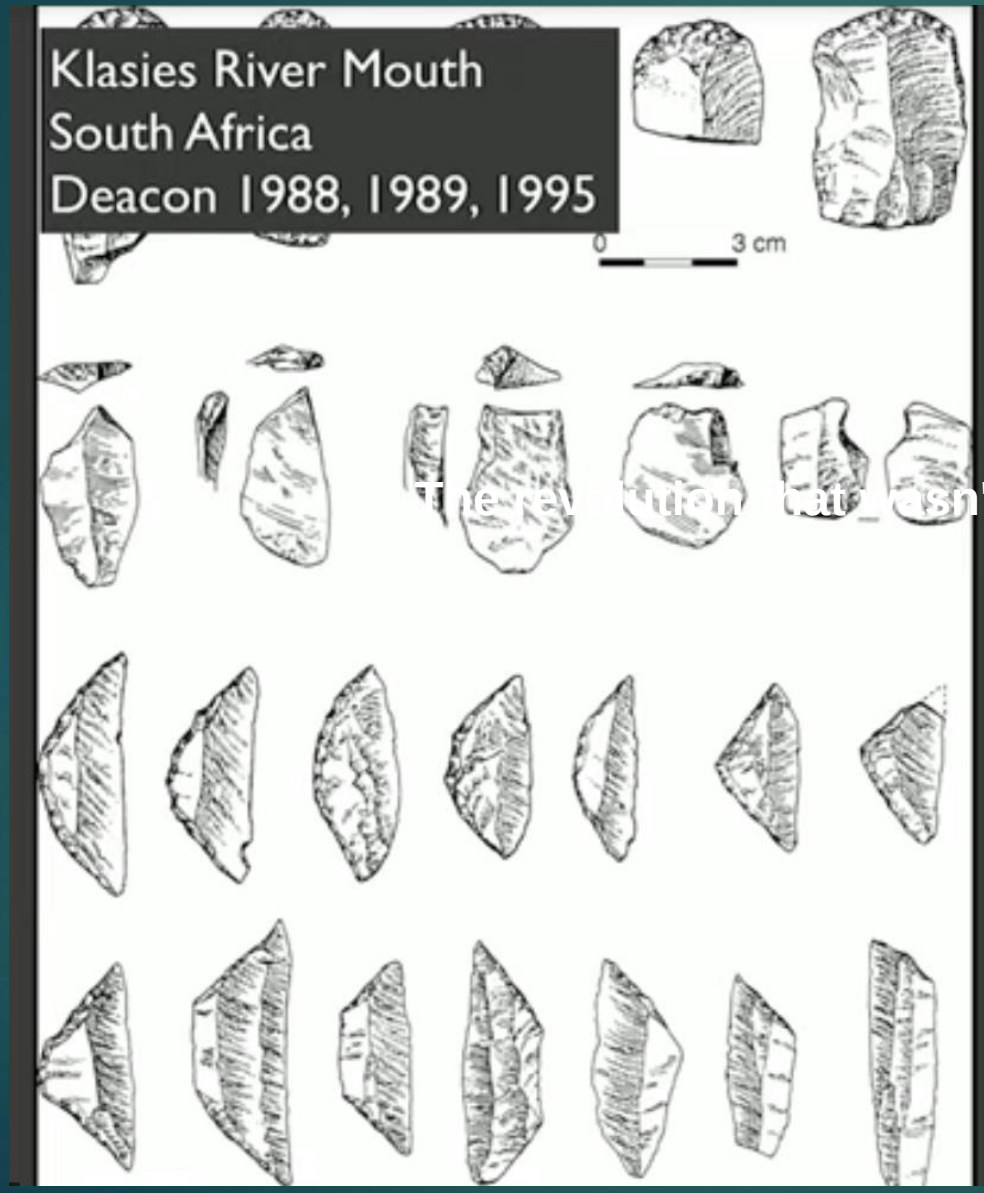
MSA to LSA

Punctuated Change

Genetic change

Technological, sociocultural, demographic change

MSA sites: complexity of tools and abundance of hearths



The revolution that wasn't

Howiesons Poort

OSL at numerous sites

~70-~55 ka

95% CI maximums of 3 models

71.3-54.4 ka

Jacobs and Roberts 2017

Sibudu
South Africa

Evidence of modern behavior in MSA: bone points

Bone barbed points

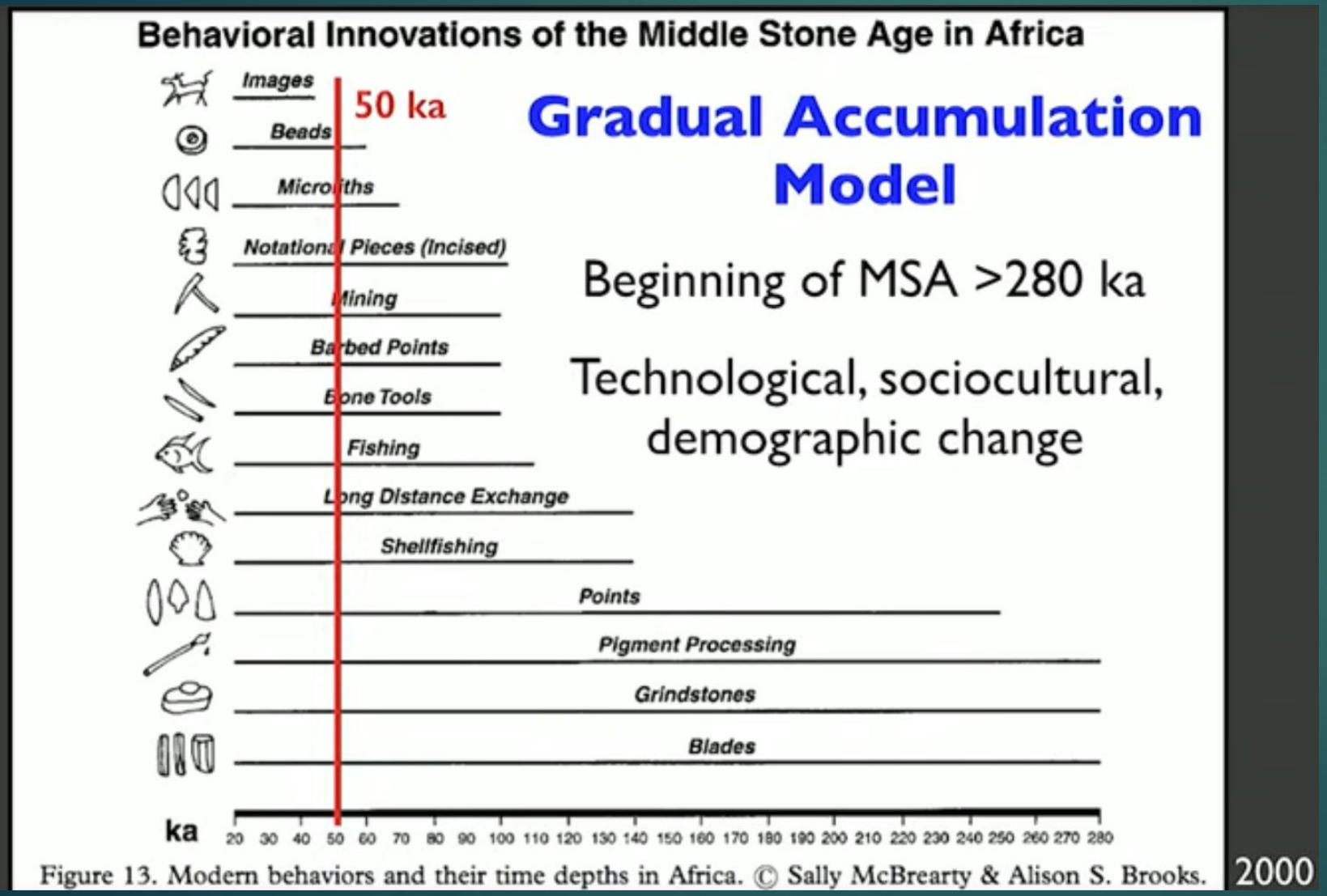
Katanda, DRC (Zaire)
~80 ka
Brooks et al. 1995
Yellen et al. 1995

Bone points

Blombos, South Africa
Still Bay: 78-72 ka
Henshilwood & Sealy 1997

Photos courtesy of the Blombos Cave Project
University of Bergen - Christopher Henshilwood

Gradual Accumulation Model of behavioral innovation



- > 280 Ka, beginning of MSA
- Intensification at 50 Ka due to population growth and environmental deterioration
- Lead to increased population density

Gradualist model supported by newer discoveries

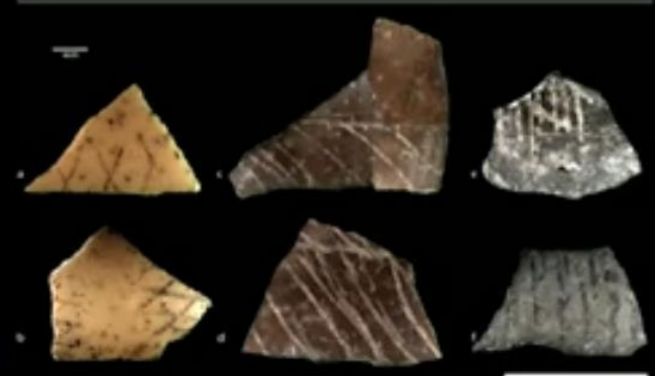
Engraved ochre
Perforated shells

Still Bay: 78-72 ka
Blombos, South Africa
Henshilwood et al. 2002
Henshilwood et al. 2004

Photos courtesy of the Blombos Cave Project
University of Bergen - Christopher Henshilwood

Engraved ostrich eggshell

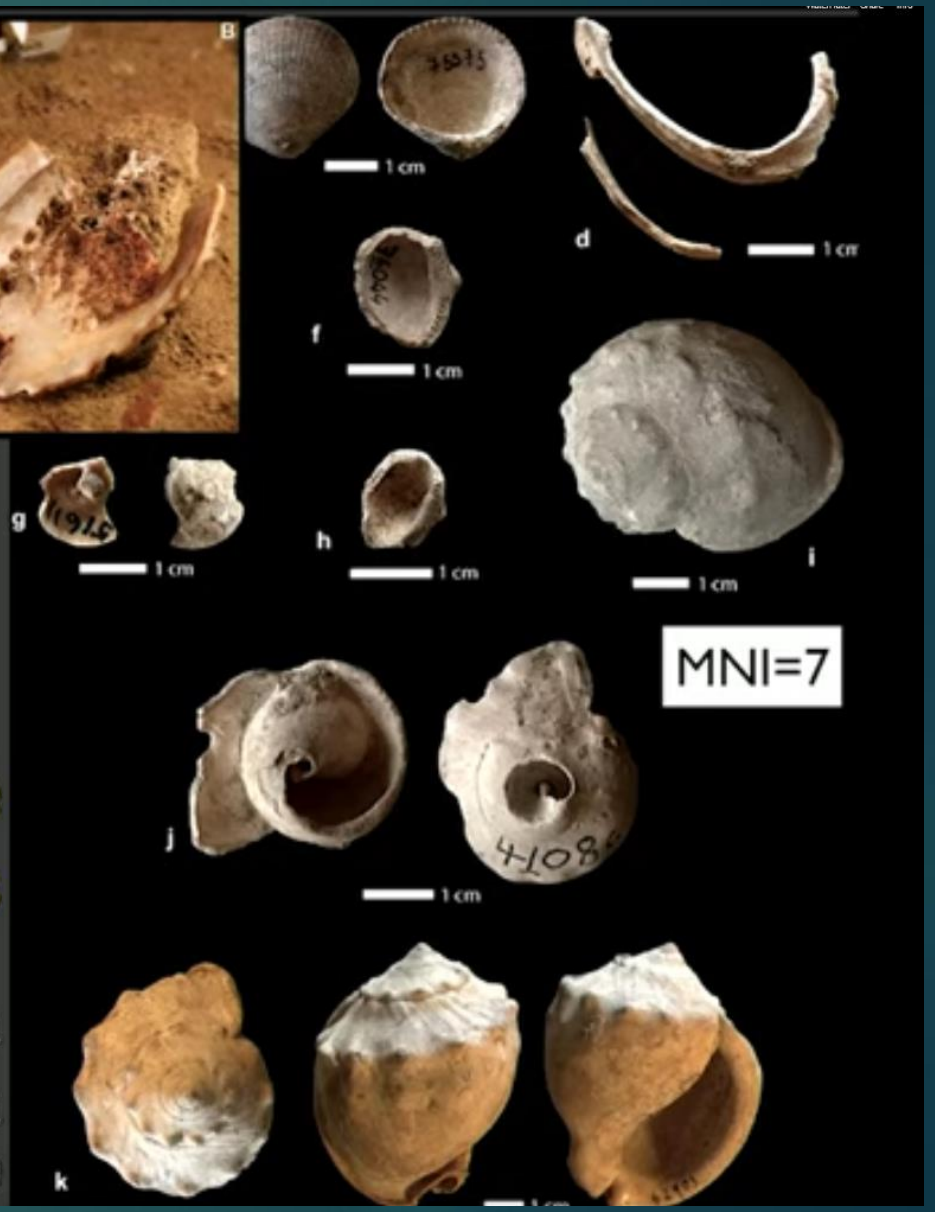
Howiesons Poort
Diepkloof, South Africa
Parkington, Texier et al. 2004, 2013
Klipdrift, South Africa
Henshilwood et al. 2014



How far back is this change in MSA?

Ochre processing kit

Blombos, South Africa
~100 ka
Henshilwood et al. 2011

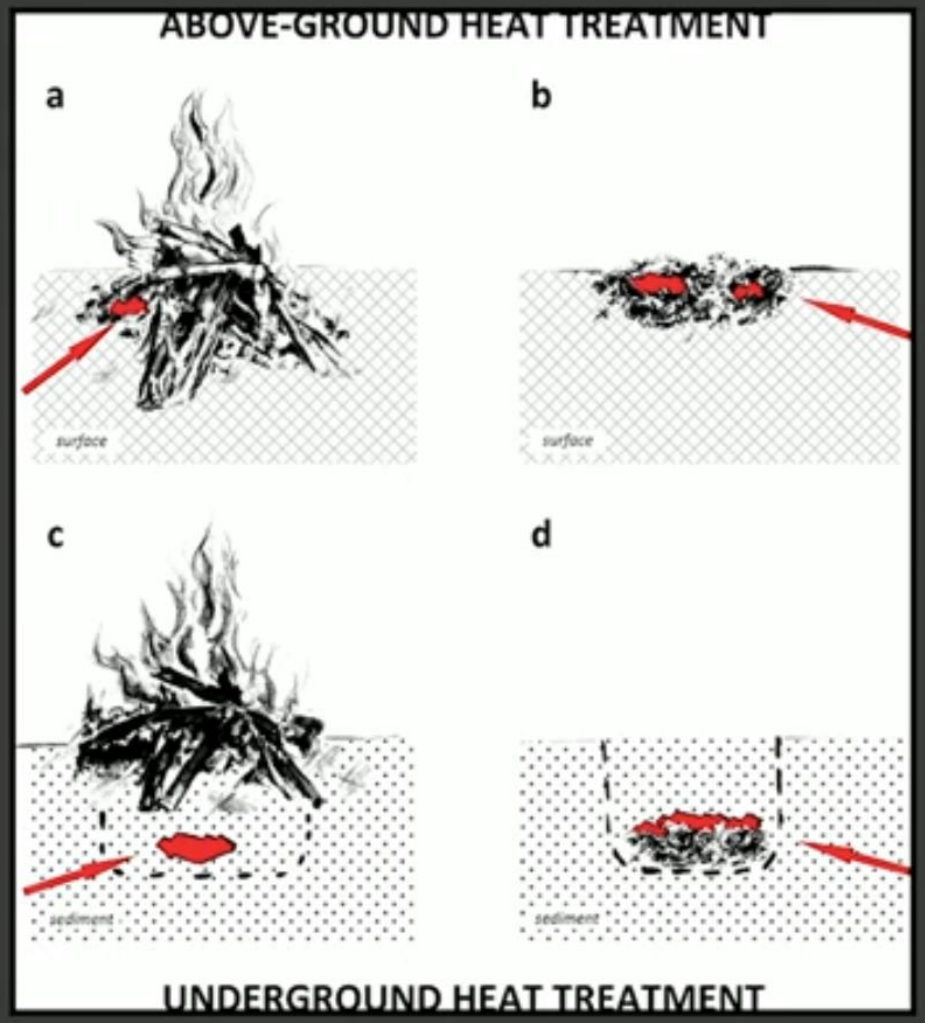


How far back within the MSA?

Ochre use
Collection of non-subsistence shells

Pinnacle Point 13B, South Africa
110-91 ka
Marean et al. 2007, Jerardino & Marean 2010

In last 10 years, other discoveries: earlier MSA use of heat treatment



Stolarczyk & Schmidt 2018

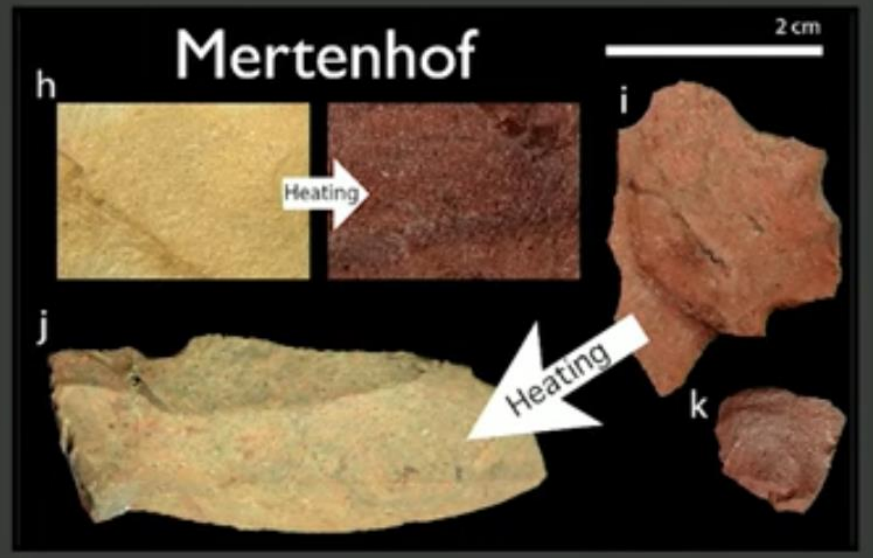
Heat treatment of silcrete

Pinnacle Point 13B & 5-6, South Africa

164 & 72 ka

Brown et al. 2009

& elsewhere



Schmidt & Mackay 2016

HOW BIG IS AFRICA?

Approximate Area in Square Miles

Africa	**11,668,545** (30,221,532 sq. km.)
China	3,681,089
Europe	3,979,405
USA	3,678,235
Total	**11,338,729** (29,367,308 sq. km.)

EUROPE
3,979,405 sq. mi.
(10,306,659 sq. km.)

(Alaska)

UNITED STATES
3,678,235 sq. mi.
(9,526,629 sq. km.)

CHINA
3,681,089 sq. mi.
(9,534,021 sq. km.)

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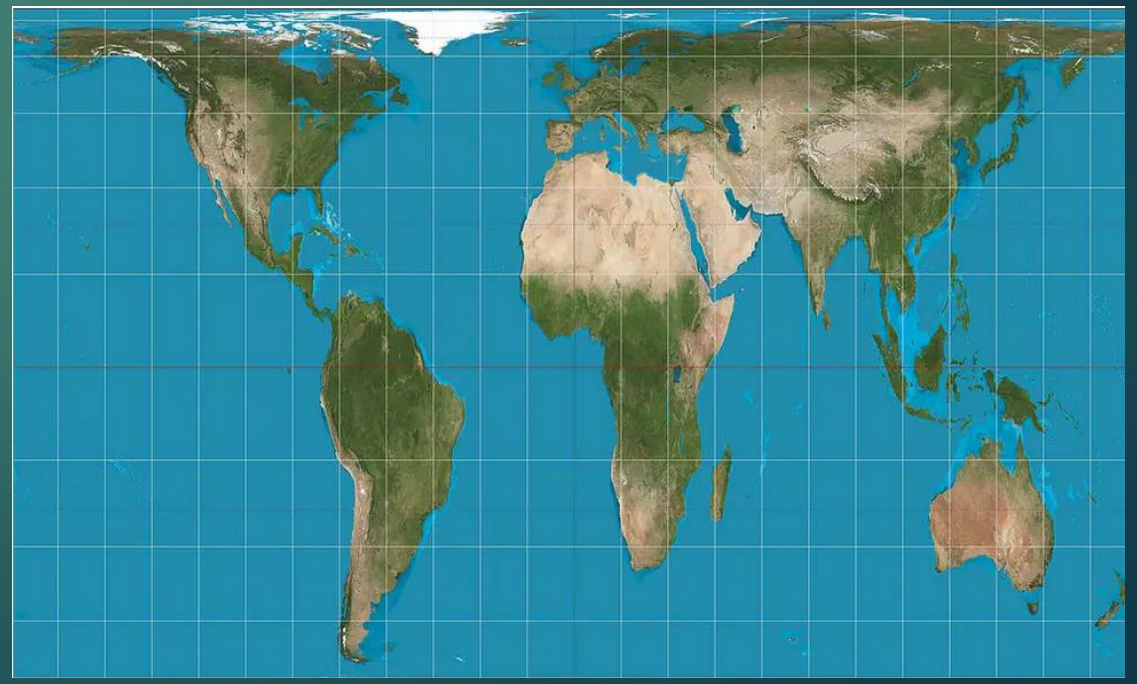
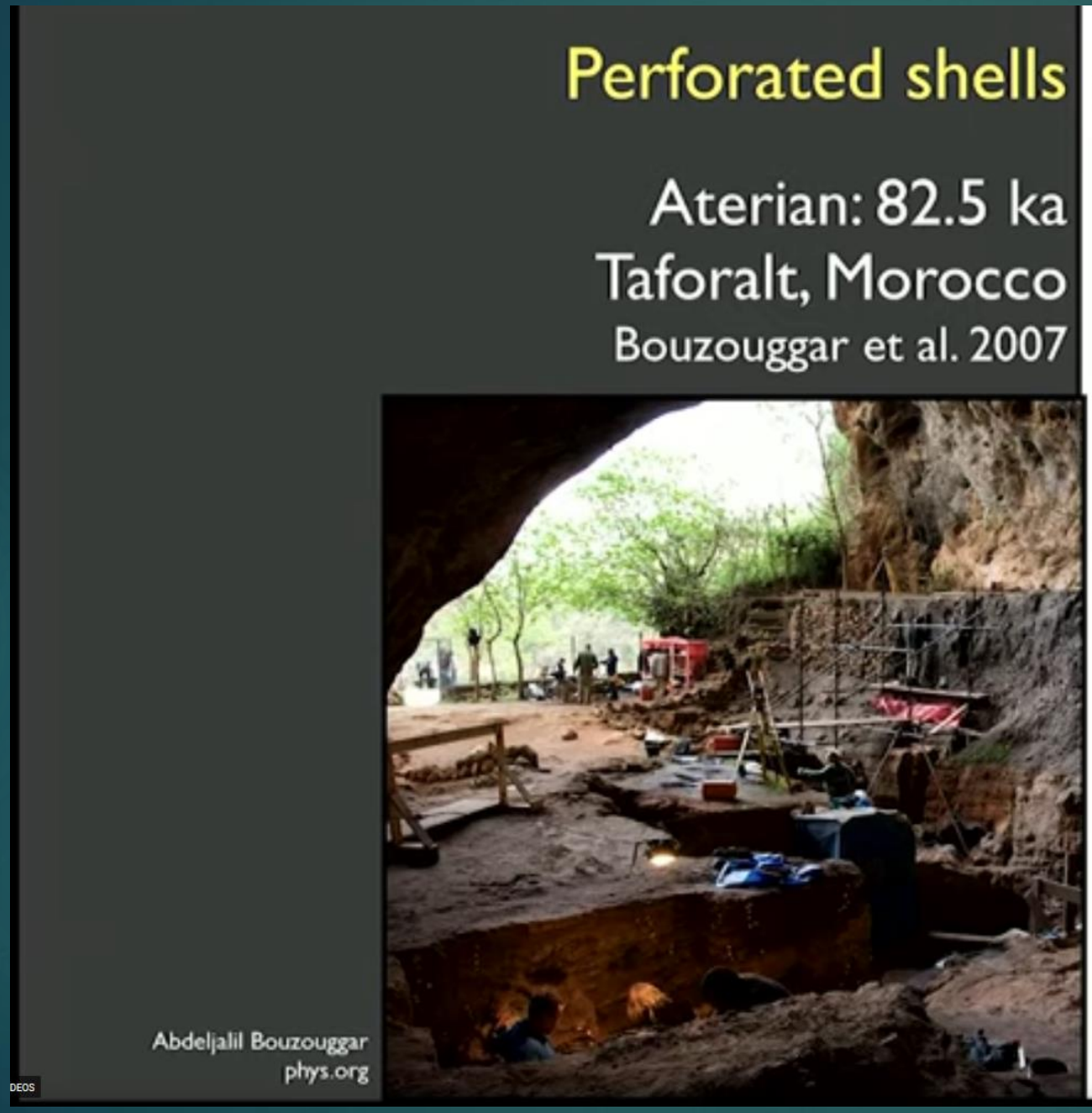
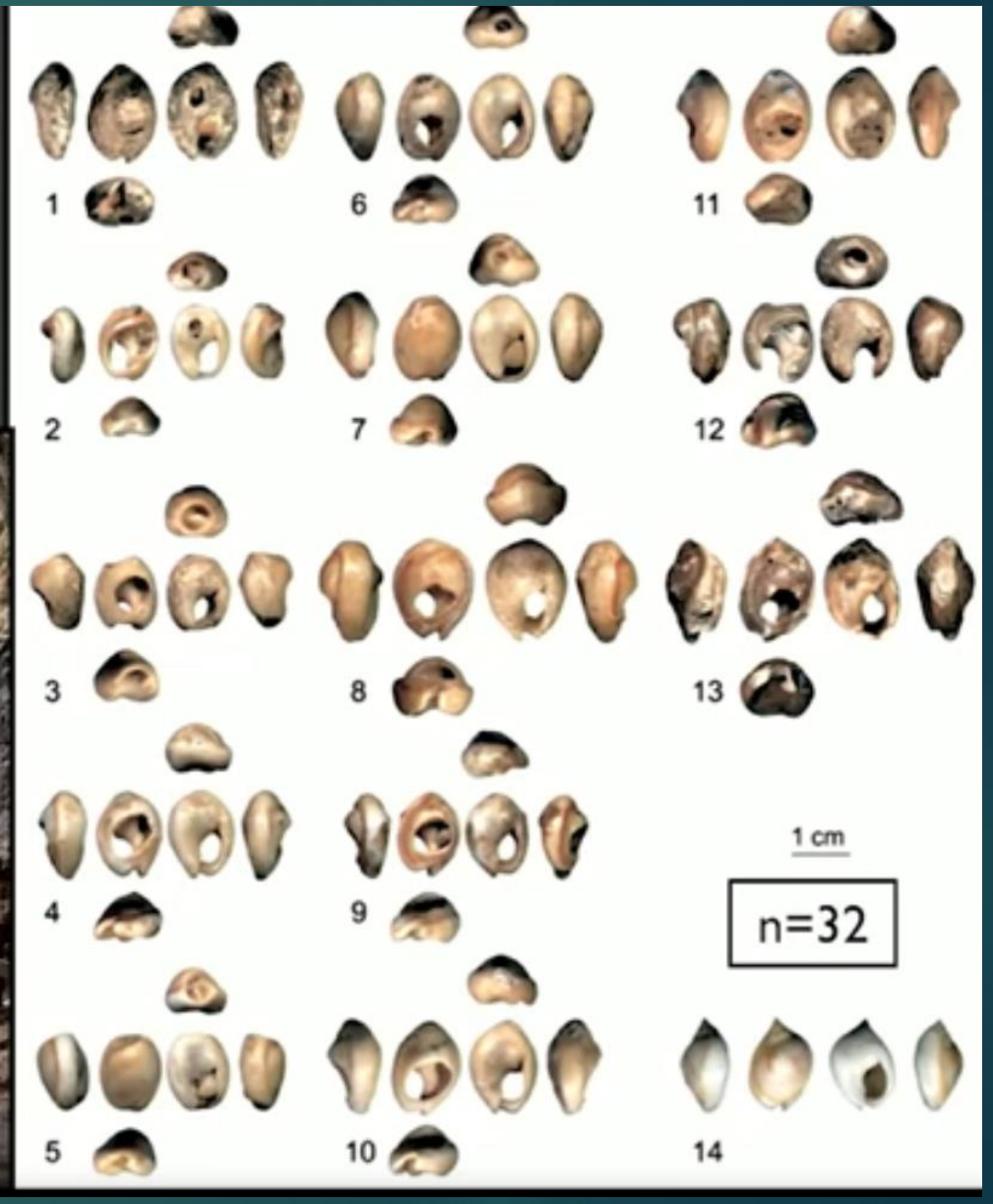
Fax: 617-353-4975
http://www.bu.edu/africa/outreach

Mollweide Equal Area Projection



Shells in Morocco and South Africa: unclear if independent invention or trade





Shells in Morocco: 115 Ka

Jebel Irhoud: Lower MSA -- no ochre, or engravings or shell ornaments

Jebel Irhoud, Morocco

315 ± 34 ka

Provides lower boundary for MSA
Levallois technology
Fire
- -Heated lithics
- -Charcoal

Hublin et al. 2017
Richter et al. 2017

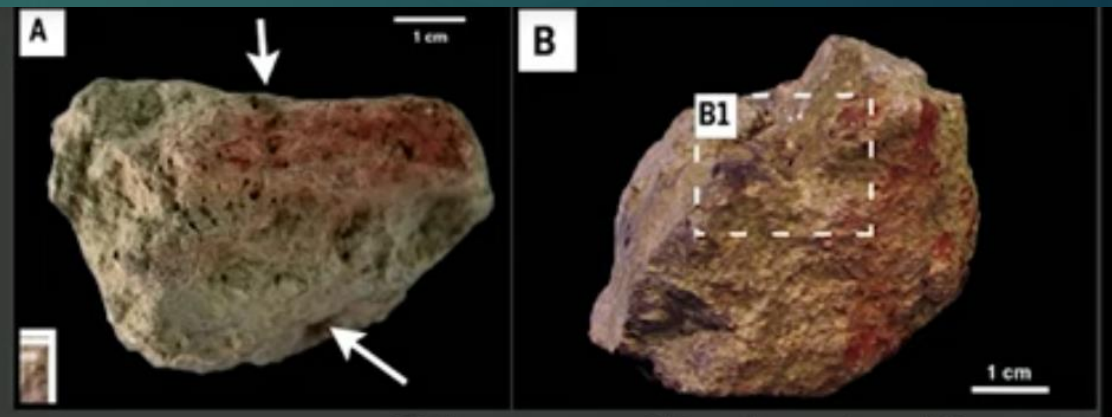
Continuity from late Earlier Stone age to early MSA; but no heating or ornamentation

10 ka
50 ka
100 ka
200 ka
300 ka
400 ka
500 ka

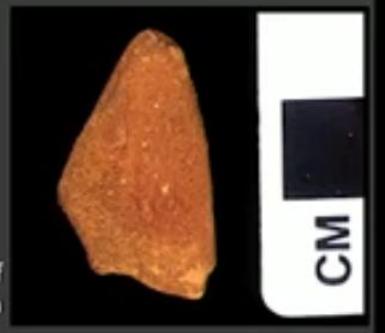
Later Stone Age

Middle Stone Age

Earlier Stone Age



Olorgesailie basin, Kenya
early MSA: ≥295 to ~320 ka
Brooks et al. 2018



Courtesy of
Richard G. Klein

Duinefontein 2, South Africa
late ESA: 292±55 ka
Feathers 2002; Cruz-Uribe et al. 2003

LSA: Border Cave is exception for evidence of perforated shells, engravings, bone points

10 ka

Later Stone Age

50 ka

100 ka

200 ka

Middle Stone Age

300 ka

400 ka

Earlier Stone Age

500 ka

Perforated shells
Ostrich eggshell beads
Bone points & tools

Border Cave, South Africa
early LSA: 44.2-42.5 ka
Villa et al., d'Errico et al. 2012

Archaeological evidence for complex cognition in the Middle Stone Age of South Africa – Lyn Wadley

- What is complex cognition?
  In the simplest terms complex cognition implies the ability to think in the way that we do today

- What is the Middle Stone Age?
  Industries appearing with the earliest anatomically modern humans about 300,000 years ago

Complex cognition includes these attributes:

- □ the use of symbols,
- □ planning for remote action,
- □ the practice of delayed gratification (response inhibition)
- □ the ability to multi-task,
- □ the ability to be flexible in problem solving
- □ understanding technological transformation,
- □ the use of analogical reasoning

- The attributes are likely to have been incremental

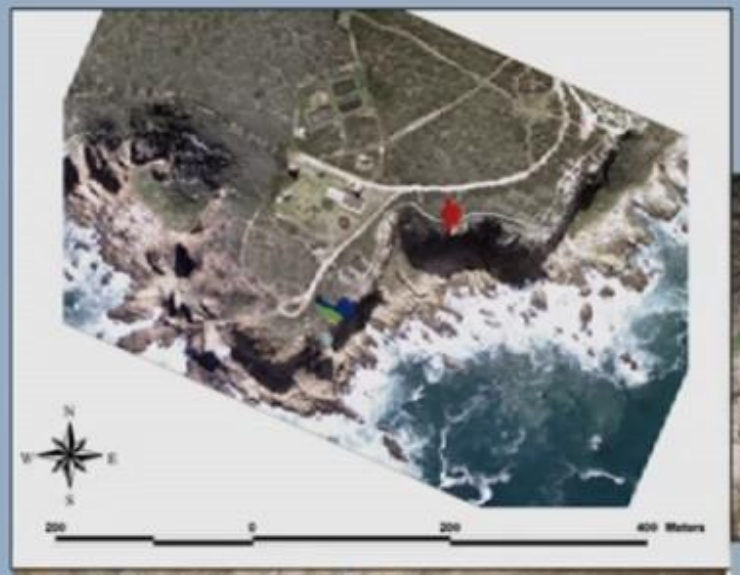
Amati and Shallice 2007; Barnard 2010; Mithen 1996; Wynn and Coolidge 2003

Blombos

photos by Henshilwood

100 Ka

Pinnacle Point



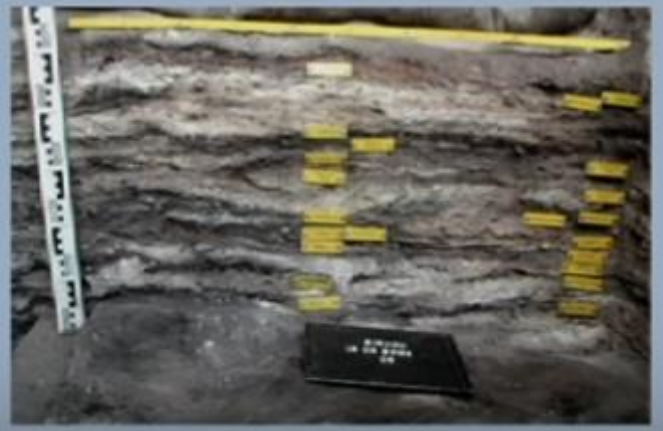
photos by Marean

160 Ka

It is inland,
not coastal

Sibudu

photos by Wadley

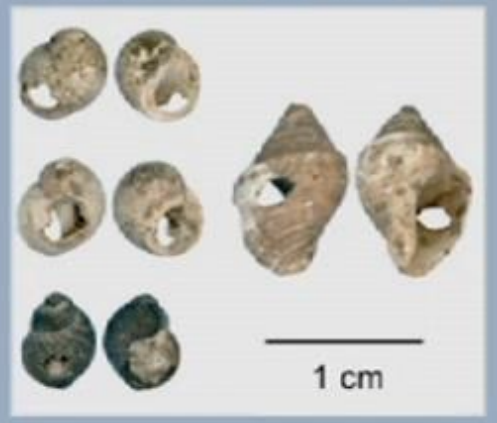


15 km inland

77 Ka

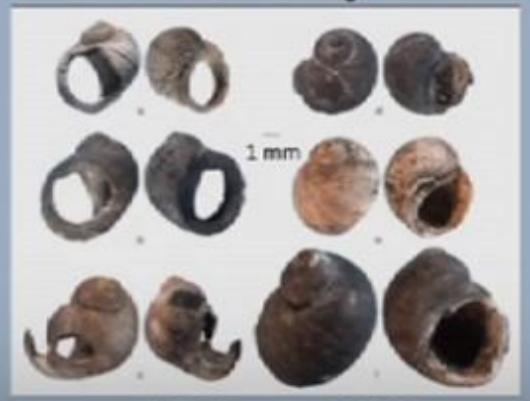
Shells at 71 Ka

Introduction of ornamentation – perforated shells: markers of self or group identity (symbolism)



Sibudu

Afrolittorina and whelk shells about 71,000 years ago



d'Errico *et al.* 2008

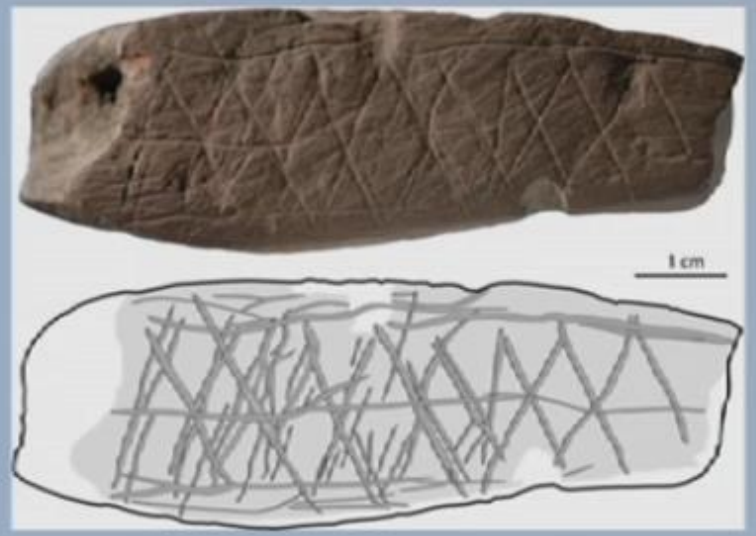
Blombos

Nassarius shells about 71,000 years ago

d'Errico *et al.* 2003

Engraved ochre: markers of self or group identity

Blombos



about 75,000 years ago

about 100,000 years ago

photos from Henshilwood *et al*. 2009

Sibudu

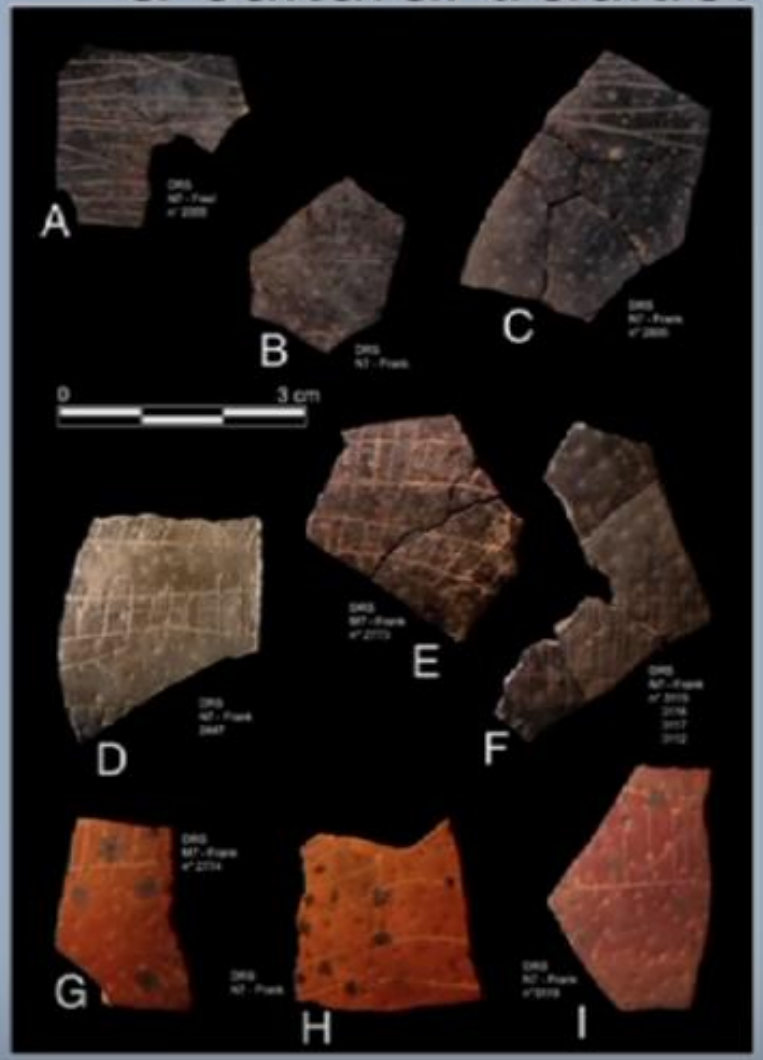
about 77,000 years ago

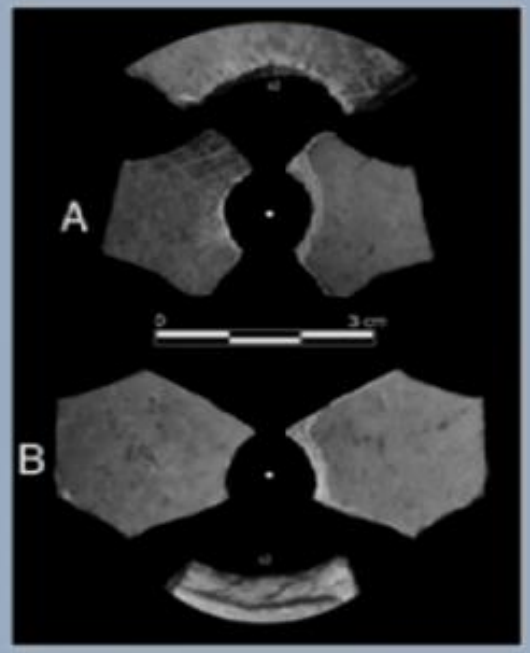
photo from Hodgskiss 2012

Cultural:

100s of Eggshell engravings

Engraved ostrich eggshell water bottles: a cultural tradition





Perforated eggshells

Diepkloof Rock Shelter
+/- 100,000 years ago

photos from Texier *et al.* 2010

Like KhoeSan of Kalahari today

ostrich eggshells used as water bottles

(photos by Bannister)

The most compelling evidence for complex cognition comes from everyday tasks like snaring

Evidence for snaring

- At Sibudu, a South African Middle Stone Age site, snares or other non-selective capture techniques may have been used during the Howiesons Poort and perhaps also the Still Bay Industry.

- The circumstantial evidence consists of
  - 1. high frequency representations of animals that prefer forested environments, including the tiny blue duiker (adult and juvenile) and the dangerous bushpig,
  - 2. high frequencies of small mammals,
  - 3. high taxonomic diversity and,
  - 4. the presence of small carnivores.

Introduction of compound adhesives: the manufacturing process involves advanced planning and multi-tasking

Experiments to transform ochre and *Acacia* gum into compound adhesive

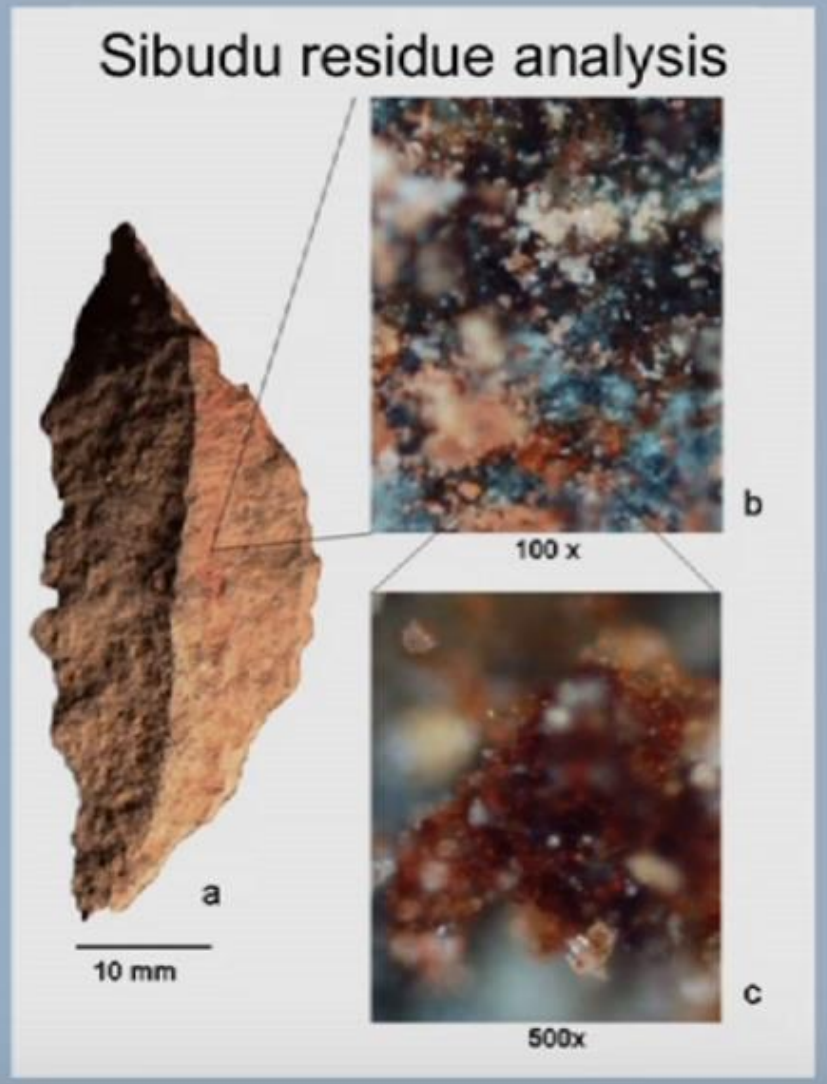
pH increases as part of the chemical change

Both ochre and Acacia gum have to be collected.

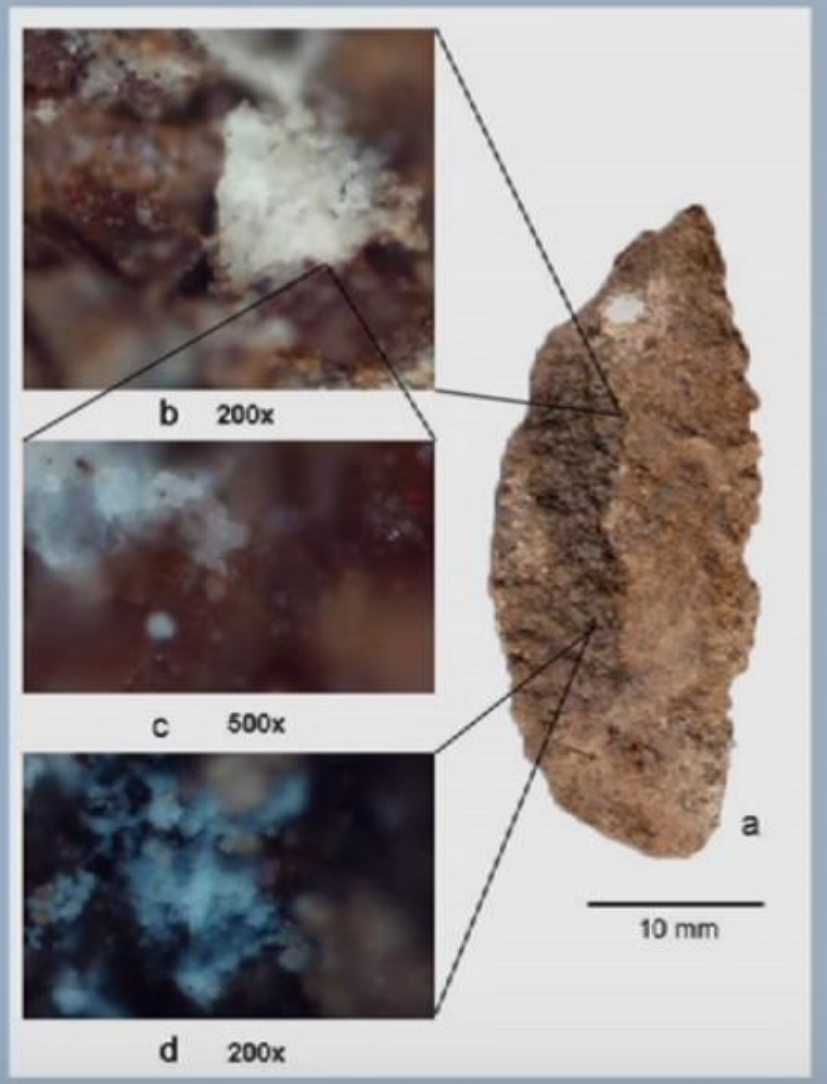
No cake recipe: must adjust to consistencies of both

Once hafted, must dehydrate with firebrand to solidify

Compound adhesives at Sibudu by 71,000 years ago



ochre and plant gum



black fat

Different recipes

Introduction of compound paint

Haliotis shells

Photos from Henshilwood *et al.* 2011

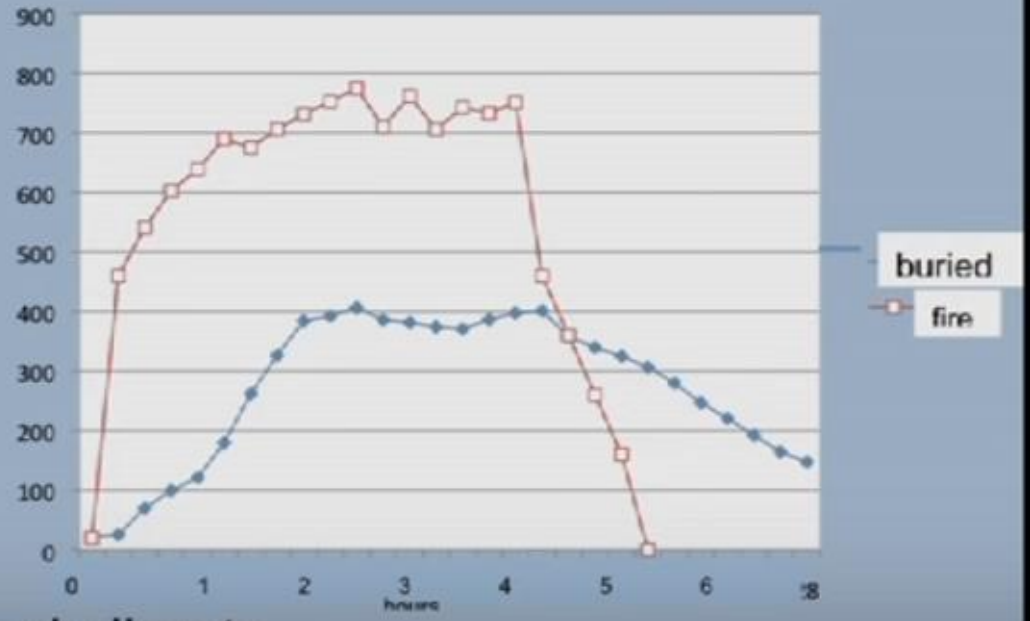
BLOMBOS 'ochre processing workshop' ~100,000 years ago

Paste of ochre, charcoal, crushed fatty bone, quartz grains and an unknown liquid

Heat treating rocks: analogical reasoning

fractured silcrete

experimental fire: above and below ground temperatures, °C



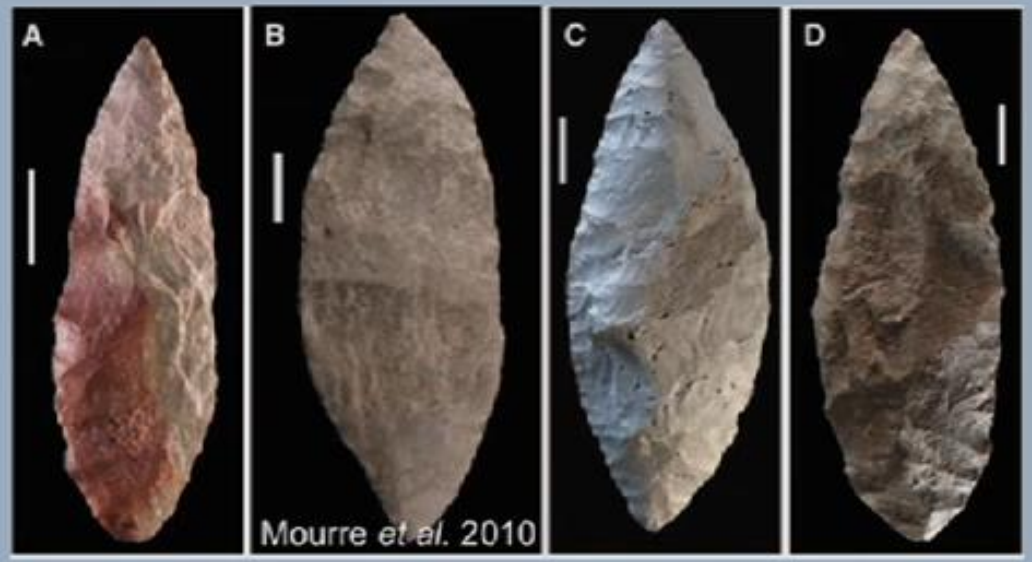
Only silicate that was buried below (vs above) ground did not fracture

Red = temperature of fire

Blue = temperature of buried silicate (300-400 degrees); Becomes more fine grained as loses water

Analogical: must control above ground fire temp

Silcrete heat treatment at Blombos and Pinnacle Point



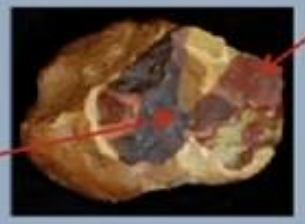
Blombos
71,000 years ago

A & B archaeological; C & D experimental

Pinnacle Point
164,000 years ago

heat-treated biface.

Brown et al. 2009

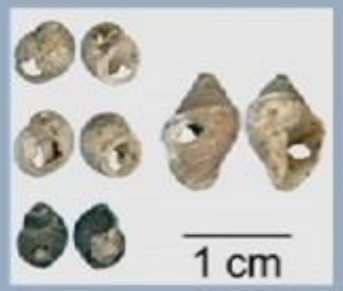


experimentally heated silcrete
knapped by Kyle Brown

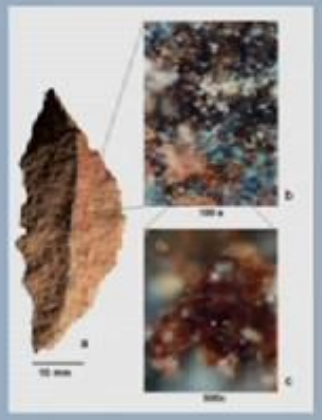
When heated and struck, flack is shiny

Summary: evidence for selected attributes of complex cognition in the Middle Stone Age

- symbolism expressed through group or individual identity



- long-term planning for remote action
- response inhibition



- multi-tasking
- the ability to be flexible in problem-solving

- the concept of transformation (irreversible change)
- the use of analogical reasoning

Newer Human Revolution model

- Between the two models presented above is the newer view – currently supported by archaeologists Chris Henshilwood, Curtis Marean,[Ian Watts and others – that there was indeed some kind of 'human revolution' but that it occurred in Africa and spanned tens of thousands of years.

- The term "revolution" = mean not a sudden mutation but a historical development along the lines of "the industrial revolution" or "the Neolithic revolution".

Newer Human Revolution model

- In other words, it was a relatively accelerated process, too rapid for ordinary Darwinian "descent with modification" yet too gradual to be attributed to a single genetic or other sudden event.

- These archaeologists point in particular to the relatively explosive emergence of ochre crayons and shell necklaces apparently used for cosmetic purposes.

- These archaeologists see symbolic organization of human social life as the key transition in modern human evolution.

Newer Model

- Pinnacle Point, in particular, shows exploitation of marine resources as early as 120 Ka, perhaps in response to more arid conditions inland.
- Establishing a reliance on predictable shellfish deposits, for example, could reduce mobility and facilitate complex social systems and symbolic behavior.
- Blombos Cave and Site 440 in Sudan both show evidence of fishing as well. Taphonomic change in fish skeletons from Blombos Cave have been interpreted as capture of live fish, clearly an intentional human behavior.
- Humans in North Africa (Nazlet Sabaha, Egypt) are known to have dabbled in chert mining, as early as ≈100,000 years ago, for the construction of stone tools.

Newer model

- Evidence was found in 2018, dating to ~ 320,000 years ago, at the Kenyan site of Olorgesailie, of long-distance trade networks (involving goods such as obsidian), the use of pigments, and the possible making of projectile points.
- The evidence of these behaviors is approximately contemporary to the earliest known *Homo sapiens* fossil remains from Africa (such as at Jebel Irhoud and Florisbad), and they suggest that complex and modern behaviors had already begun in Africa around the time of the emergence of anatomically modern *Homo sapiens*.
- In 2019, further evidence of early complex projectile weapons in Africa was found at Aduma, Ethiopia, dated 100,000-80,000 years ago, in the form of points considered likely to belong to darts delivered by spear throwers.
- Olduvai Hominid 1 (12 Ka) wore facial piercings (rubbed vs incisors).

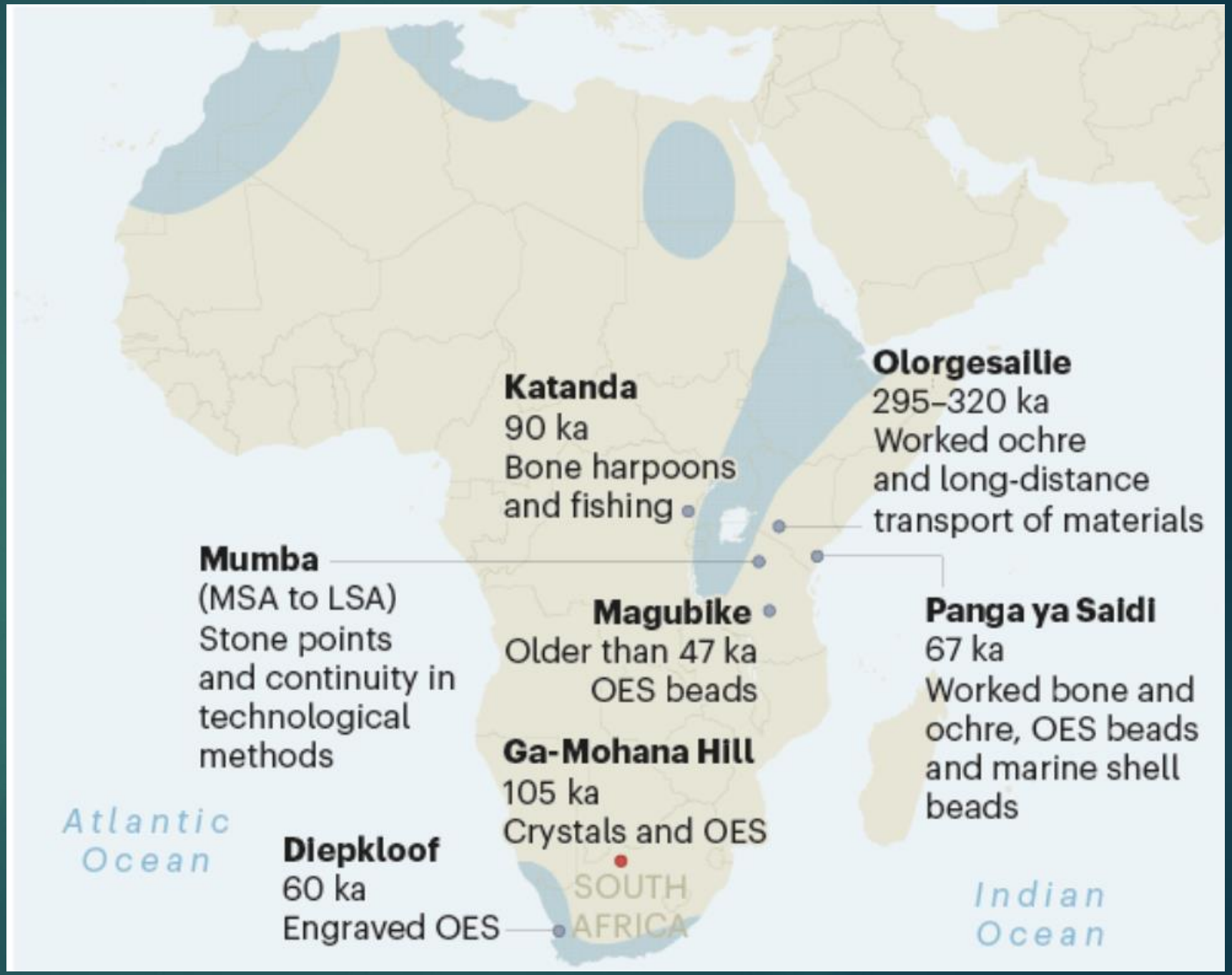
AMH and BMHs from 200 Ka

- 2021 study: Key sites associated with modern human fossils in Africa were re-dated, and at some early sites, innovative MSA technologies were found.
- This suggested that Africans ~ 200 Ka, and perhaps earlier, were already modern, both anatomically and culturally.
- But, generally, they relied mainly on the same kind of flaked stone tool that their hominin cousins, the Neanderthals and Denisovans, were producing at the same time in Eurasia.
- In sub-Saharan Africa, this technology is referred to as Middle Stone Age (MSA). In Eurasia and northern Africa, similar types of artefact belong to what is termed the Middle Palaeolithic. Both industries date to between around 300,000 and 30,000 years ago.

Pamela R. Willoughby, 2021

Some African MSA archaeological sites

OES = ostrich egg



Some African MSA archaeological sites

- Certain mostly coastal regions have a long history of excavations that have shed light on the evolution of early human populations.
- By contrast, the named inland sites have been investigated only during the past three decades.
- These inland studies have revealed notable technological innovations during the Middle Stone Age (MSA), which occurred between 300 & 30 Ka.
- Wilkins *et al*. report the discovery of ostrich eggshell (OES) fragments and crystals in a rock shelter at Ga-Mohana Hill, which suggests that humans collected unusual objects by at least 105 ka.
- MSA innovations were varied and variable, in time and space

J. Hublin: Evolution continues

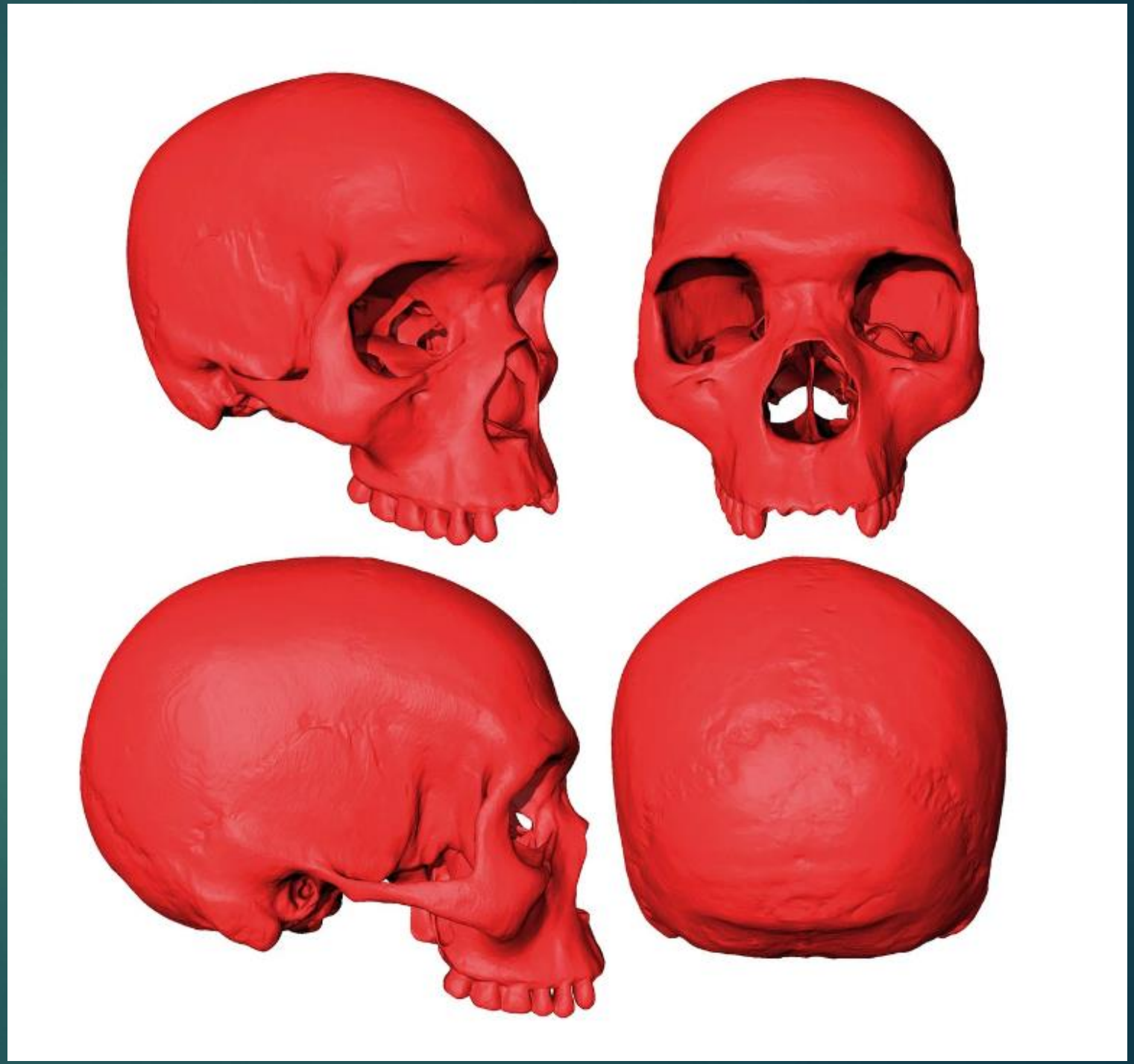
- MHs in Africa were not the MHs of today or of MHs of Europe during N period; early MHs in Eurasia were archaics, and not so different from Ns
- Changes in Parietal and cerebellum
- Changes in WM and neurodevelopment
- Changes in gene expression

*** Fossil Evidence for Human Origins in Africa

African late MP hominin diversity and the origin of our species – A. Mounier and Marta Mirazón Lahr, 2019

- A phylogenetic modelling method to predict possible morphologies of a last common ancestor of all modern humans, which we compare to LMP African fossils (KNM-ES 11693, Florisbad, Irhoud 1, Omo II, and LH18).
- Our results support a complex process for the evolution of *H. sapiens*, with the recognition of different, geographically localized, populations and lineages in Africa – not all of which contributed to our species' origin.
- Based on the available fossils, H. sapiens appears to have originated from the coalescence of South and, possibly, East-African source populations, while North-African fossils may represent a population which introgressed into Neandertals during the LMP.
- High level of phenotypic diversity in the LMP African hominin record

A computer reconstruction of a skull that may have belonged to the earliest common ancestor of living humans.
~300 Ka;
similar to fossils of about the same age found in East Africa and South Africa.
The scientists propose that modern humanity arose through a merging of populations in these two regions.



A. Mounier and Marta Mirazón Lahr, 2019

- Current genomic data point towards a southern or an eastern African origin, or one across an east-south African cline; paleoanthropology suggests a northern, or eastern African origin.

- Our results tend to support a complex evolutionary pattern that may have involved different source populations, possibly including south and east African groups as it has been recently advocated through genomics.

- Both the Southern African fossil Florisbad, and the Eastern African specimens KNM-ES 11693 and Omo II show similarities with the vLCAs and early H. sapiens

A. Mounier and Marta Mirazón Lahr, 2019

- The speciation process appears to have been complex, going through different phases that may not have contributed to the genetic and phenotypic structure of current modern human populations.
- A first stage of phenotypic diversification, from 350 to 200 ka, different contemporary populations forming local morphs of pre-*Homo sapiens* groups as they are represented in the LMP fossil record.
- This phase may have been followed by a period of fragmentation and differential expansion of populations leading to hybridization and coalescence of groups, which could have resulted in the emergence of morphologically derived populations of anatomically modern humans between 200 to 100 ka, as exemplified by the fossils from Herto, Skhūl and Qafzeh.

A. Mounier and Marta Mirazón Lahr, 2019

- It is unlikely that all LMP local populations would have contributed equally, or at all, to the lineage that gave rise to the population ancestral to *H. sapiens*.

- Local extinctions and founder effects would have shaped considerably the emergence of anatomically modern humans.

- This may indicate that chronologically older fossils of anatomically modern H. sapiens, representing populations which outlived most of the LMP hominin groups, are yet to be found.

Late MP skulls in Africa

- All LMP African fossils show a mosaic of derived and archaic characters. For instance, the Jebel Irhoud remains were originally described as showing strong similarities with Neandertals, while the study of the new Irhoud remains emphasizes their affinities with *H. sapiens*, despite the absence of key modern humans apomorphies (i.e., tall and globular vault, and inverted T chin). Have low vault and no chin.
- The Guomde, Ngaloba, Eliye Springs and Florisbad specimens along with Omo II and possibly the pathological Singa calvarium, have been mostly referred to as 'archaic *H. sapiens*'.
- This situation challenges any attempt at identifying the ancestral population, or populations, of modern humans.

Late MP skulls in Africa

- Derived cranial features of *H. sapiens* are fully displayed in the digital vLCAs—a domed neurocranium, a reduced face and a marked basicranial flexion, and only partly balanced by more archaic features.

- The African LMP fossil mosaic morphologies combine archaic and modern characters, and the first occurrence of a full modern morphologyis not documented before Omo I (195 ka) and the Herto BOUVP16/1 specimen (160 ka).

Mounier, 2019: Late MP skulls in Africa

- Given the complexity of the morphological variation within the genus Homo during the African LMP, it is likely that some LMP African fossils were not associated with any population ancestral to H. sapiens.

- The speciation process for *H. sapiens* appears to have been complex, going through different phases that may not have contributed to the genetic and phenotypic structure of current modern human populations.

- C. Stringer, J. Hawks and J. Hublin no longer believe that *H. heidelbergensis* is ancestral to *H. sapiens* in Africa*:* Date of Irhoud 1 at 315 Ka raises big issues

MSA and LSA
African Fossil Skull Review,
350 to 12 Ka

Chris Stringer: The origin and evolution of *Homo sapiens*

- If we restrict the use of Homo sapiens in the fossil record to specimens which share a significant number of derived features in the skeleton with extant H. sapiens,
  - the origin of our species would be placed in the African late middle Pleistocene,
  - based on fossils such as Omo Kibish 1, Herto 1 and 2, and the Levantine material from Skhul and Qafzeh.

- However, genetic data suggest that we and our sister species Homo neanderthalensis shared a last common ancestor in the middle Pleistocene approximately 400–700 ka, which is at least 200 000 years earlier than the species origin indicated from the fossils just mentioned.

Chris Stringer, 2016

The origin and evolution of *Homo sapiens*

- Thus, it is likely that the African fossil record will document early members of the sapiens lineage showing only some of the derived features of late members of the lineage.
- Stringer argues that human fossils such as those from Jebel Irhoud, Florisbad, Eliye Springs and Omo Kibish 2 do represent early members of the species,
  - but variation across the African later middle Pleistocene/early Middle Stone Age fossils shows that there was not a simple linear progression towards later sapiens morphology, and there was
  - chronological overlap between different ‘archaic’ and ‘modern’ morphs.

The origin and evolution of Homo sapiens

- Even in the LSA within and outside Africa, we find H. sapiens specimens which are clearly outside the range of Holocene members of the species, showing the complexity of recent human evolution.

- Extant H. sapiens share specific morphological traits: high neurocranium, rounded in lateral profile, a small face retracted under the frontal bone, a true chin even in infants, small discontinuous supraorbital tori, a lengthened post-natal growth period and life history, and a narrow trunk and pelvis with short superior pubic rami.

The origin and evolution of Homo sapiens

- In addition, distinctive morphologies of elements of inner ear anatomy are being increasingly well characterized in H. sapiens.

- In the cranial vault, the shape of the parietal region in H. sapiens seems particularly distinctive and makes a significant contribution to globularity in both lateral and occipital views

Origin of *H. sapiens*

- A second major question concerns the mode of evolution of the species H. sapiens—whether this was relatively punctuational or gradual.
- The subsequent European record had indicated a gradual, though not always precisely ordered, accretion of further Neanderthal synapomorphies
- A third question is the nature of the last common ancestor (LCA) of the sapiens and neanderthalensis lineages, and when that LCA lived.
- Since 1983, Stringer has built the case that shape resemblances between the Broken Hill and Petralona crania indicate the existence of a widespread middle Pleistocene population which can be called Homo heidelbergensis if the Mauer mandible is also included, or H. rhodesiensis if it is not.

The origin and evolution of Homo sapiens

- He has argued that this species represents the most reasonable LCA for the neanderthalensis and sapiens lineages, with their common origin placed at about 400 ka based on the estimated mtDNA coalescence date of the two lineages

- A fourth question follows from the previous ones. Once the Neanderthal and modern human lineages began to evolve, did more ancient (and perhaps 'ancestral') morphologies in Eurasia and Africa soon die away, or could they have persisted alongside their 'descendants' for a considerable time?

- And if the latter, might the contemporaneous lineages have exchanged genes?

Origin of *H. sapiens*

- There is growing evidence of the survival of what could be considered as earlier middle Pleistocene morphologies (cf. *H. heidelbergensis or H. rhodesiensis*) into at least the later middle Pleistocene of Europe and Africa.

- Genetic exchanges could also have been occurring in the middle Pleistocene.

Origin of *H. sapiens*

- The fossil record available to reconstruct the evolution of H. sapiens in Africa is still relatively sparse and poorly dated, and is dominated by material from the fossiliferous sedimentary basins of East Africa.

- Huge expanses of Central and West Africa were clearly inhabited during the later middle Pleistocene, as shown by the evidence of artefacts, but not a single informative fossil has yet been recovered to identify who those early inhabitants were.

- Thus, the available record is probably highly biased and unrepresentative of the continent as a whole.

Chris Stringer on “archaic *Homo sapiens*”

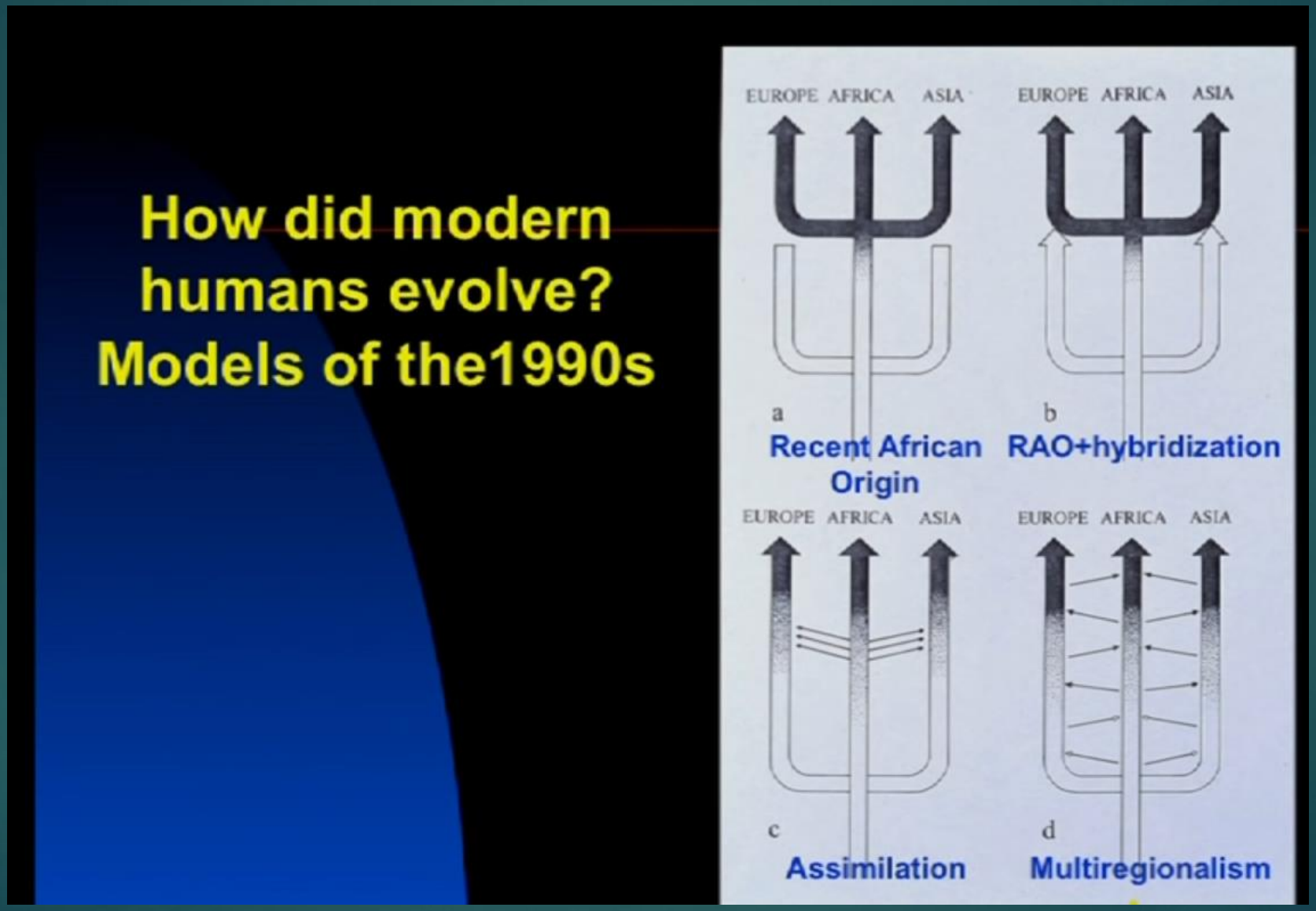
- Anatomically modern human morphology is typically seen in the high and rounded skull, the small face, the chin, the lighter-built skeleton with a narrow pelvis.

- This pattern is found in Africa back to between 150-200 ka (Herto 1 and 2, Omo I).

- Beyond 200 ka, there are specimens in the *Homo sapiens* line that do not yet show the majority of the modern features: Florisbad, Eliye Springs, Ngaloba, Jebel Irhoud.

- Different African specimens are showing different combinations of these modern human and archaic features.

C. Stringer, 2013: Fossil Record of AMH



2018 Chris Stringer

- The RAO (Recent African Origin) theory posits that by 60,000 years ago, the shared features of modern humans had evolved in Africa and, via population dispersals, began to spread from there across the world

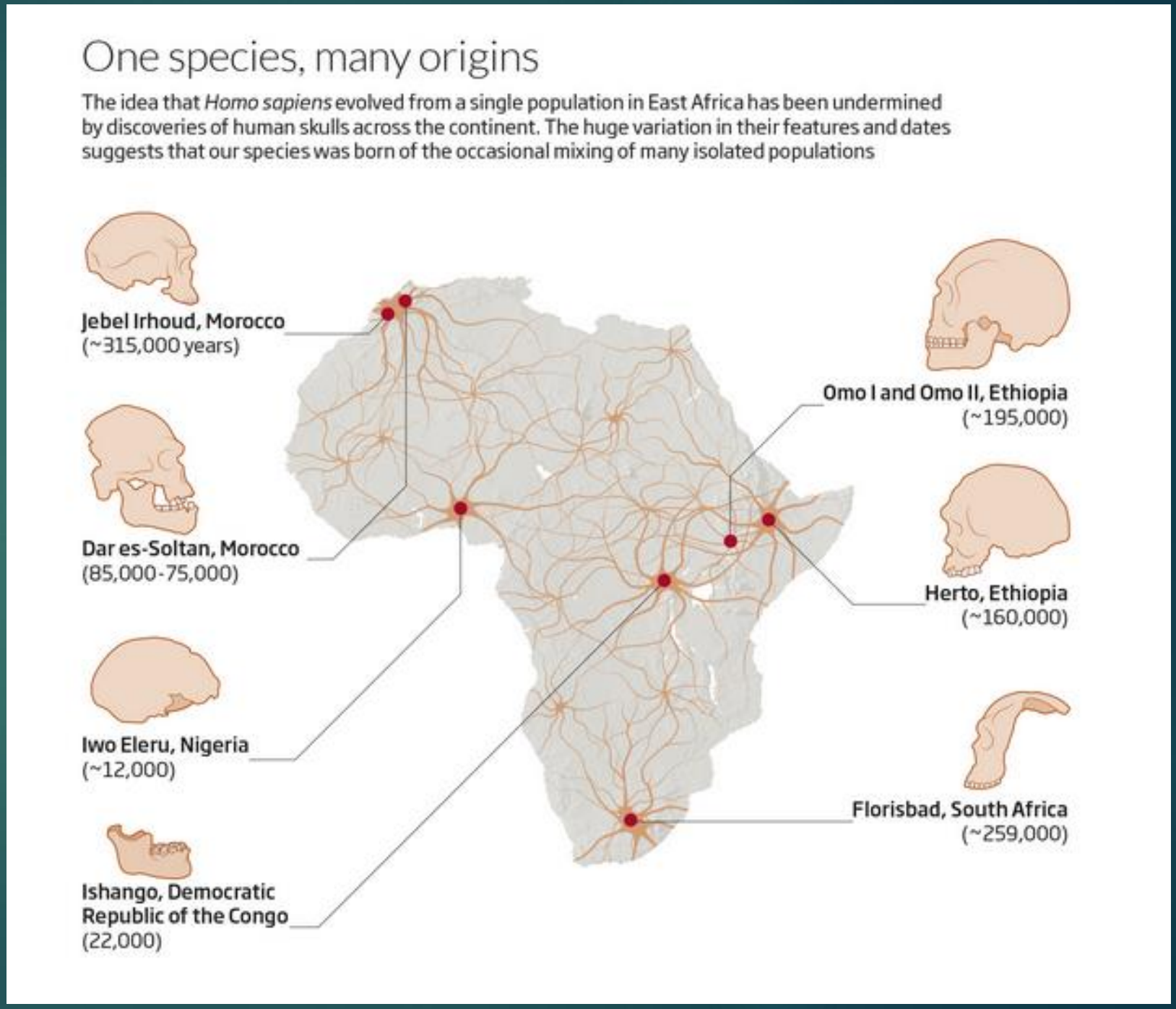
- New fossil discoveries, the growth of ancient DNA research, and improved dating techniques have raised questions about whether the RAO theory of *H. sapiens* evolution needs to be revised or even abandoned

- Yet, Neandertal genome sequences and the discovery of past interbreeding between Neandertals and *H. sapiens* provide support for their belonging to the same species under the biological species concept, and this finding has revived multiregionalism.

- .

How did Homo sapiens *evolve?* **Julia Galway-Witham** *& Ch***ris Stringer, 2018**

Scerri, 2018: African Multiregionalism



2018 Stringer

- With only a few dissenters:
  - the strictest versions of both RAO (which denies interbreeding with other lineages or species) and
  - Multiregionalism (which argues for an interbreeding network of one species over the past ~1.8 million years)
  - are now generally regarded as falsified.
- Instead, two intermediate theories best accommodate the complex interactions between hominin taxa ~40,000 to 100,000 years ago:
  - RAO with hybridization (RAOWH) and
  - Assimilation model (AM).
- The two theories differ in their reconstructions of the processes by which the DNA of dispersing *H. sapiens* populations mixed with those of other populations outside of Africa.

2018 Stringer

- Assimilation model: AM emphasizes:
  - The AM was based originally on morphological evidence for introgression in Eurasia
  - demic diffusion, in which populations of African *H. sapiens* and Eurasian Neandertals and Denisovans would have mixed over wide areas.
  - Genes would have flowed gradually between these regional populations, catalyzing genetic and anatomical changes and leading to the spread of modern traits.

2018 Stringer

- In contrast, RAOWH (RAO with hybridization) envisages
  - *H. sapiens* genes as largely entering and traversing Eurasia within the bodies of dispersing humans of African origin.
  - Along the way there were successful hybridization events with indigenous populations, but these were effectively absorbing fragmented local populations in a relatively rapid replacement process, where they overlapped.

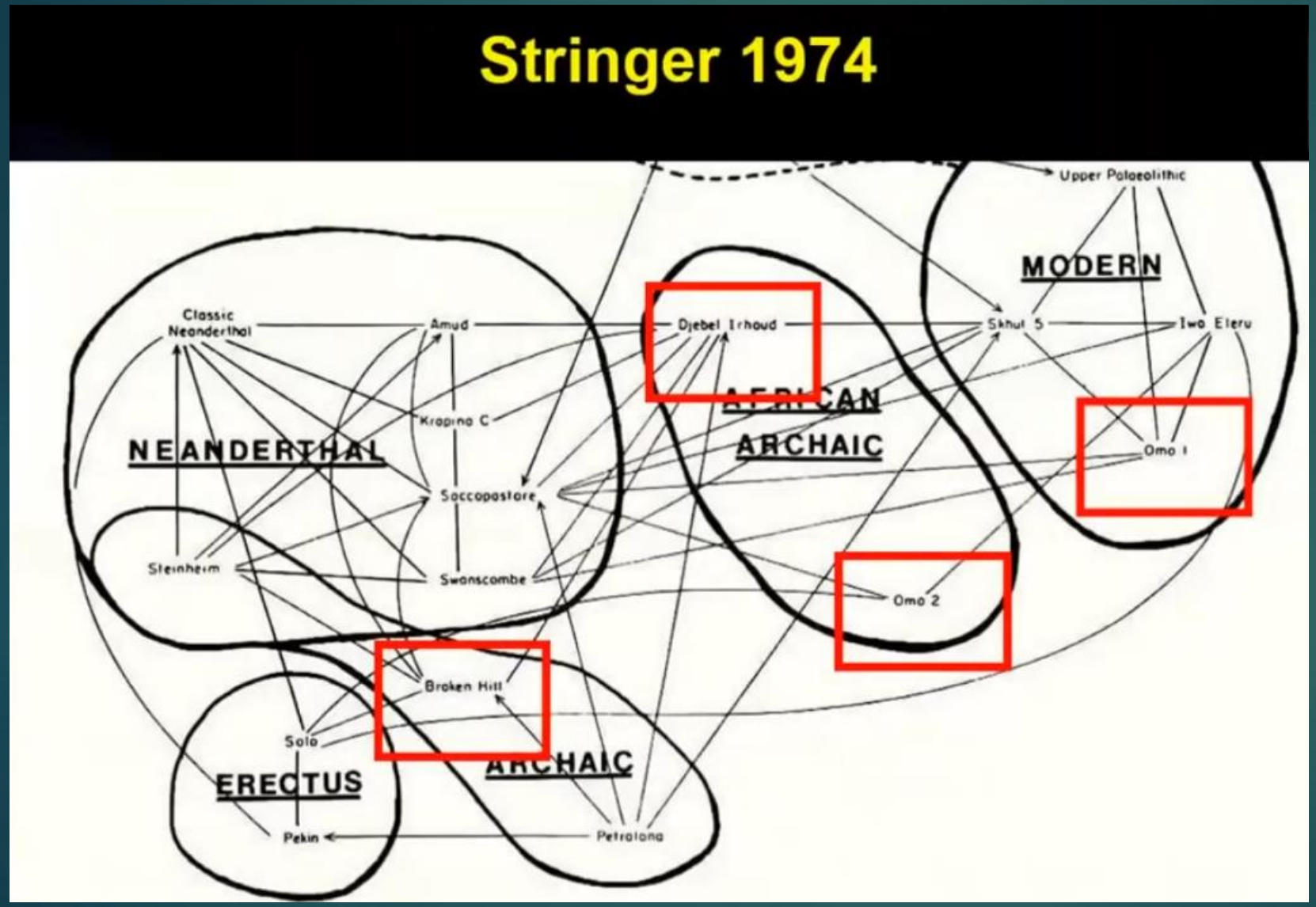
2018 Springer

- The low percentage of surviving Neandertal DNA in the human genome seems to reflect a replacement process, but the much greater amount (~6%) of Neandertal plus Denisovan-like DNA persisting in some extant Oceanian populations may indicate more extensive interactions.
- In addition, growing evidence for a longer-term coexistence of *H. sapiens* and other lineages outside of Africa extends the potential for interactions in both time and space, consistent with AM.
- It may be that at the scale of human generations, the processes resembled Assimilation, whereas viewed through the lens of deeper time, they look more like the replacement envisaged in RAOWH.

Recent African Origin with modifications

- 1 Neandertal and Denisovan traits begin to emerge in Eurasia.
- 2 Neandertal and Denisovan traits continue to develop and spread; traits assorted with *H. sapiens* begin to emerge across Africa; Africa and Eurasia remain isolated.
- 3 Novel *H. sapiens* traits evoive in Africa. *H. sapiens* disperse into Eurasia, with areas of interbreeding at the overlapping ranges with Neanderthal and Denisovans (RAOWH).
- 4 Alternatively, H. *sapiens* traits spread into Eurasia, with more extensive blending between *H. sapiens,* Neanderthals, and Denisovans; novel *H. sapiens* traits evolve in Africa, but the interbreeding between the various species may catalyze the evolution of new traits (AM).
- 5 Portions of Neandertal and Denisovan genes are distributed across populations of *H. sapiens* today.

Principal component analysis of skulls



Jebel Irhoud = Intermediate African archaic

African skulls:

Broken Hill = Very archaic

Omo I = very Modern

Omo II = not MH or N

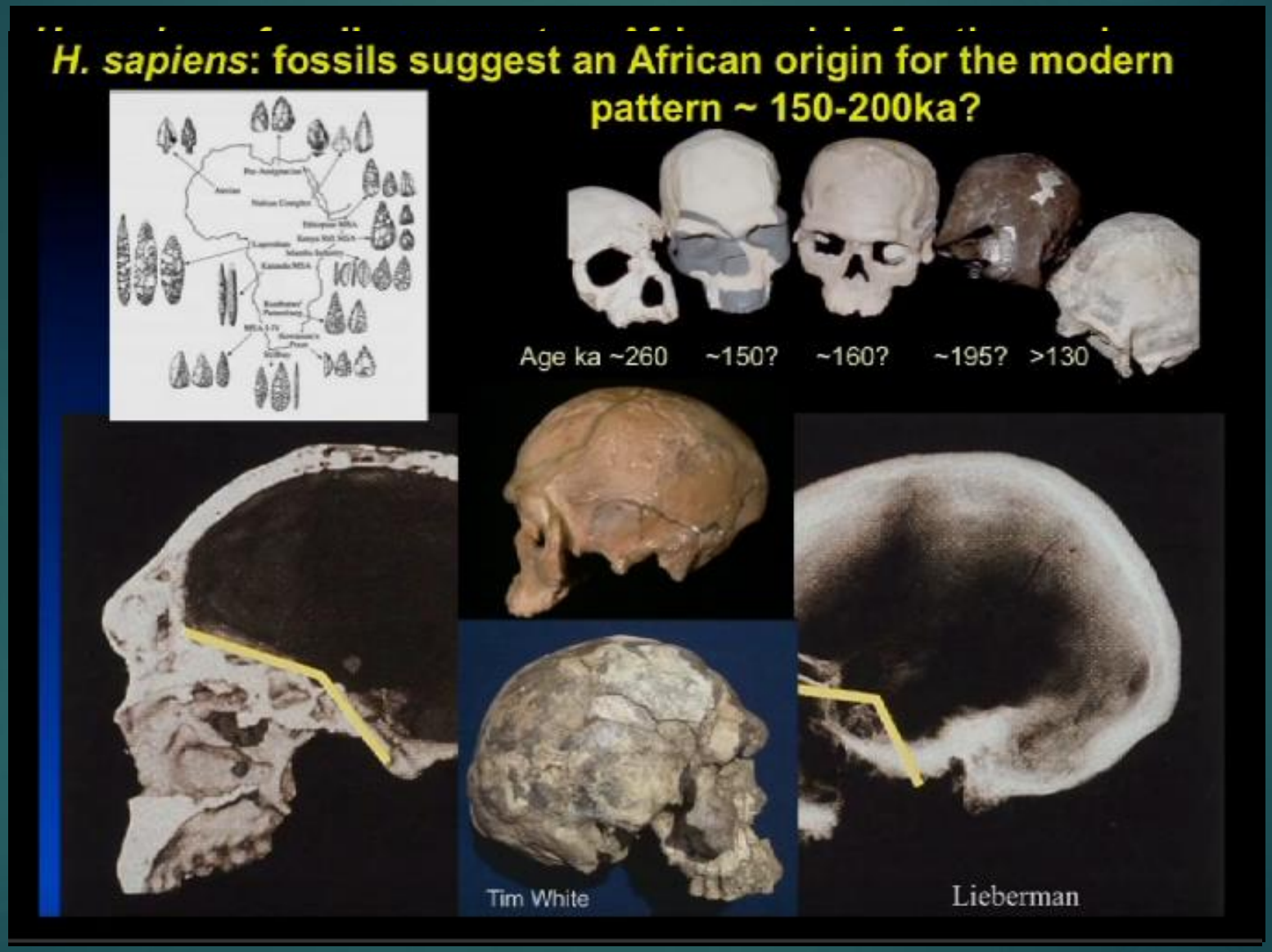
Very few good dates

400 MH skulls (W. Howells') as well as 74 ancient skulls

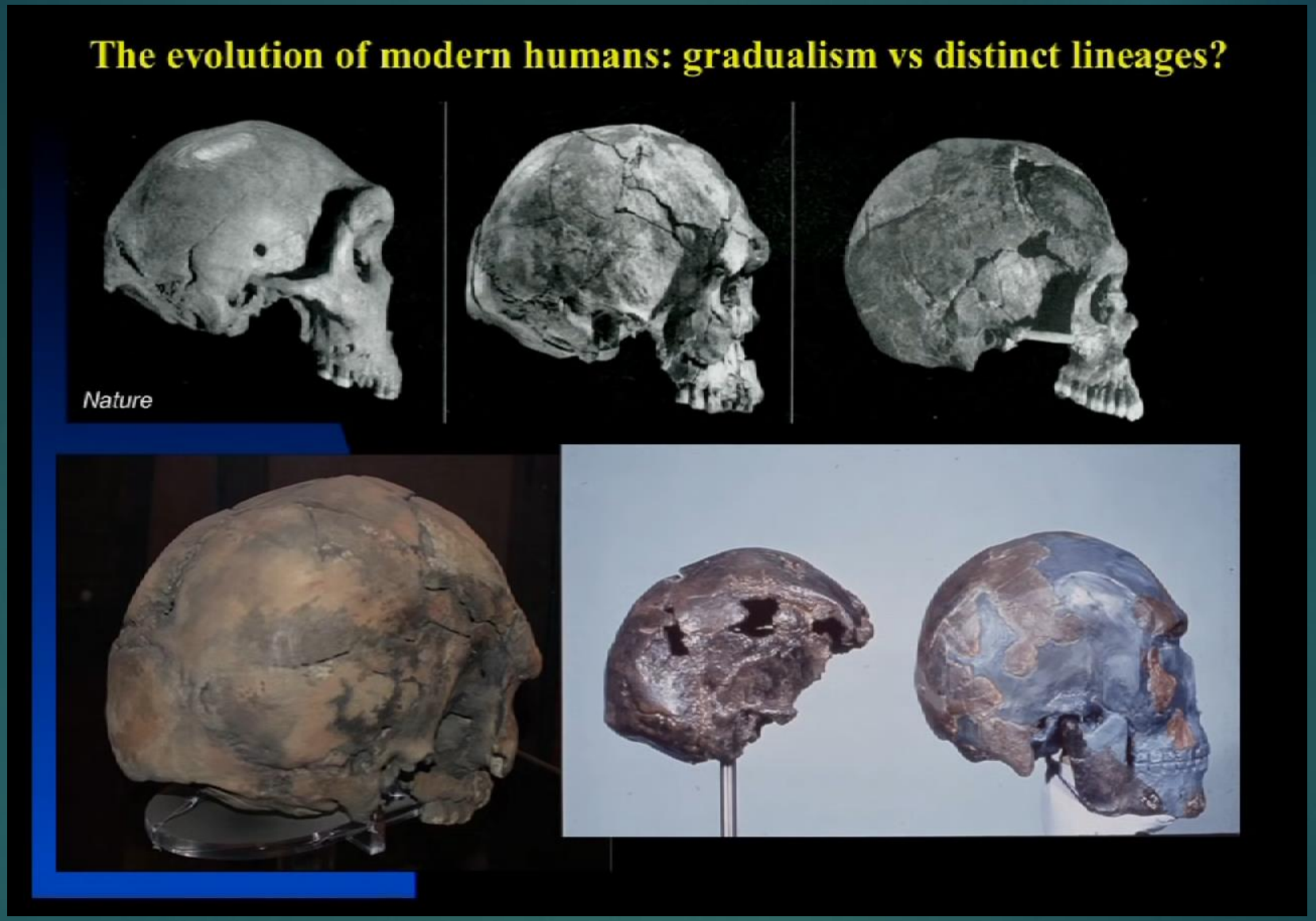
Ns not ancestral to MHs

Stone tools present in most of Africa;

But fossils in only 10%



Africa is only area with transitional MH fossils: Jebel Irhoud, Herto



But Omo I and Omo II, ~195 Ka, 2 miles apart:

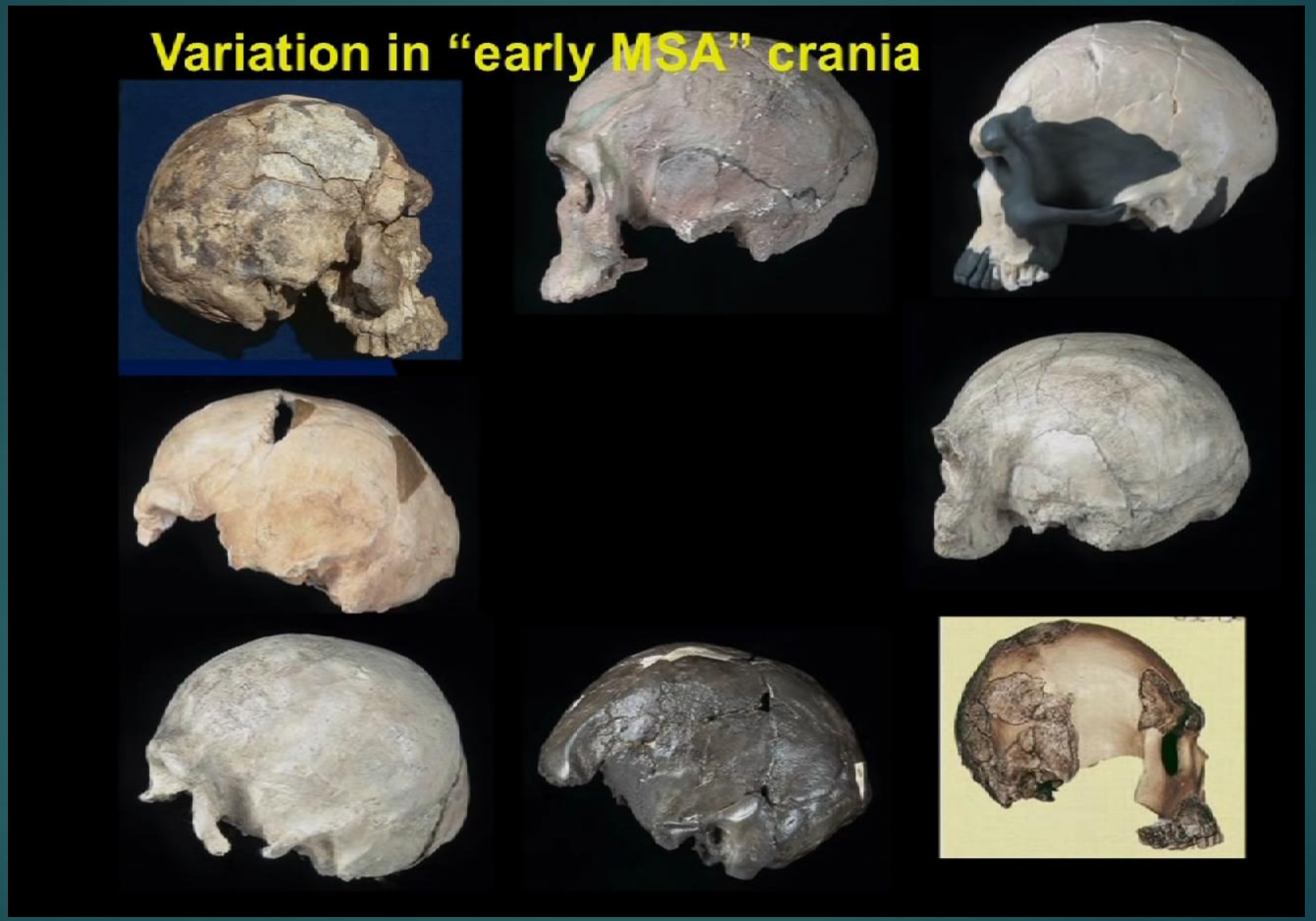
Omo I = MH;

Omo II = archaic

Tim White, Herto paper: transition from Broken Hill to Herto to MH

MSA: a lot of variation

Jebel Irhoud 1



Herto

Irhoud 2

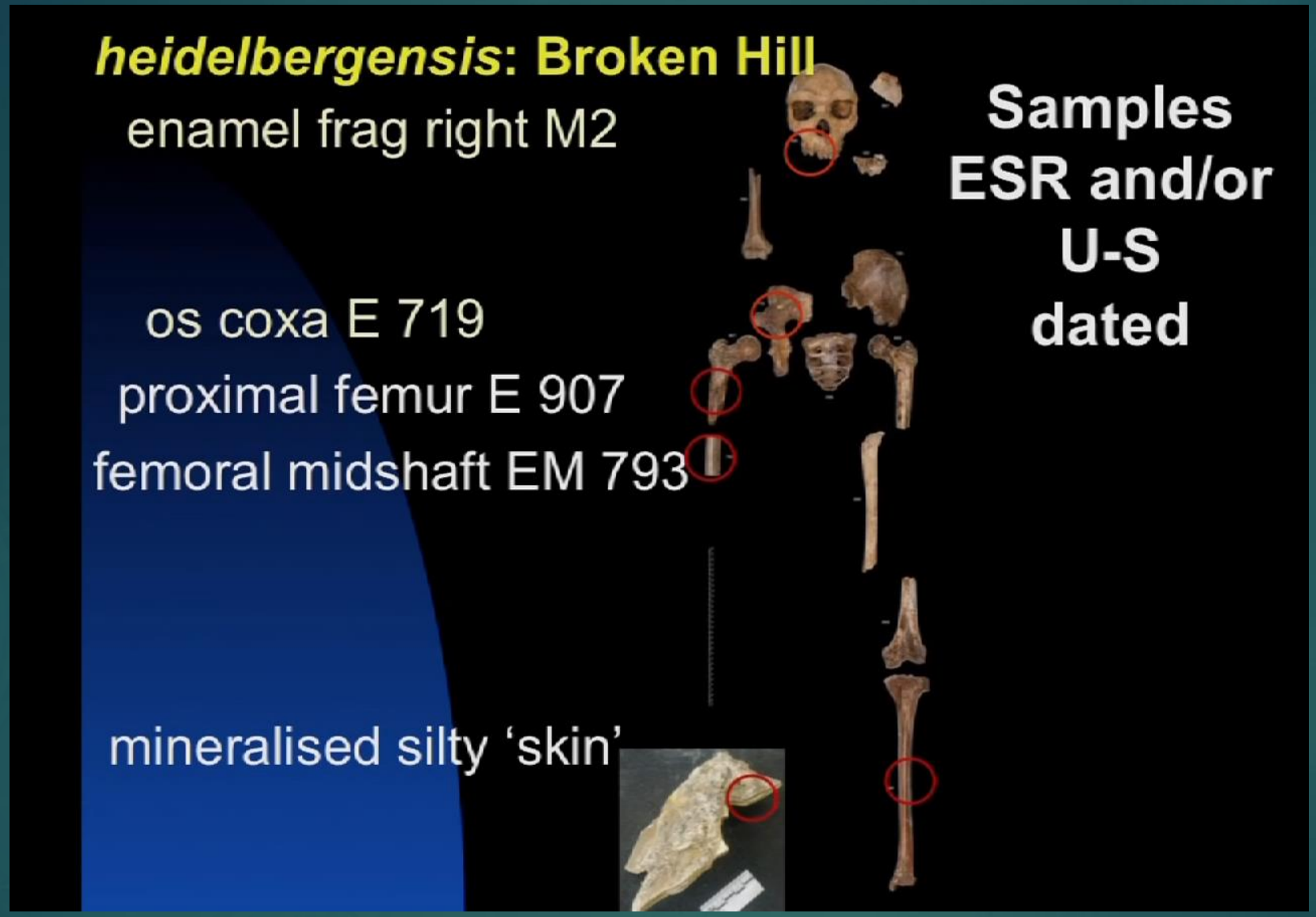
Singa

Ngaloba,
Laetoli, Tanzania,
H18

E. Springs

Omo I

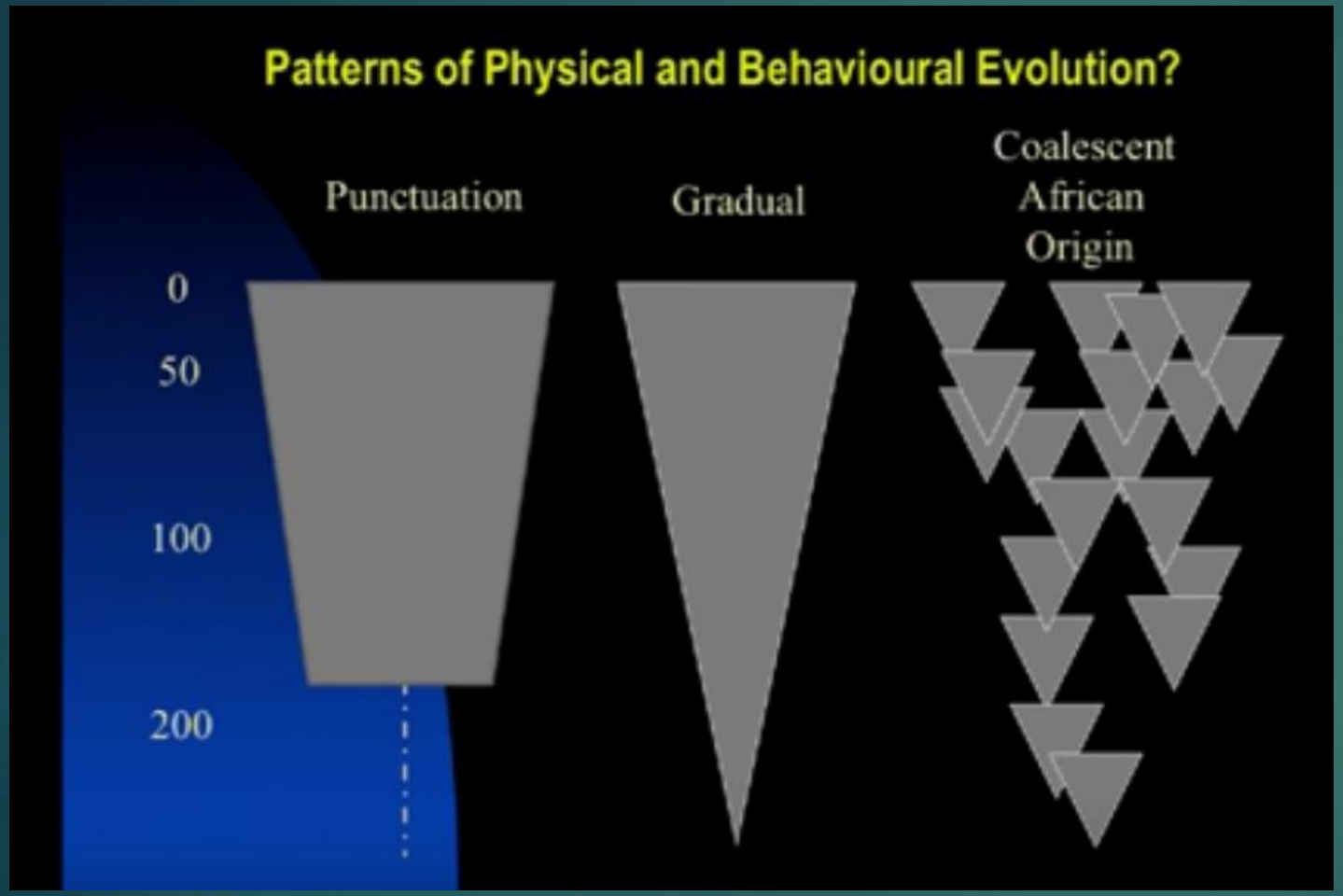
Omo II



Broken Hill/Kabwe: Once thought as ancestral to MH

Now dated: 300 Ka

Contemporaneous with MHs

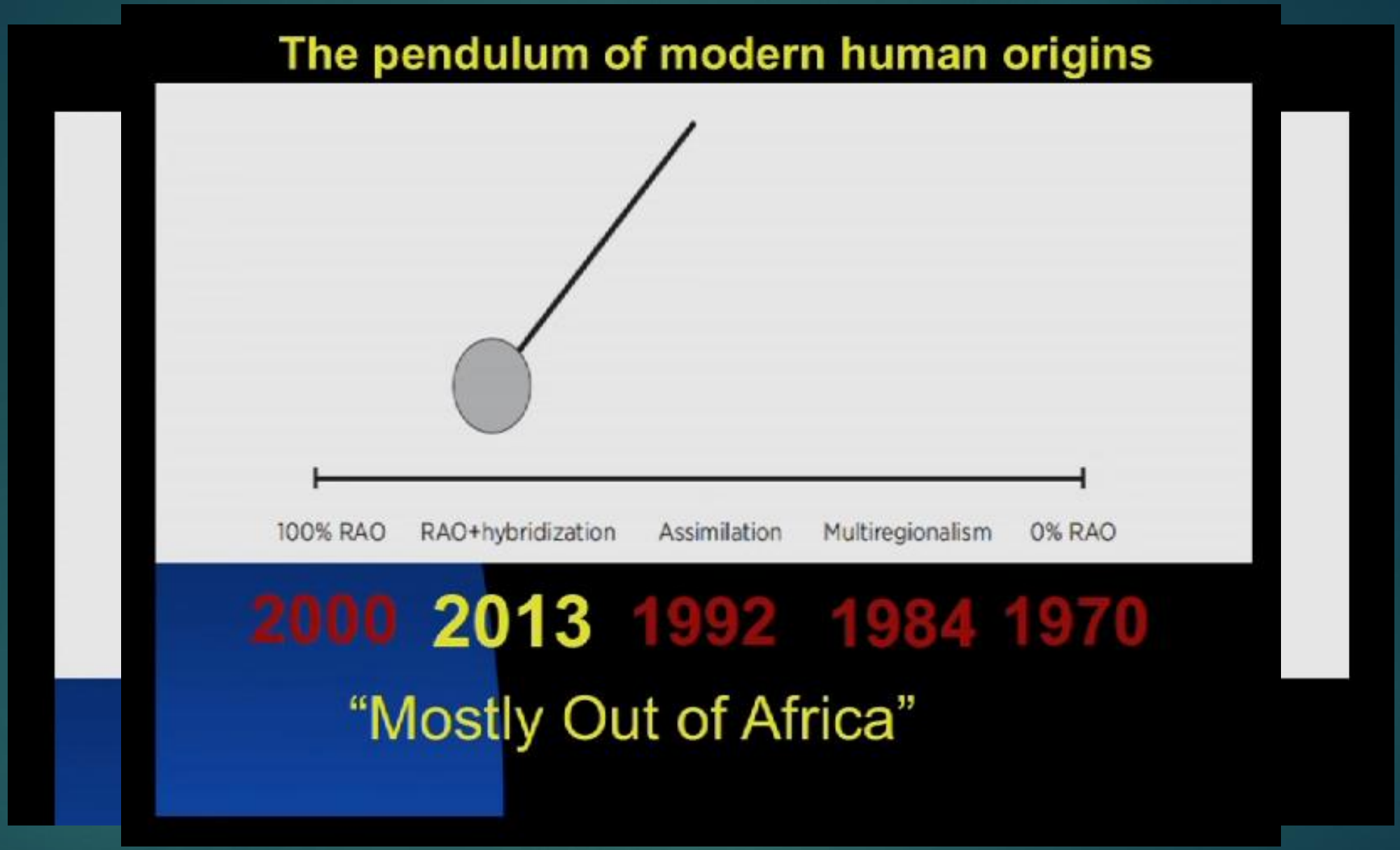


20 years ago: punctuation view: 1 isolated place in Africa is where MH became AMHs and then spread out

Gradual view: like Ns in Europe, gradual change toward MH

Now: Coalescent African Origin: different populations contributed to MH behavior, morphology & genes

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



1970: no one believed Recent African Origin; Many thought Europe, Asia as origin;
2000: most accept RAO. Africa was place of origin of MHs

Chris Stringer on “archaic *Homo sapiens*”

- Growing evidence that the divergence of the *Homo sapiens* lineage with the Neanderthal lineage goes back a long way, and we need a term for *Homo sapiens* in Africa before we have the majority of modern human features.

- Here we can refer to archaic *Homo sapiens* in Africa for the early part of our lineage.

- Some other Middle Pleistocene fragmentary fossils (Ndutu, Salé, Thomas Quarry) could be even early *Homo sapiens* rather than *Homo heidelbergensis* .

- The use of that term outside of Africa is meaningless.

Selected Human Fossils from Africa, 300 to 50 Ka, by date

Site	Anatomical Type	Approx. Age	Discovery Date
Ilerst, Kenya	Intermediate?	300,000-270,000	1992
Jebel Irhoud	Modern	300,000	2017
Kabwe, Zambia	Archaic	~300,000	1921
Florisbad, RSA	Intermediate	~260,000	1932
Omo Kibish 1, Ethiopia	Modern	195,000	1967
Omo Kibish 2, Ethiopia	Modern?	195,000	1967
Singa, Sudan	Intermediate	170,000-150,000	1924
Ngaloba, Laetoli, Tanzania	Intermediate	150,000-90,000	1978
Dar-es-Soltan, Cave 2, Morocco	Modern	127,000-40,000(?)	1975
Klasies River Mouth, RSA	Modern	115,000-60,000	1972
Border Cave, RSA	Modern	90,000-50,000	1941
De Kelders Cave, RSA	Modern	71,000-45,000	1976
Equus Cave, RSA	Modern	71,000-27,000(?)	1985

The Pan-African dawn of *Homo sapiens*: Long before the out-of-Africa dispersal of *H. sapiens*, there was dispersal within Africa

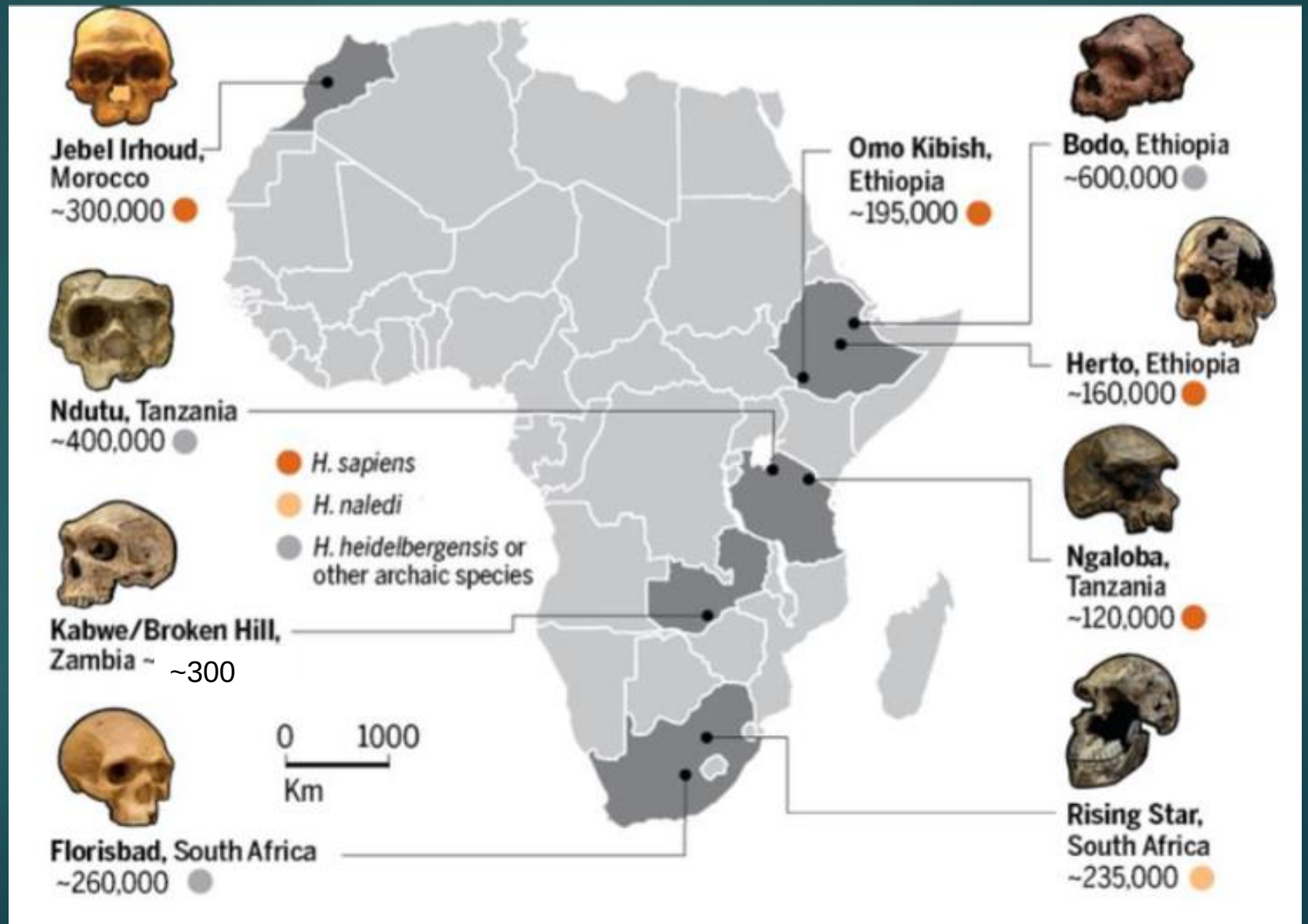
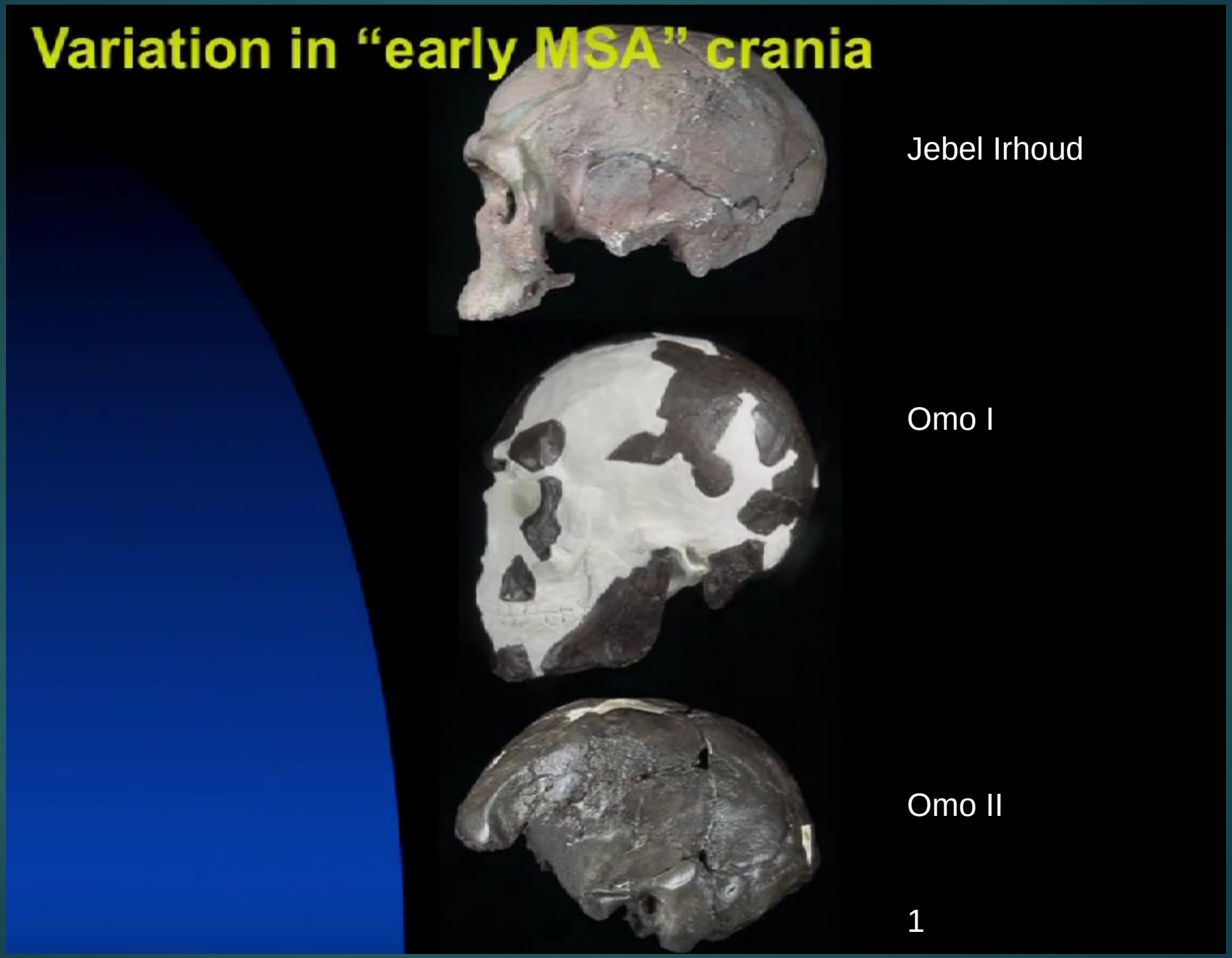


Figure 1. Left lateral views of African and Israeli archaic and early modern *Homo sapiens* crania (replicas unless otherwise stated). Top (L to R): Florisbad, Jebel Irhoud 1, Jebel Irhoud 2 (original), Eliye Springs, Guomde (reversed), Omo 2. Bottom (L to R): Omo 1, Herto (original, reversed), Ngaloba, Singa, Skhul 5, Qafzeh 9.

C. Stringer, 2016

1974 specimens



Stringer originally thought
all 1 group, but too much variation

Jebel Irhoud

Herto

Ngaloba,
Laetoli H18

Jebel Irhoud 2

Eliye Springs,
KNM-ES-11693

Omo I

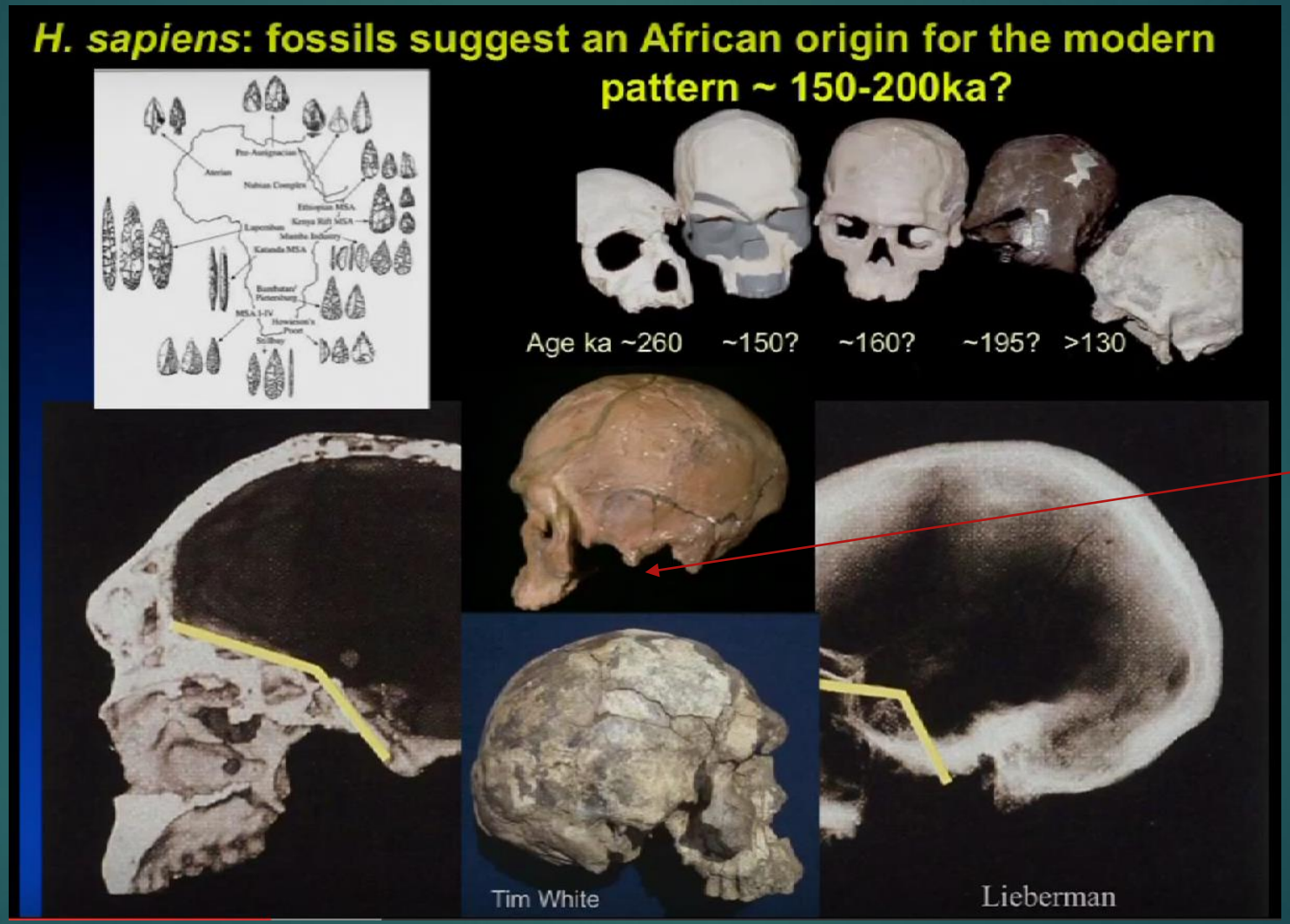
Singa

Omo II

MSA lithics indicate MHs all over Africa;

But fossils don't match distribution – Mostly from S Africa, Rift Valley, Morocco;

Few fossils from Middle or West Africa

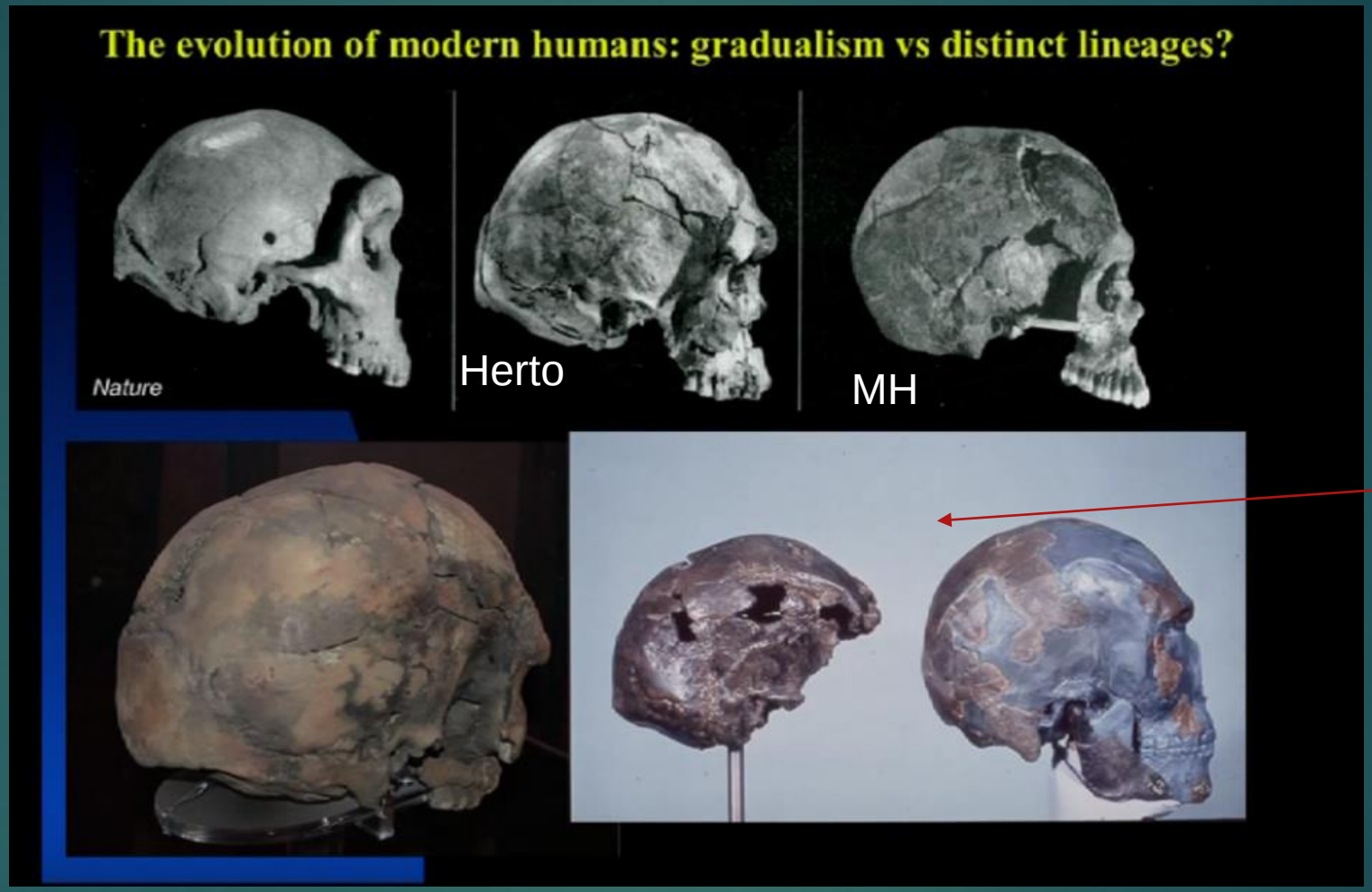


Homo heidelbergensis: Broken Hill CT scan

Modern Human

Africa is only continent with transitional skulls: Jebel Irhoud & Herto which show mosaics between *H. heidelbergensis* and MHs

Gradualism:
Gradual change from *H. heidelbergensis* into MHs



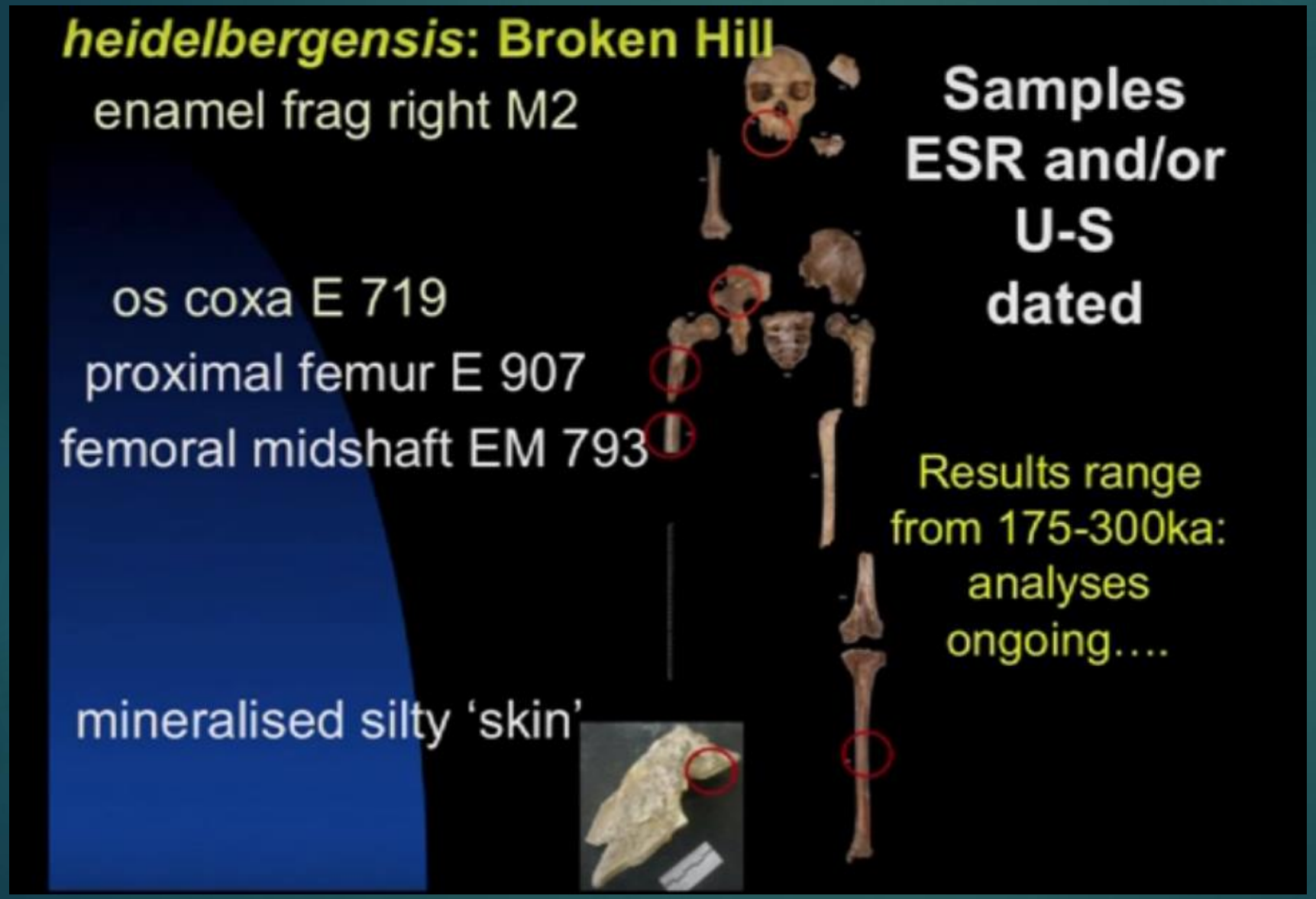
Archaic
Omo II

MH
Omo I

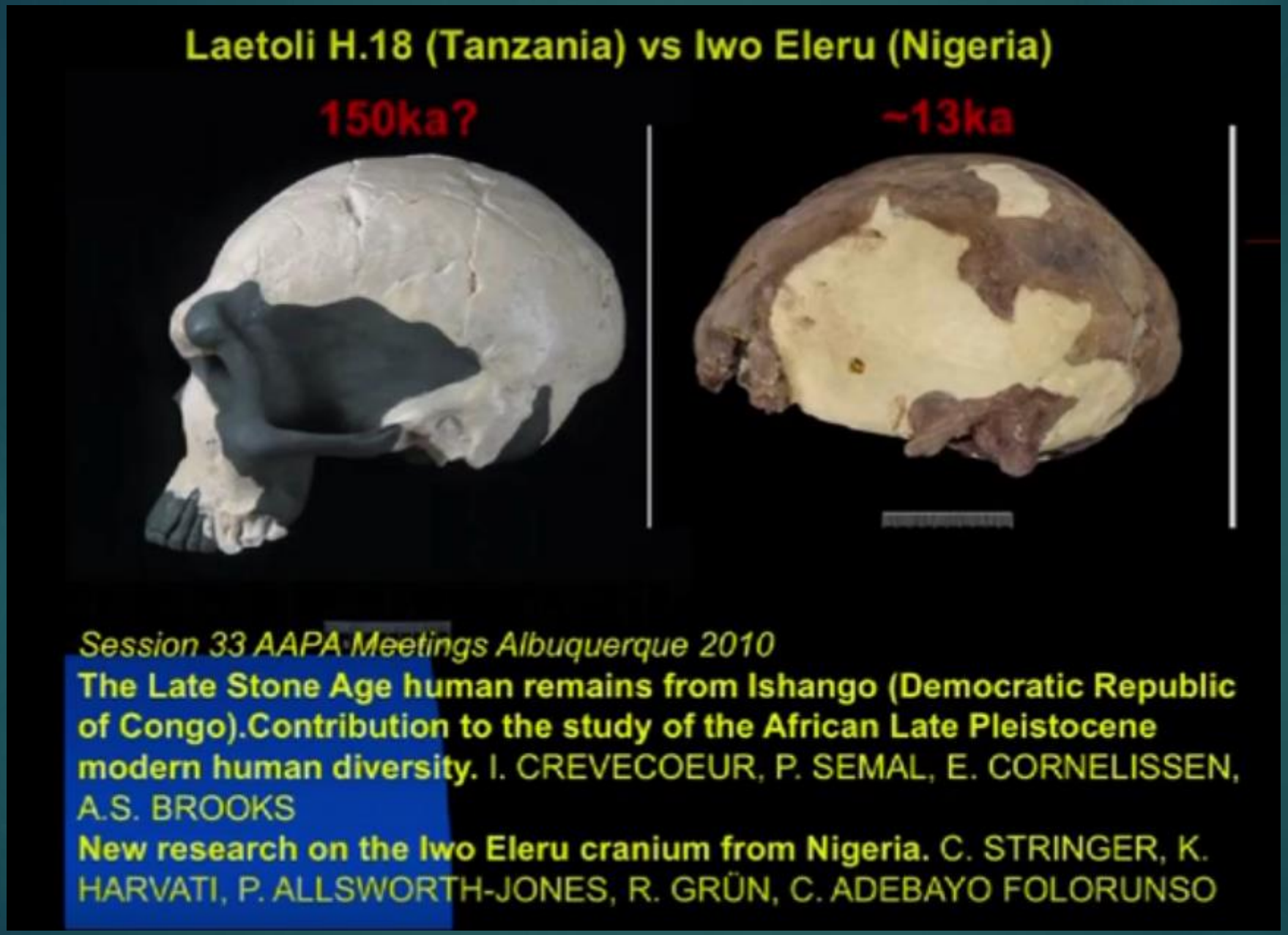
Vs. Distinct lineages like Omo I and 2, both ~196 Ka; Few miles apart;

Tim White: variation in a single population;

Stringer: separate lineages



1974: Stringer: *H.* heidelbergensis hung on in Africa & Eurasia along with MHs

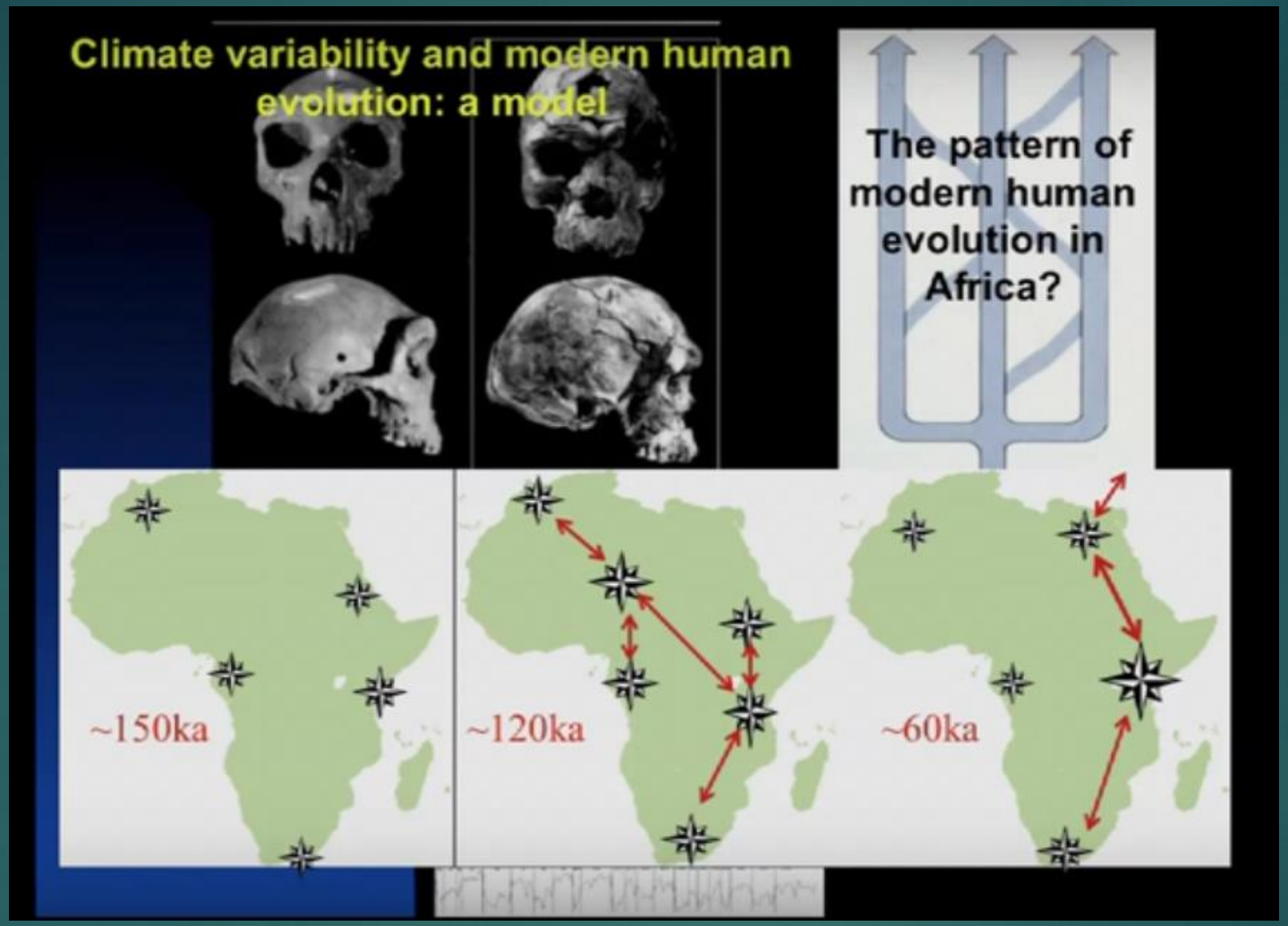


Oldest fossil in West Africa; distinct from recent W. Africa populations; shows archaic features; Nearest geomorphic skull to Laetoli H. 18

150K: arid Africa, separate, isolated, populations

120K: humid N Africa, gene flow between populations, use of red ocher, shell jewelry spread around Africa

60K: more arid, populations cut off; extinctions; E Africa center for dispersal out of Africa



Roger Lewin's1990's global multiregional pattern may actually apply to what happened to MH evolution in Africa

Stringer's current theory: no single African center of human evolution; different parts of Africa contributed to what is now MHs through movements of populations and gene flow and exchanges of ideas

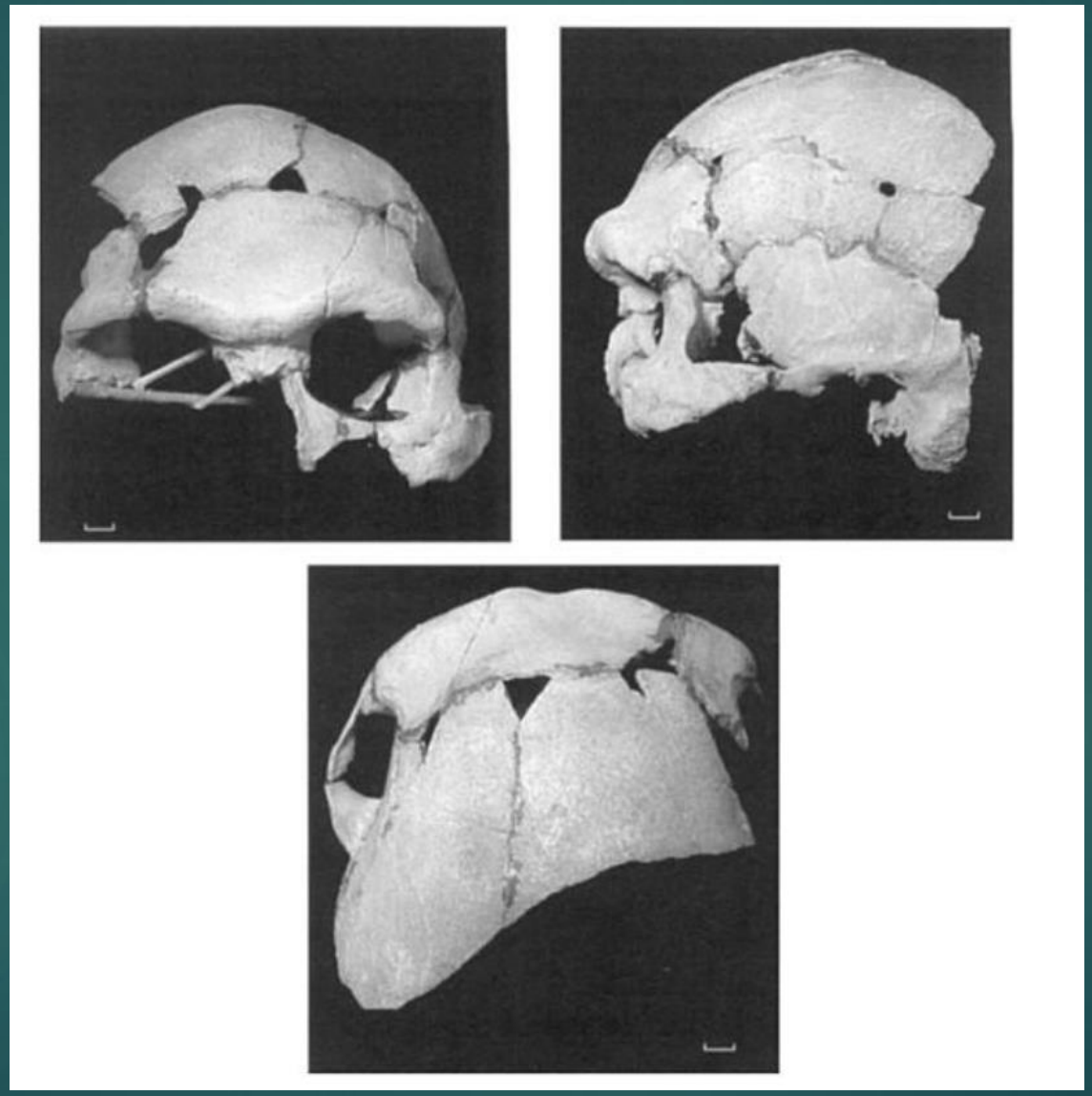
Northwest & Northern Africa

- Aterian artifacts= MSA, c 130-40 Ka, N African; tanged/stemmed tools (which have been widely assumed to be among the earliest projectile weapon tips) and Levallois flakes and cores

North African MHs: only fragments

- Mugharet el Aliya, Tangier: First AMH from North Africa discovered by Carleton Coon in 1939. Consisted of an M2, left maxillary fragment with premolars, a canine; with Aterian tools (N African tool tradition of tanged artifact with narrow projections for hafting)
- Rabat, Temara, Morocco: mandible in 1959 and partial cranium in 1975
- Zouhra Cave: a mandible & canine, 41 Ka
- Dar-es-Soltan, Morocco: 3 individuals – partial cranium, parts of upper face, hemi-mandible, juvenile calvaria; cranium 5 –robust, facial breadth, large browridge; but flattened face & high vault; have enlarged masticatory, pronounced megadonty;

1975, Dar-es-Soltane 5



Dar-es-Soltane
80 Ka, Alteran industry

Moroccan Dar-es-Soltane skull;
Morphological continuity with
Jebel Irhoud, Qafzeh/Skhul skulls

(K. Harvati & J. Hublin)

Much older coalescent point in Africa for ancestor of MHs: Southern African ancient genomes estimate modern human divergence to 350,000 to 260,000 years ago

Coalescence time 350 to 260 ka and ancient population structure in Africa

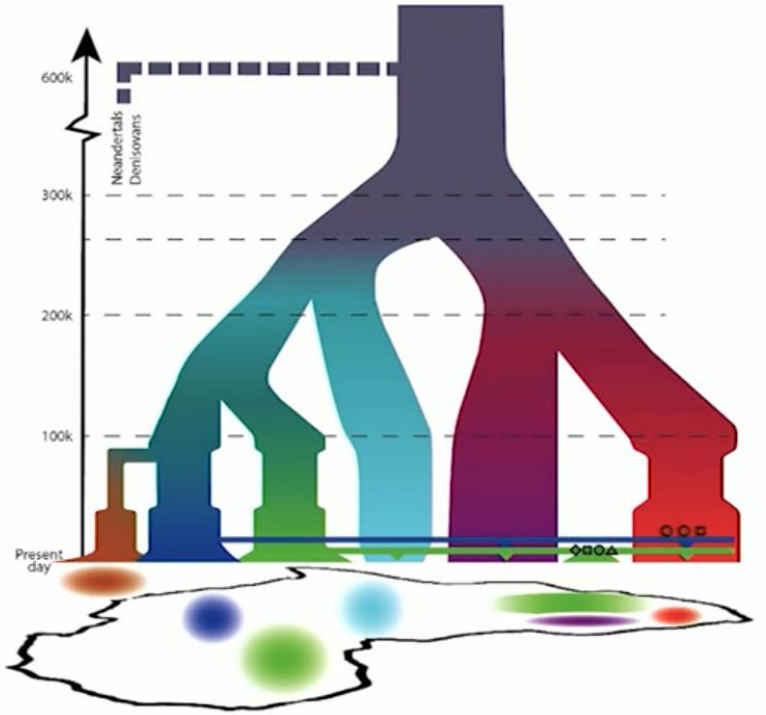
RESEARCH

HUMAN EVOLUTION

Southern African ancient genomes estimate modern human divergence to 350,000 to 260,000 years ago

Carina M. Schlebusch,[1,2]** Helena Malmström,[1,2]** Torsten Günther,[1] Per Sjödin,[1] Alexandra Coutinho,[3] Hanna Edlund,[3] Arielle R. Munters,[3] Márcia Vicente,[3] Maryna Steyn,[4] Himla Soodyall,[5] Marlize Lombard,[6,7] Mattias Jakobsson[1,8,9]

Southern Africa is consistently placed as a potential region for the evolution of *Homo sapiens*. We present genome sequences, up to 12× coverage, from seven ancient individuals from KwaZulu-Natal, South Africa. The remains of three Stone Age hunter-gatherers (about 2000 years old) were genetically similar to current-day southern San groups, and those of four Iron Age farmers (300 to 500 years old) were genetically similar to present-day Bantu-language speakers. We estimate that all modern-day Khoe-San groups have been influenced by 9 to 30% genetic admixture from East Africans/Eurasians. Using traditional and new approaches, we estimate the first modern human population divergence time to between 350,000 and 260,000 years ago. This estimate increases the deepest divergence among modern humans, coinciding with anatomical developments of archaic humans into modern humans, as represented in the local fossil record.

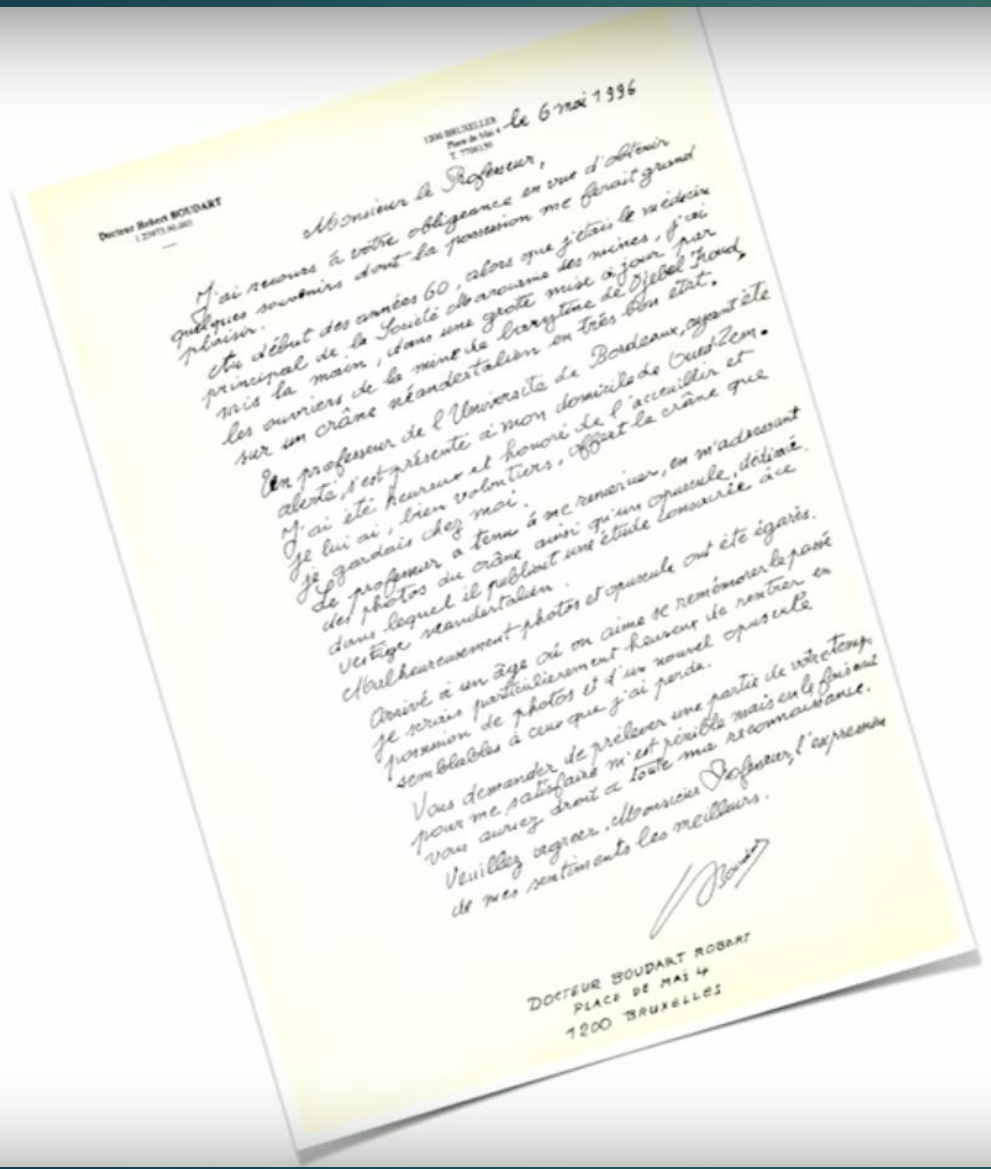


(Schlebusch et al. 2017)

Different human ancestral subgroups all over Africa, separated by environmental & climactic events

Far north: Jebel Irhoud, Morocco

1960s: barite mining discovered this skull, long considered an African Neandertal



Docteur Robert BOUDART

le 6 mai 1996

Monsieur le Professeur,

J'ai l'honneur à votre obligeance en vue d'obtenir quelques souvenirs dont la possession me ferait grand plaisir.

Au début des années 60, alors que j'étais le médecin principal de la Société d'exploitation des mines, j'ai pris la main, dans une grotte mise à jour par les ouvriers de la mine de barytine de Djebel Irhoud, sur un crâne néandertalien en très bon état.

Un professeur de l'Université de Bordeaux, ayant été alerté, s'est présenté à mon domicile de Casablanca. Je lui ai, bien volontiers, offert le crâne que je gardais chez moi.

Le professeur a tenu à me remercier, en m'adressant des photos du crâne ainsi qu'une opuscule, détaillé dans lequel il publiait une étude consacrée à ce Vertige néandertalien.

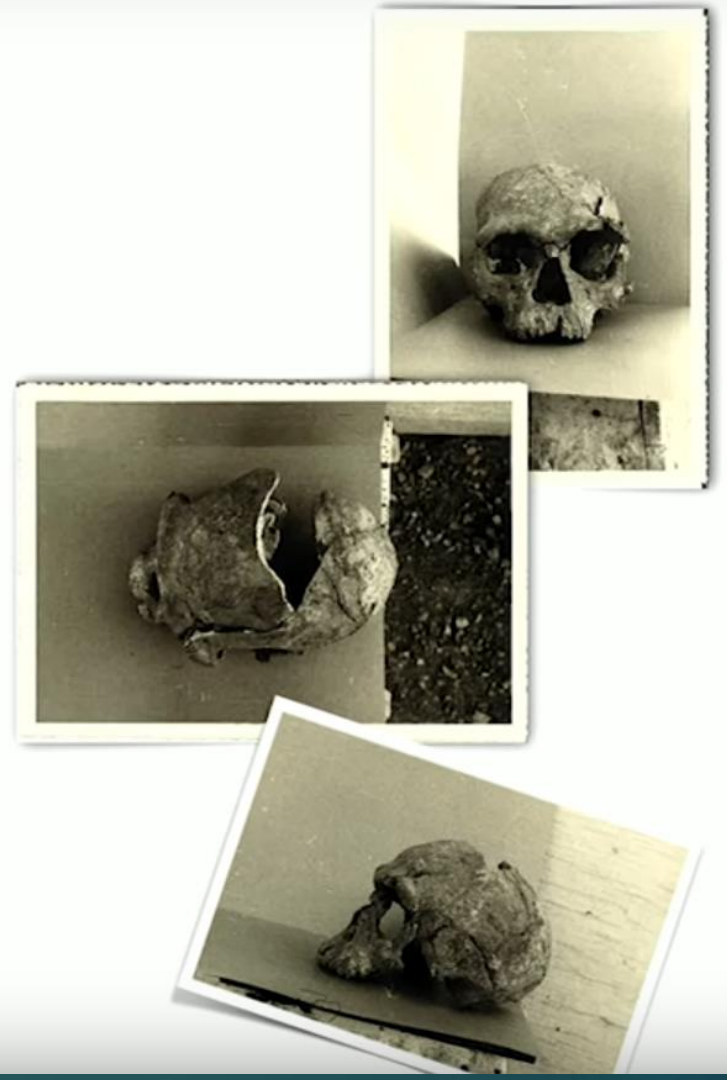
Malheureusement photos et opuscule ont été égarés.

Arrivé à un âge où on aime se remémorer le passé je serais particulièrement heureux de retrouver la panoplie de photos et d'un nouvel opuscule semblables à ceux que j'ai perdu.

Vous demander de prélever une partie de votre temps pour me satisfaire m'est pénible mais en la faisant vous aurez droit à toute ma reconnaissance.

Veuillez agréer, Monsieur le Professeur, l'expression de mes sentiments les meilleurs.

DOCTEUR BOUDART ROBART
PLACE DE MAI 4
1200 BRUXELLES

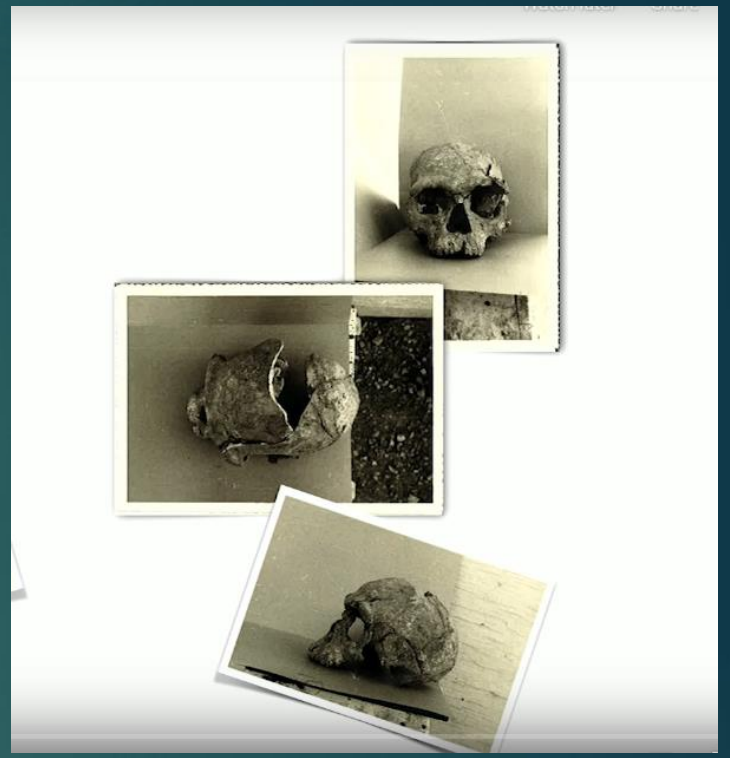


2004: Jebel Irhoud, Morocco: Hublin begins new excavations

Cave’s covering rock and much sediment were removed

North African: Jebel Irhoud, Morocco, 90-125K

- Jebel Irhoud: older Mousterian hominins; 4 individuals, 1961-1969
- Originally considered African “Neandertal”
- Irhould 1, complete cranium, 1961; Irhould 2, calvaria, 1962; Irhould 3, child’s mandible, 1968, 160K, with chin; Irhould 4, child’s humerus, 1969
- Tools: sidescrapers predominant; Levallois type
- Irhould 1: archaic & modern; long & wide cranium, low vault; more vertical frontal convexity; no occipital torus; cranial capacity = 1305-1480cc
- Original Dating: 90-125 Ka, but also 130-190 Ka



La Ferrassie 1 Neanderthal skull

Jebel Irhoud 1 skull

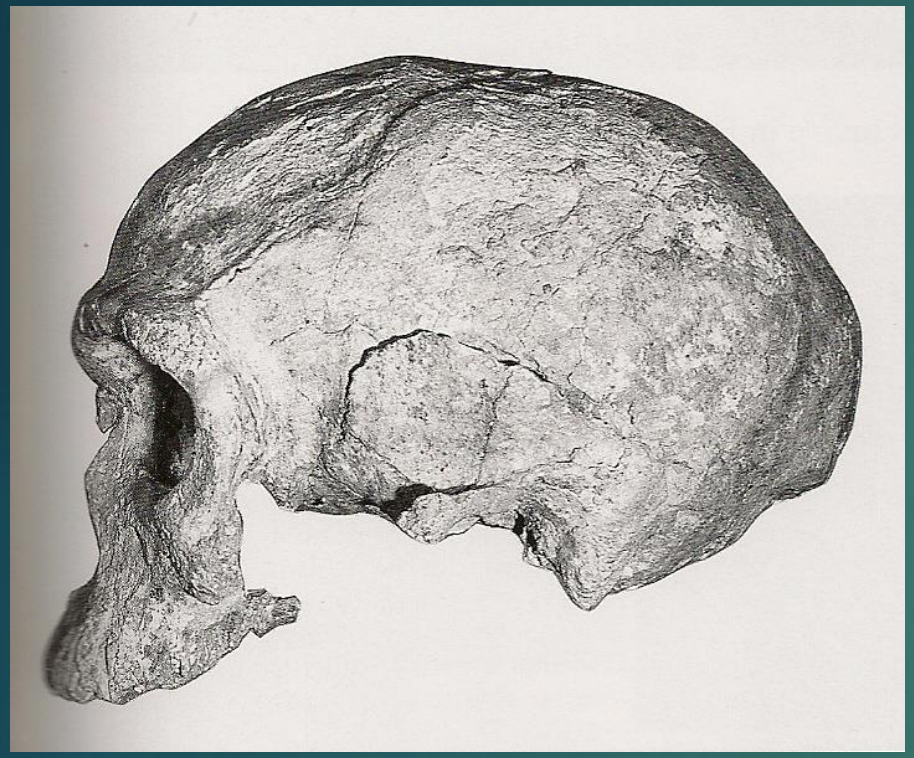
The face of Jebel Irhoud is shorter than the Neanderthal, but it has a clear and continuous browridge, and its braincase is not very much like modern humans. Photo courtesy of Milford Wolpoff.

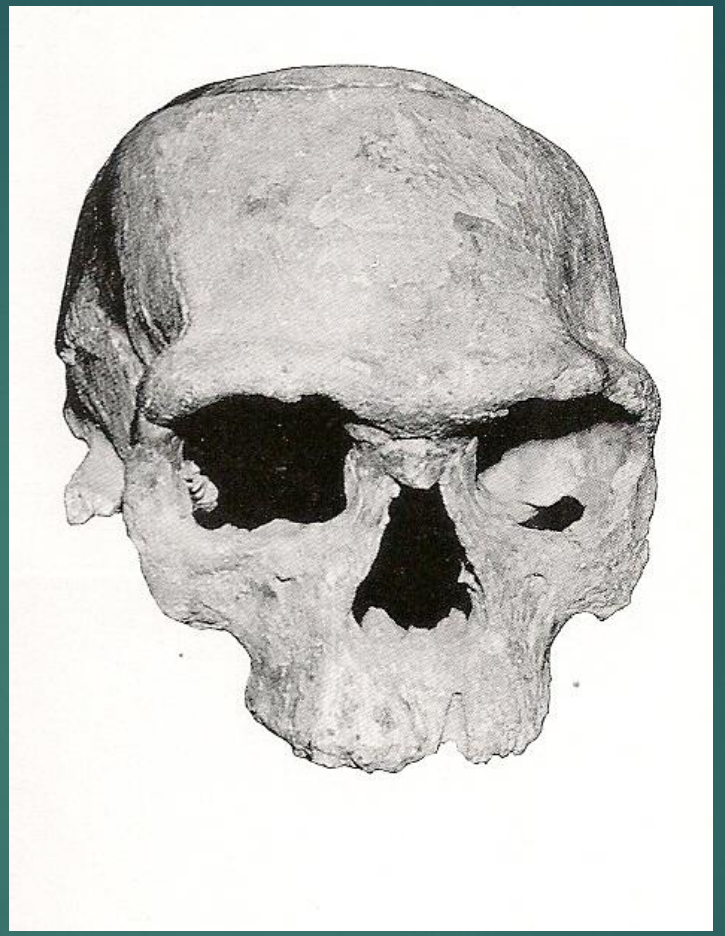
North Africa: both originally dated to 120 Ka in same context

• Jebel Irhoud 1 has a very flat, vertical face with a reduced supraorbital torus, features that are associated with modernity. More modern than 2.

• Jebel Irhoud 2 couples some of those features. Again, we have a very reduced supraorbital torus with an overall lower cranial vault, and a longer cranial vault that has a bit of a projection in the occipital bone in the back, something that in Europe we might describe as an occipital bun, a feature that we associate with European Neanderthals.

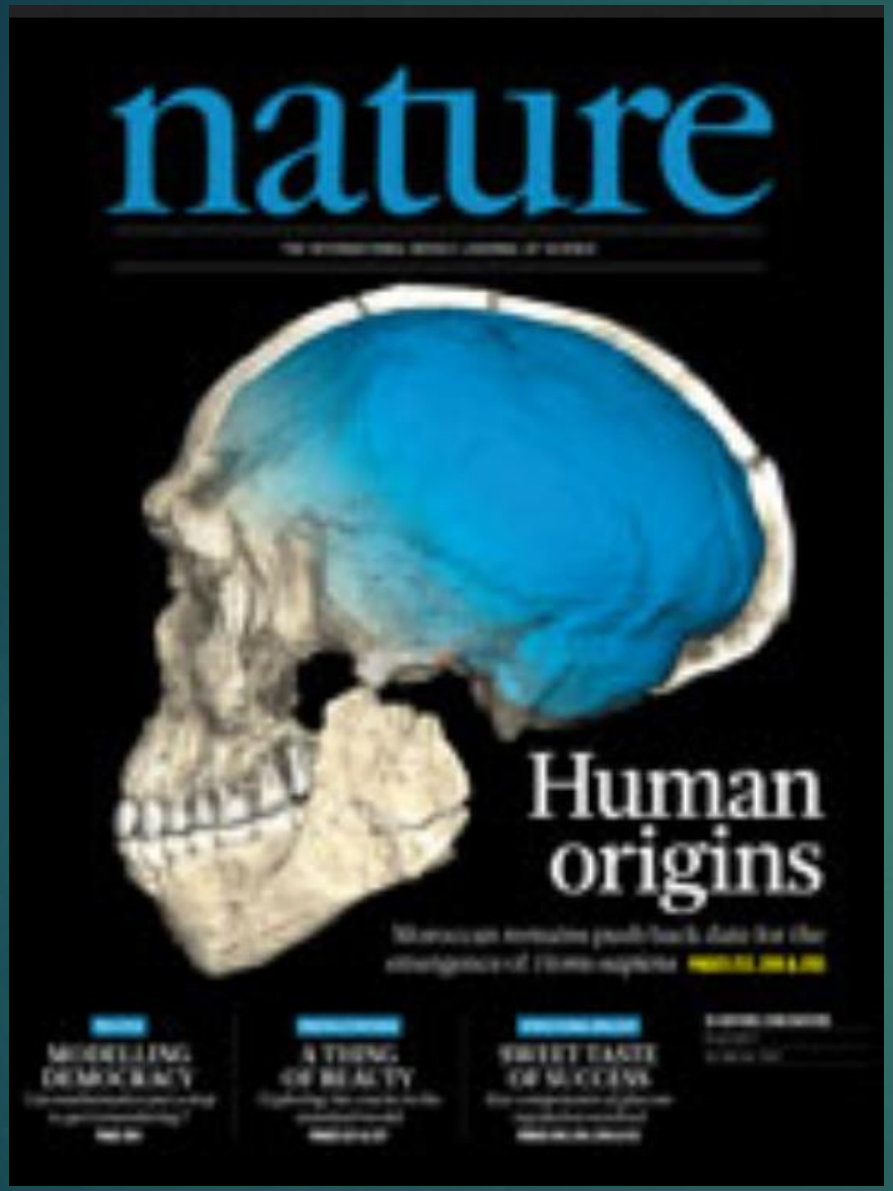
2004: Jebel Irhoud





- 2004: Jebel Irhoud, archaic modern
- Originally dated: 120 K
- Discovery: Jean-Jacques Hublin
- C. Stringer: related to Qafzeh/Skhul skulls

cranial capacity = 1305-1480cc



- 2017: Fossils from Jebel Irhoud, Morocco, can be regarded as the currently earliest known representatives of our species *Homo sapiens*

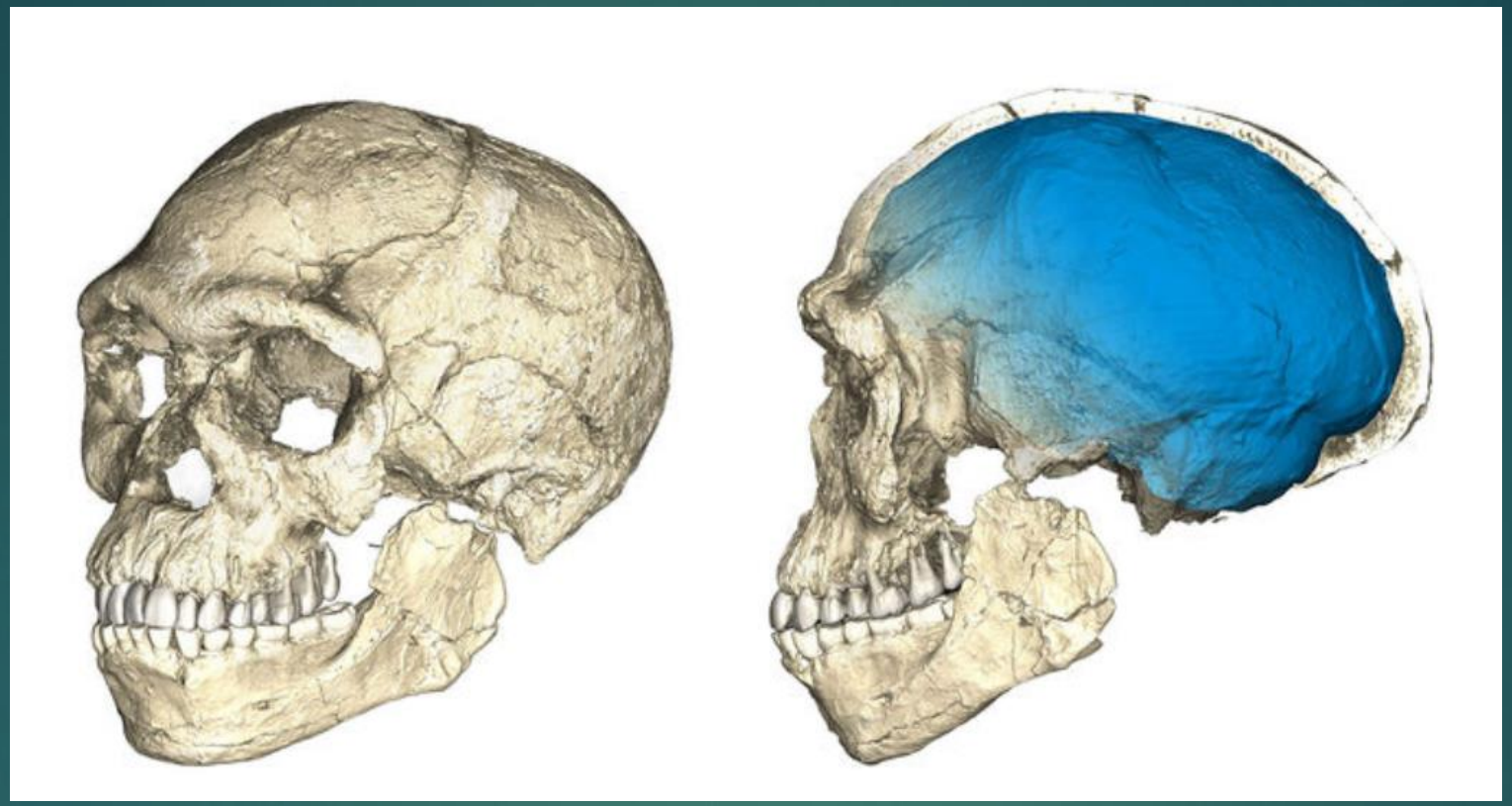
Stringer, C & Galway-Witham, *Nature,* **546**, 214 (2017)

Hublin, J.-J. *et al. Nature* **546,** 289–292 (2017).

Richter, D. *et al. Nature* **546,** 293–296 (2017).

http://www.nature.com/nature/journal/v546/n7657/full/546212a.html

Oldest *Homo sapiens*, Jebel Irhoud, Morocco, 315 Ka



2017 reassessment: A composite computer reconstruction of fossils from Jebel Irhoud shows a modern, flattened face paired with an archaic, elongated braincase; 100 K older than Omo II skull. Evolutionary processes behind the emergence of H. sapiens involved the whole African continent. The fossils suggest that faces evolved modern features before the skull and brain took on the globular shape seen in the Herto fossils and in living people.

Anne Gibbons, Science, 2017

Globular vs elongated endocasts

- Present-day modern humans have globular brains and globular endocasts with steep frontal, bulging parietal, and enlarged, rounded cerebellar areas. Together with small and retracted faces, this globularity characterizes the modern human skull.
- In contrast, Neandertals and other archaic *Homo* individuals have anterior-posteriorly elongated endocasts.

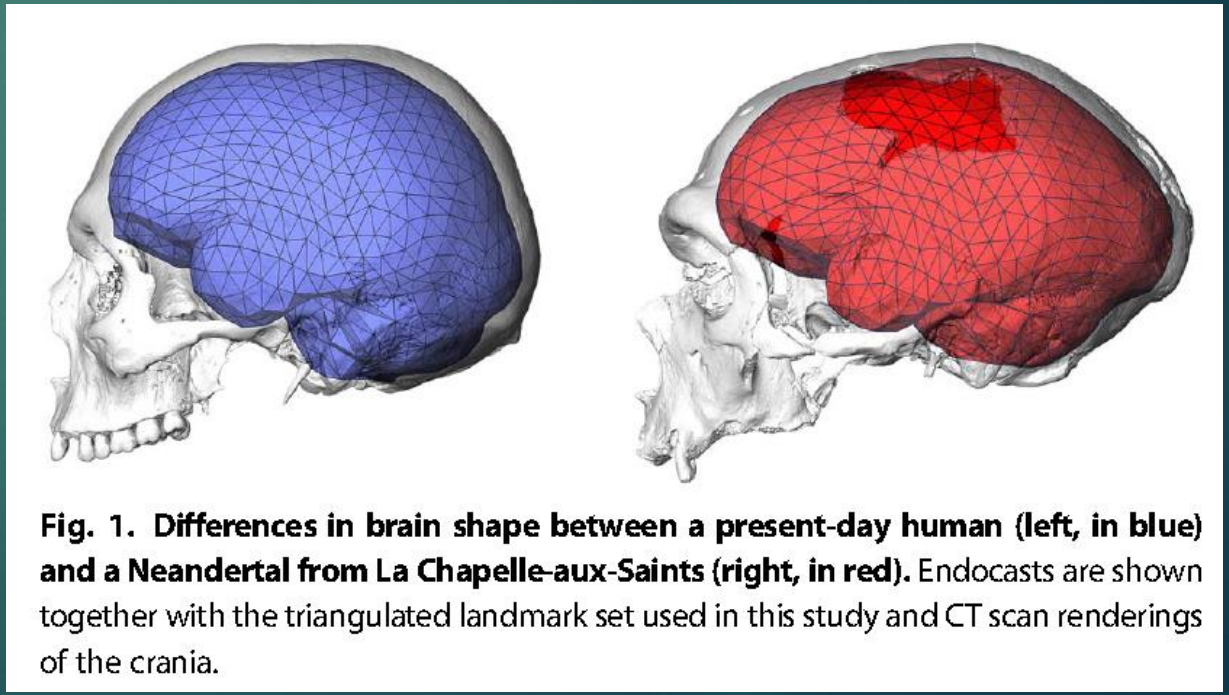


Fig. 1. Differences in brain shape between a present-day human (left, in blue) and a Neandertal from La Chapelle-aux-Saints (right, in red). Endocasts are shown together with the triangulated landmark set used in this study and CT scan renderings of the crania.

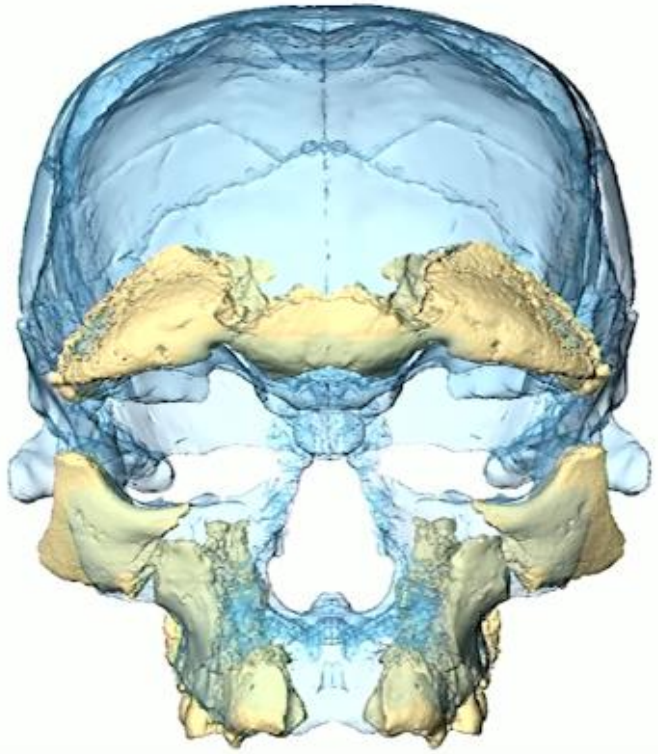
Late MP skulls: Jebel Irhoud I

- 2017: redating: estimate of 315 ka.

- Jebel Irhoud, Morocco (1961). Age: 280-350 ka.
- The human remains of Jebel Irhoud are considered the earliest representatives of *Homo sapiens* since this reassessment in 2017.
- Assessment was based on the:
  - modern face (gracile check bones and lack of projection),
  - the morphology of the dentition and the jaw (despite its large size),
  - combined with other primitive features, such as the elongated and low skull shape and the supraorbital arches.

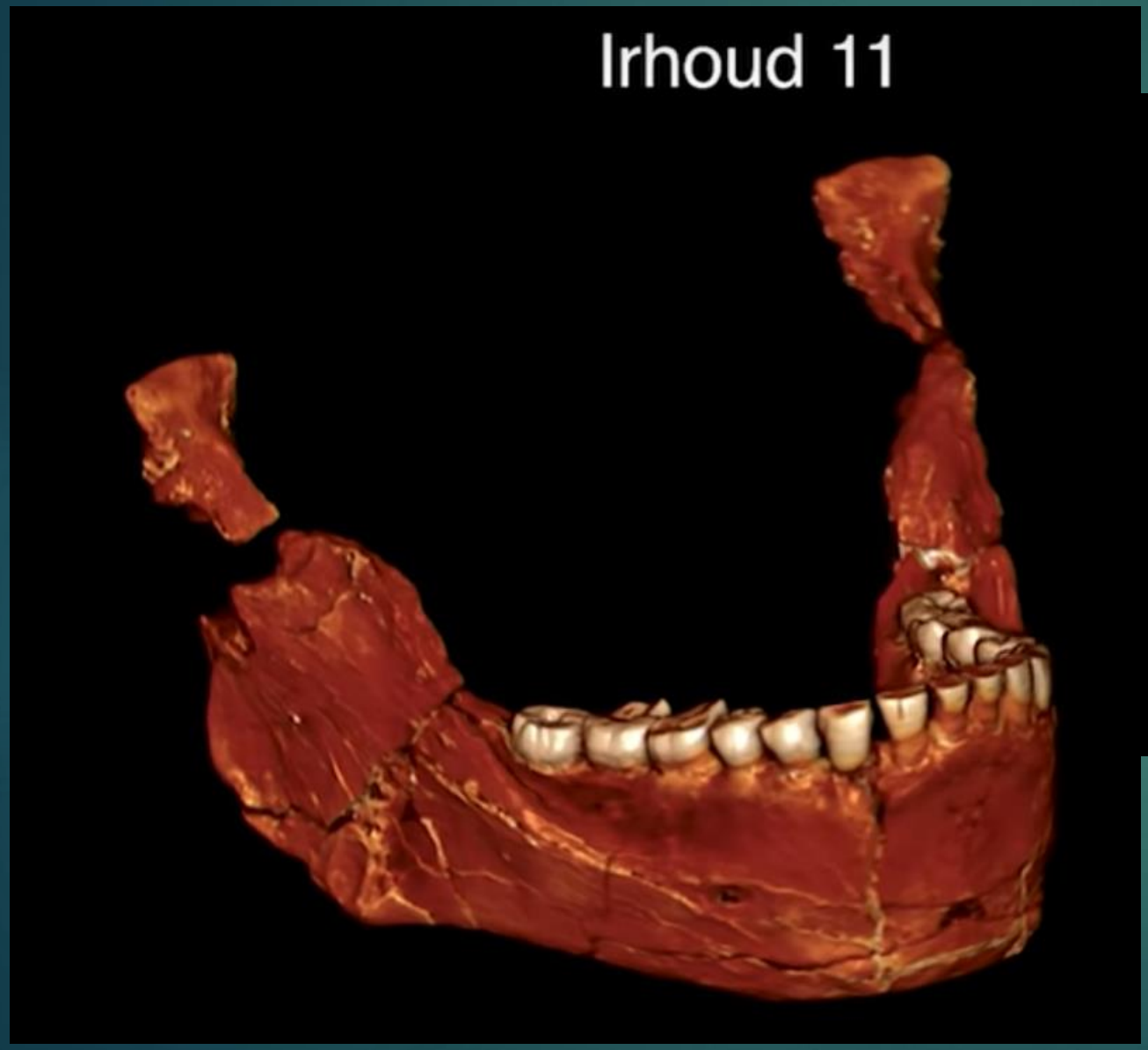
2004 excavation: new fossils

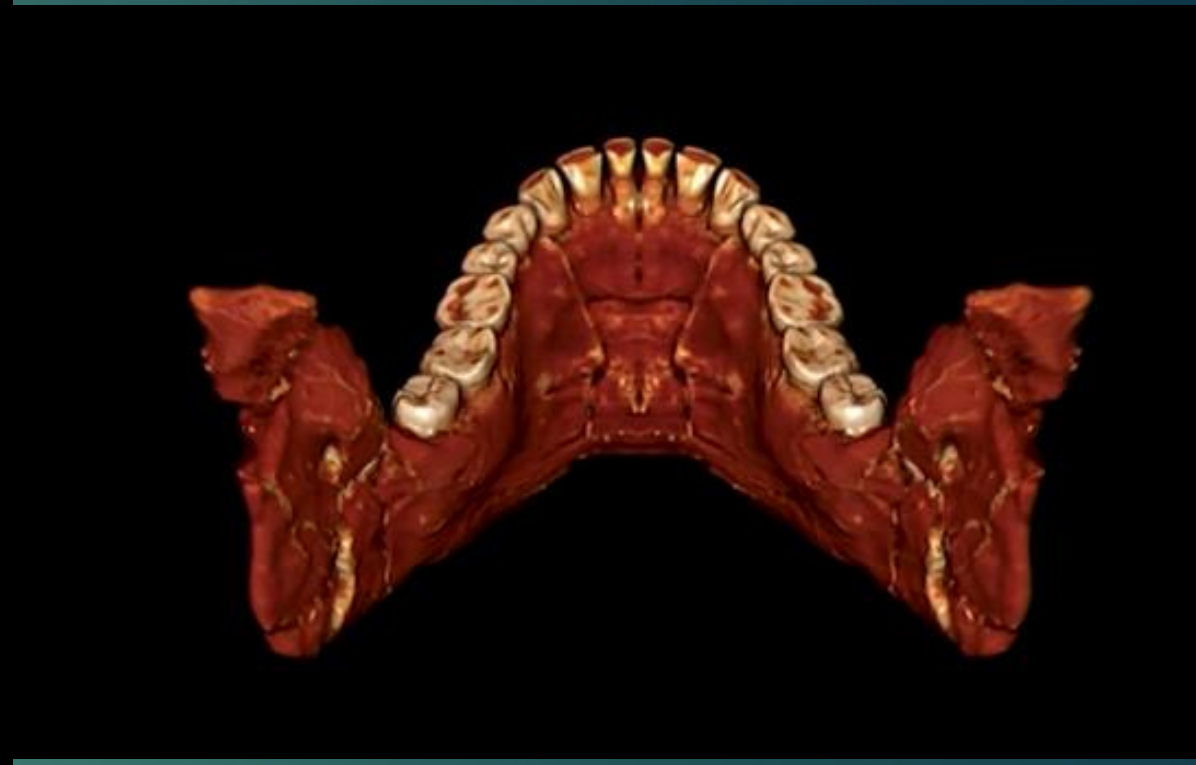
22 hominin remains
representing at least 5 individuals



Irhoud 10

Best Mandible of the MSA: no chin but early form of MH





Mandible

Irhoud 11 mandible: Mandibular body has a pattern typical of *H. sapiens*: its height strongly decreases from the front to the back. The Irhoud teeth are generally very large

Lower jawbone from Jebel Irhoud is nearly complete. Human fossils from this time period in Africa are exceedingly rare. Credit: Jean-Jacques Hublin, *Leipzig*

Early Human Origin: new timing

- Until recently most scholars believed that anatomically modern humans first appeared just under 200,000 years ago in East Africa, based on fossils of that age found at Omo Kibish in Ethiopia.

- Genetic analyses done since the 1990s indicated that all humans alive today descended from a single group of *sapiens* that began moving out of Africa some 60,000 to 70,000 years ago.

- These MHs reached the Middle East between 60,000 to 50,000 years ago, where they likely met and interbred with the dwindling Neanderthals, leaving all non-African populations with a small percentage of Neanderthal DNA.

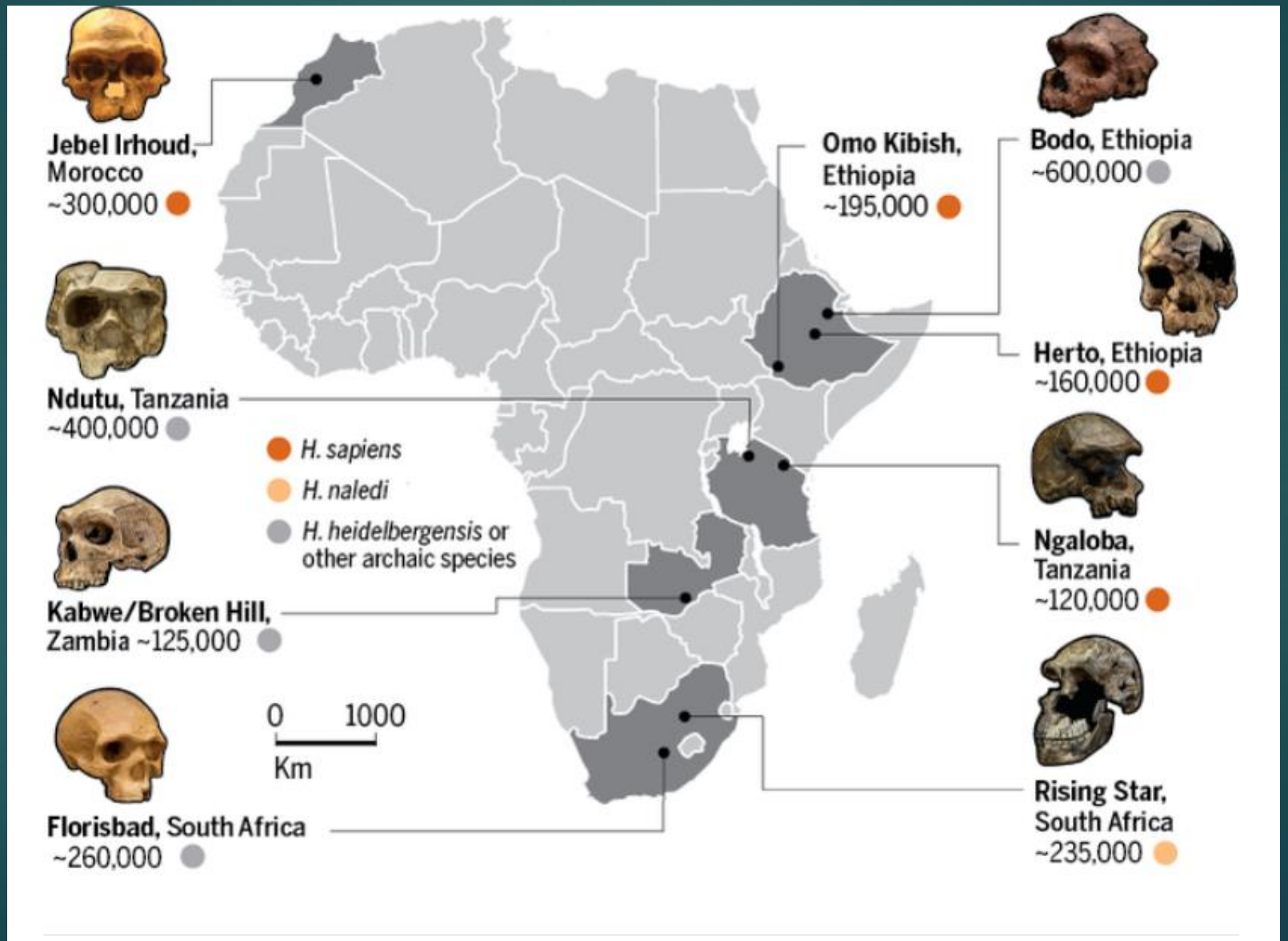
Early Human Origin

- While the last part of the story still stands, the idea of a relatively quick and late evolution followed by a single exodus from Africa no longer squares up with the most recent evidence

- It now seems that our ancestors appeared much earlier. The Jebel Irhoud bones push back the emergence of our species to at least 315 Ka.

- The pattern that is emerging now is that new populations of early Homo sapiens were constantly emerging from Africa, "leaking" out of the continent, interbreeding and coexisting with other hominins

The pan-African dawn of Homo sapiens: Long before the out-of-Africa dispersal of Homo sapiens, there was dispersal within Africa



Oldest *Homo sapiens*, Jebel Irhoud, Morocco, 300 Ka

Jebel Irhoud 1 Early MH, 315 ka

France, Modern Human, 20 Ka

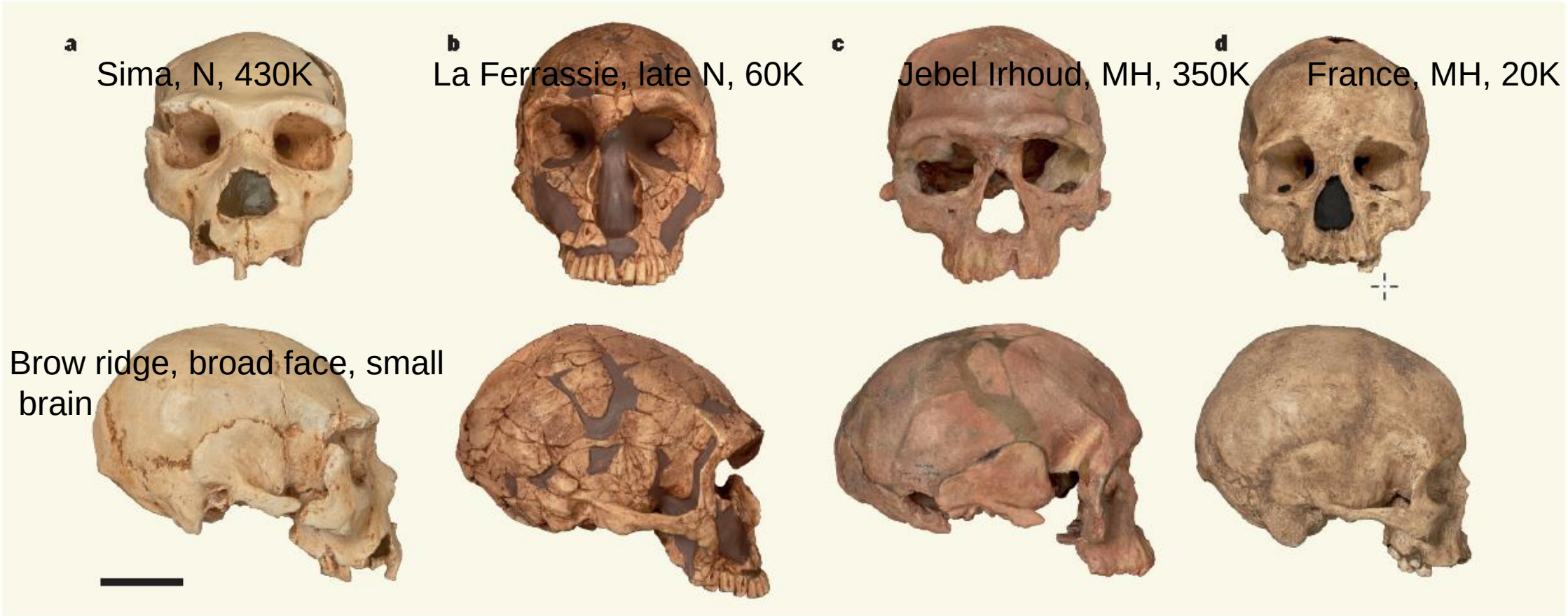


Figure 1 | Skull-shape differences. Structural differences in ancient skulls can illuminate evolutionary steps. Replica casts of the original skulls are shown. **a**, A skull found in Sima de los Huesos, Spain, that is around 430,000 years old[1,2] is thought to represent an early form of Neanderthal. The Sima cranium exhibits some traits observed in more-recent Neanderthals, such as the characteristic Neanderthal brow-ridge shape, but also retains some more ancestral features not seen in later Neanderthals, such as a broader face and smaller average brain size. **b**, An approximately 60,000–40,000-year-old skull[16] from La Ferrassie, France, is an example of a late Neanderthal. **c**, Hublin *et al.*[1] and Richter *et al.*[2] report approximately 350,000–280,000-year-old fossils from Jebel Irhoud in Morocco that could represent an early stage in *Homo sapiens* evolution. The facial shape of a Jebel Irhoud fossil previously discovered at the site[5] shows similarities to the structure of more-modern humans, such as the presence of delicate cheekbones. However, the shape of the braincase (the section of the skull enclosing the brain) is archaic in form, and has an elongated shape that is less globular than the structure of more-modern *H. sapiens*. **d**, An approximately 20,000-year-old *H. sapiens* fossil[16] from Abri Pataud, France, has a globular braincase. Scale bar, 5 cm.

Jebel Irhoud 1 to Qafzeh 9 evolution -- Braincase changes from 300 Ka to 95 Ka

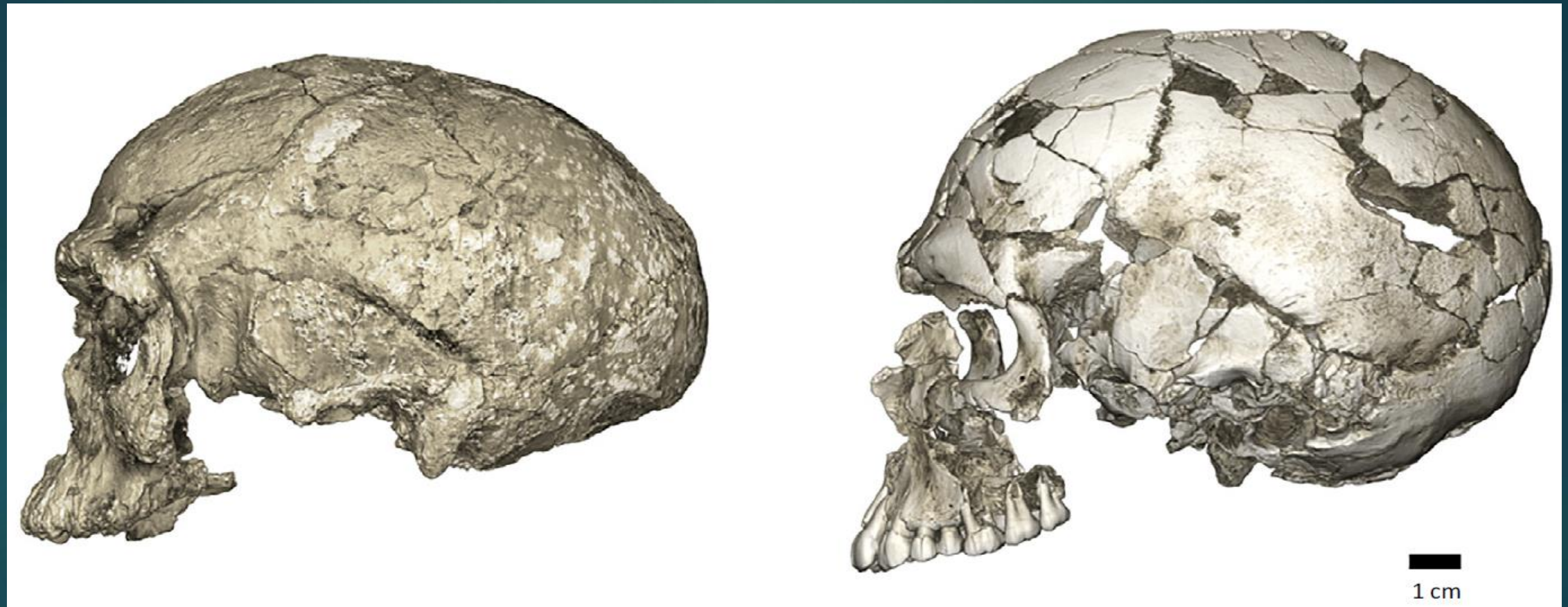
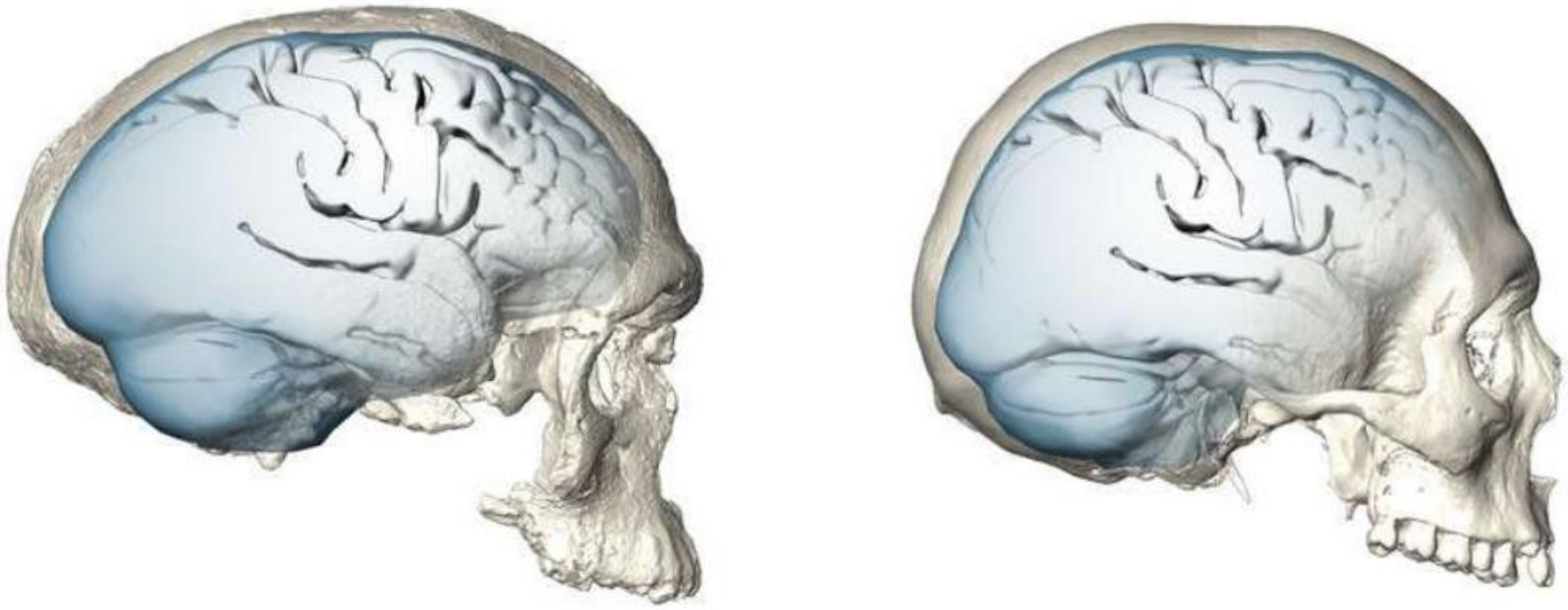


Figure 1. Evolutionary Changes of Braincase Shape from an Elongated to a Globular Shape. The latter evolves within the *H. sapiens* lineage via an expansion of the cerebellum and bulging of the parietal. (Left) Micro-computerized tomography scan of Jebel Irhoud 1 (~300 ka, North Africa). (Right) Qafzeh 9 (~95 ka, the Levant).

Jebel Irhoud: Evolution of H. sapiens braincase

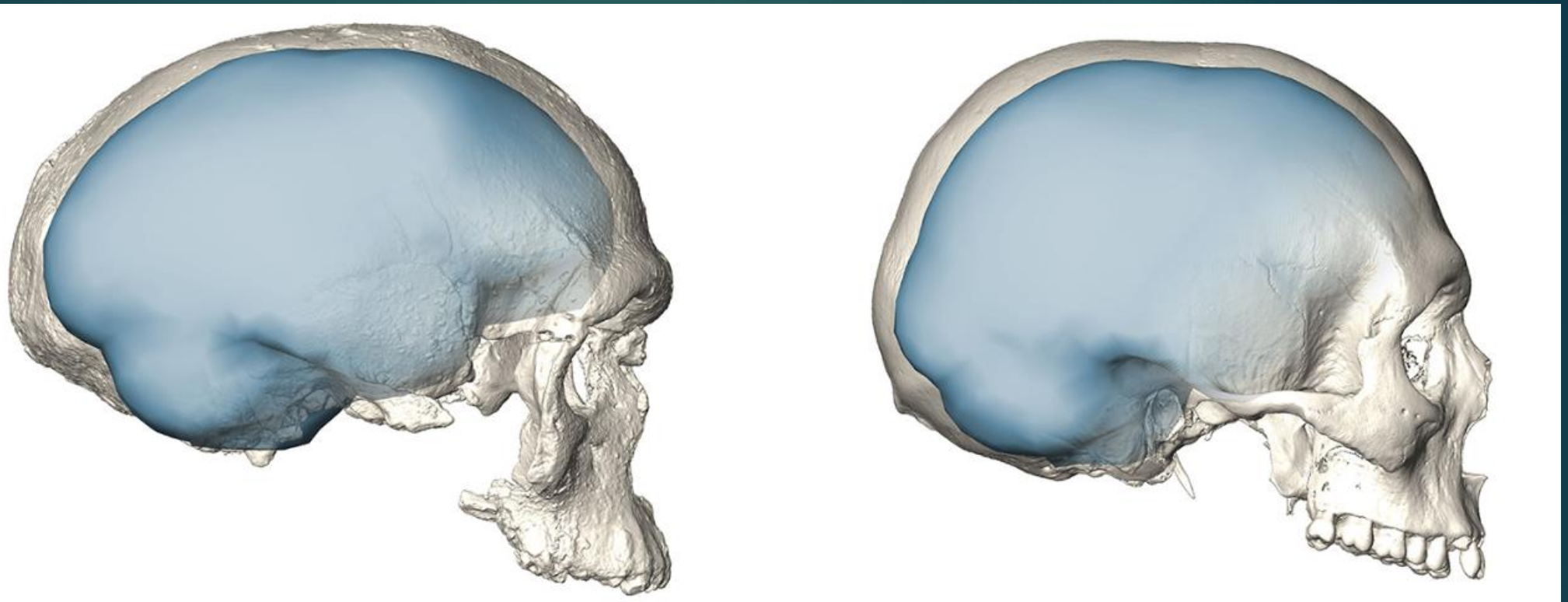
300 K



190 K

Brain shape evolution in Homo sapiens: brain shape of one of the earliest known members of our species, the 300,000 year-old cranium Jebel Irhoud 1 (left). Brain shape, and possibly brain function, evolved gradually. Brain morphology has reached the globularity typical for present day humans suprisingly recently (right). Credit: MPI EVA/ S. Neubauer, Ph. Gunz (License: CC-BY-SA 4.0)

Brain organization, and possibly brain function, evolved gradually within our species and unexpectedly reached modern conditions only recently. The Jebel Irhoud fossils document an early evolutionary phase of Homo sapiens on the African continent. Their face and teeth look modern, however their elongated braincase appears more archaic as in older human species and in Neandertals. In contrast, it is a globular braincase, which characterizes the skull of present-day modern humans together with small and gracile faces



The still elongated endocast of Jebel Irhoud 1, an early representative of our species (left) compared to a present-day human's endocast (right). (CC-BY-SA 4.0, Simon Neubauer, Philipp Gunz)

Jebel Irhoud endocasts are not round but elongated like those of Neanderthals and more ancient *Homo* individua

Jebel Irhoud

- Their facial morphology is almost indistinguishable from that of recent MH

- Like in the Neanderthal lineage, facial morphology was established early on, and evolution in the last 300 ka primarily affected the braincase.
- This occurred together with a series of genetic changes affecting brain connectivity, organization and development.
- Our species came into the world face-first, evolving modern facial traits while the back of the skull remained elongated like those of archaic humans

Chris Stringer @ChrisStringer65 · Aug 14

#FossilFriday early sapiens J.Irhoud (L) + La Ferrassie showing forward placement of face+jaw in a late #Neanderthal

N jaw was more prognathic (pushed forward) compared to Jebel Irhoud 1

MH facial features are ancient

- Paleoanthropologist John Hawks of the University of Wisconsin–Madison says their modern-looking traits might not actually reflect a connection to our species.
- He notes the analysis by Hublin and his colleagues did not compare the Jebel Irhoud remains with *H. antecessor* fossils from Spain dating to more than 800 Ka
- "There is an archaic human population with facial morphology that resembles modern humans in many ways, and it is a lot older than Jebel Irhoud," he says of *H. antecessor.*
- "Maybe Jebel Irhoud was evolving into modern humans, but another possibility is that it is retaining facial morphology from an *H. antecessor*–like population that may have been the last common ancestor of Neandertals and later African archaic humans."
- Chris Stringer agrees: MHs kept ancient facial form, Ns did not

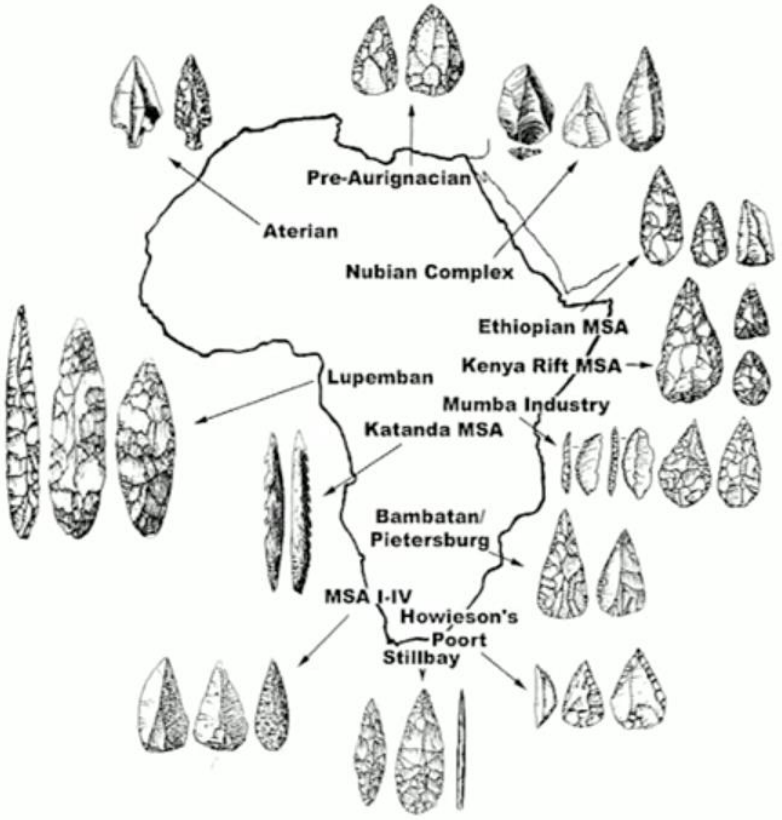
Jebel Irhoud

- Research team calls them early *H. sapiens* rather than the “early anatomically modern humans” described at Omo and Herto.
- Some people might still consider these robust humans “highly evolved *H. heidelbergensis*,” says paleoanthropologist Alison Brooks (GWU).
- R. Klein: “The main skull looks like something that could be near the root of the *H. sapiens* lineage"; he would call them “protomodern, not modern.”
- J. Hublin doesn’t propose that the Jebel Irhoud people were directly ancestral to us; Rather, they were part of a large, interbreeding population that spread across Africa when the Sahara was green about 300-330 Ka; they later evolved as a group toward modern humans

The Oldest MSA in Africa

Jebel Irhoud stone tools; Stone technology of variety of MH species in Africa

Late African Middle Stone age



(McBreaty & Brooks 2000)

(Scerri et al. 2018)

After 300 Ka, increasing diversity and complexity of stone & bone tools & ornaments
Increasing diversity of fossils in Africa

The Pan-African Origin of *Homo sapiens*

Eliye Spring, Kenya
>200 ka

Jebel Irhoud , Morocco
300 ka

Florisbad,
South Africa
260 ka ?

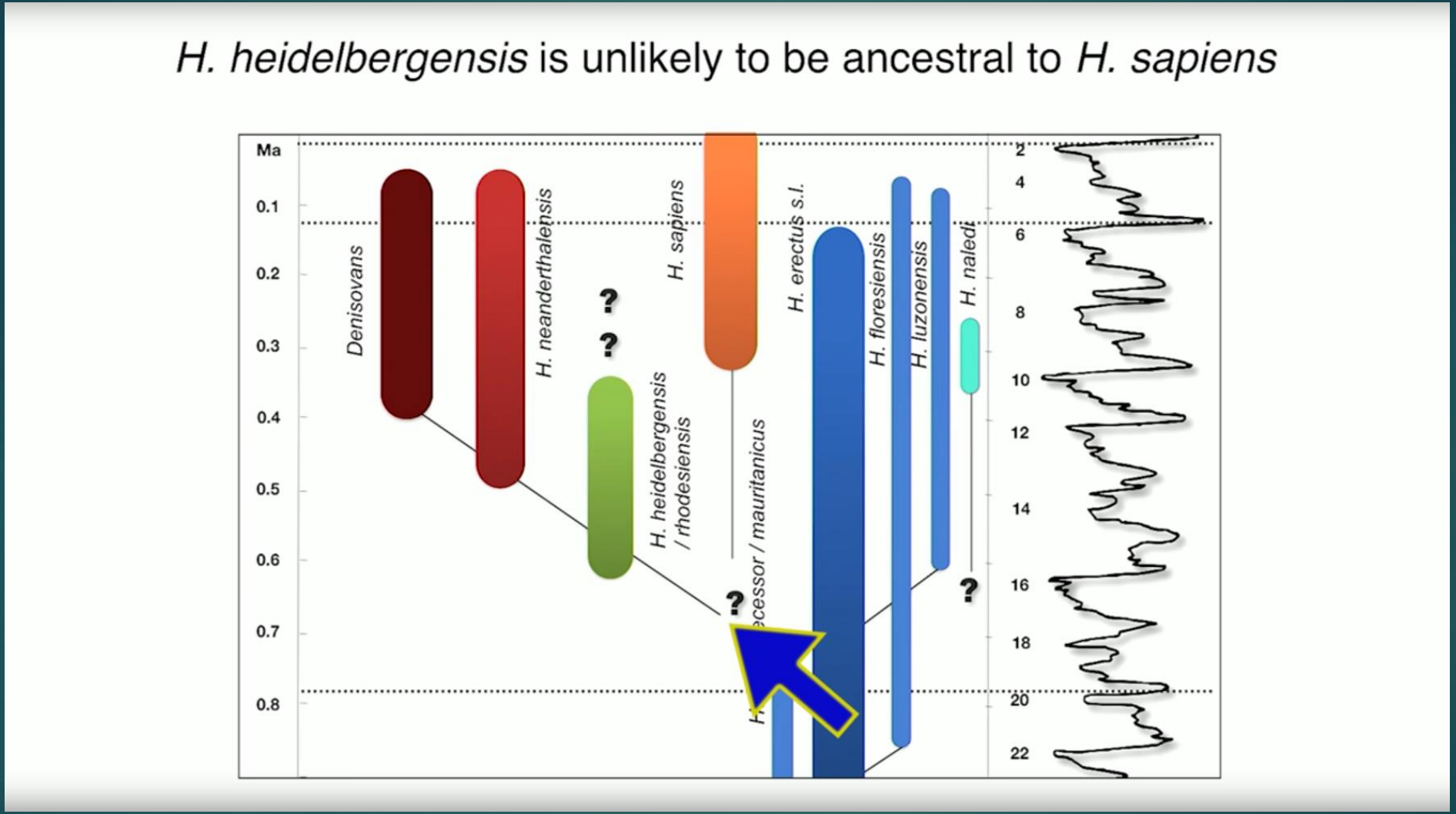
200 Ka, East Africa, Garden of Eden concept

- For last several decades, theory that there was a Garden of Eden in East Africa, that produced the first behaviorally and anatomically modern humans.

- J. Hublin: “We’re not claiming that Morocco is the cradle of modern humankind,”; our emergence as a species was pan-African.

- “There is no Garden of Eden in Africa—or if there is, it’s Africa,” Hublin said. “The Garden of Eden is the size of Africa.”

Jean Hublin, 2020: split point at 650 Ka



H. heidelbergensis as ancestral to *H. neanderthalensis* and Denisovans, but not *H. sapiens;*
Leaves question of origins of *H. sapiens* open

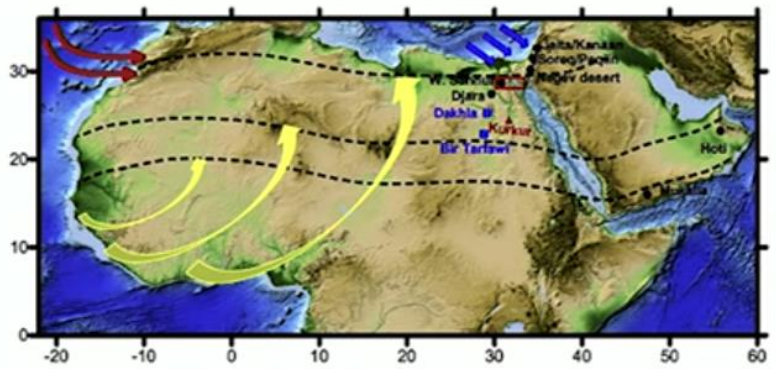
Jebel Irhoud ecology: Green Sahara

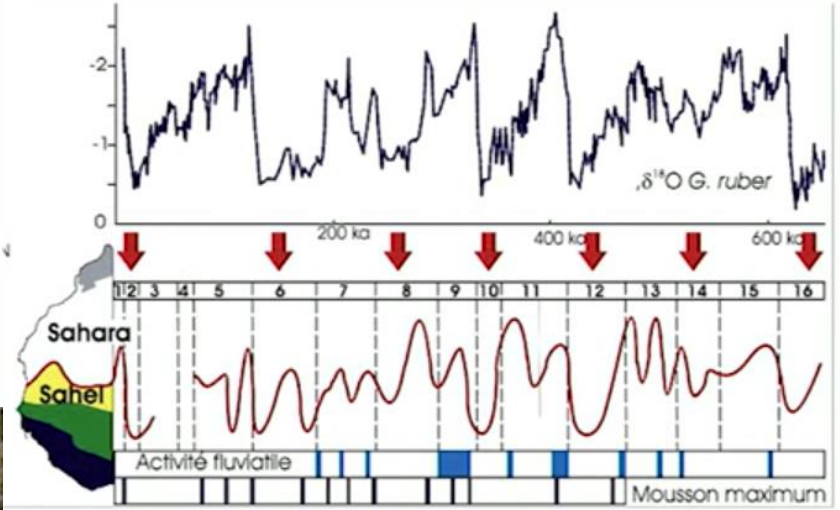
- The Saharan desert was greatly reduced during a series of Middle Pleistocene ‘green Sahara’ episodes, with an especially marked but short period around 330 ka.

- This would have allowed ecological continuity between north Africa and sub-Saharan Africa.

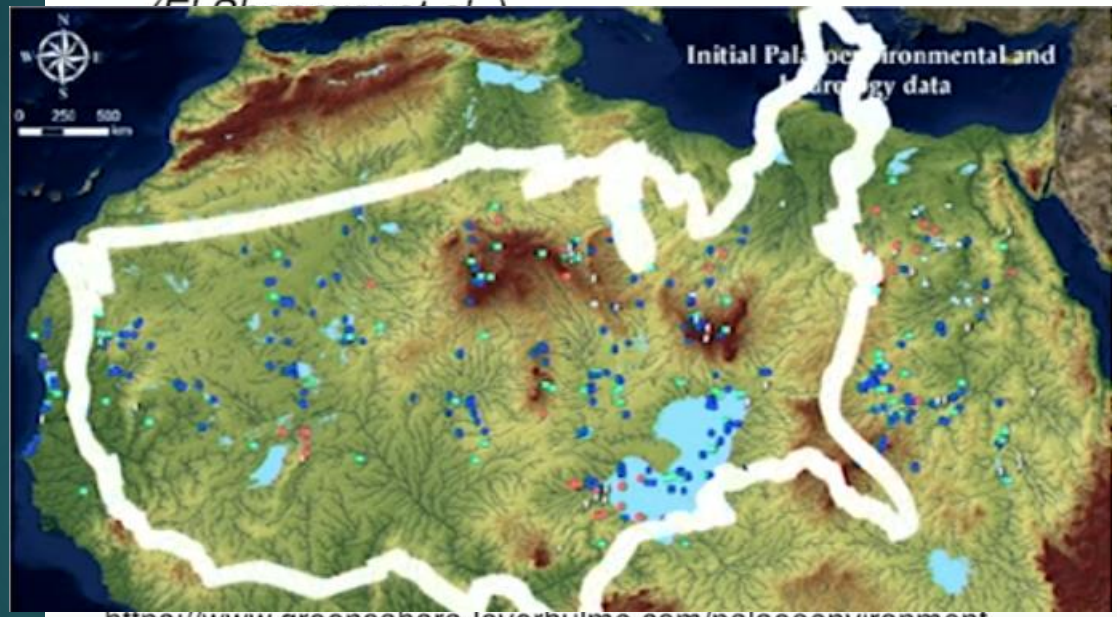
- Biological continuity between east and northwest Africa is also supported by strong faunal similarities, especially for the Middle Pleistocene, suggesting at least frequent communication between these regions.

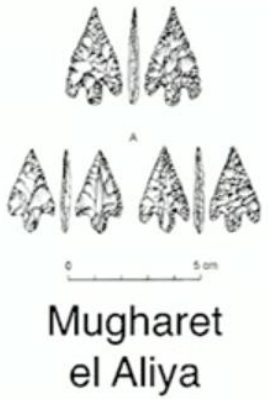
“Green Sahara” Episodes





(Lézine 2009)





Mugharet el Aliya

Ifri n’ Ammar

Points from N. Africa

Repeated greening of the Sahara due to climatic changes; Monsoons from Pacific went much further north. Sahara was home to hunter-gathers during this period.

Pan-African hypothesis

- In Hublin and colleagues' "pan-African" hypothesis, every African fossil that had parted ways with Neanderthals is part of a single lineage, a stem population for modern humans.
- They connect the evolution of these early *H. sapiens* people to a new form of technology, the Middle Stone Age, which was found in various regions of Africa by 300,000 years ago.
- So how many other archaic groups were in Africa? Under the Hublin model, there may have been none.
- Every fossil sharing some modern human traits may have a place within the "pan-African" evolutionary pattern. These were not river channels flowing into the desert, every channel was part of the mainstream.
- Geneticists disagree: think there were others.

2018: The evolution of modern human brain shape

- ***H. sapiens* endocasts had increasingly more modern shapes in accordance with their geologic age.**

- Surprisingly, only fossils younger than 35,000 years show the same globular shape as present-day humans, suggesting that modern brain organization evolved sometime between about 100,000 and 35,000 years ago.

- We also found that brain size at 300,000 years ago falls already within the range of that of present-day humans.

Simon Neubauer, et al. 2018

More modern brain shapes correlate with younger geologic age

- **So, which fossils are then "anatomically modern humans"?**

- Fossils from Jebel Irhoud, from Florisbad (South Africa, about 260,000 years old) and from Omo Kibbish (Ethiopia, about 195,000 years old) show clear affinities with present-day human facial morphology.

- Even fossils from Skhul and Qafzeh (Israel) and Laetoli (Tanzania) from about 100 Ka have not achieved fully modern brain shape

- Therefore, "anatomically modern humans" is an outdated, rather misleading term that should be dropped. We should recognise that *H. sapiens* is an evolving species with deep African roots.

Brain shape changes

- Changes in facial and endocranial form cannot be the driving force for globular brains: modern faces and large brains evolved long before the evolutionary brain rounding started.

- Two features of the globularization process stand out: bulging of parietal and cerebellar areas.

- The parietal lobe is an important hub in brain organization and involved in various integration and transformation functions.

- The cerebellum, in addition to motor-related functions, is associated with language, social cognition and affective processing.

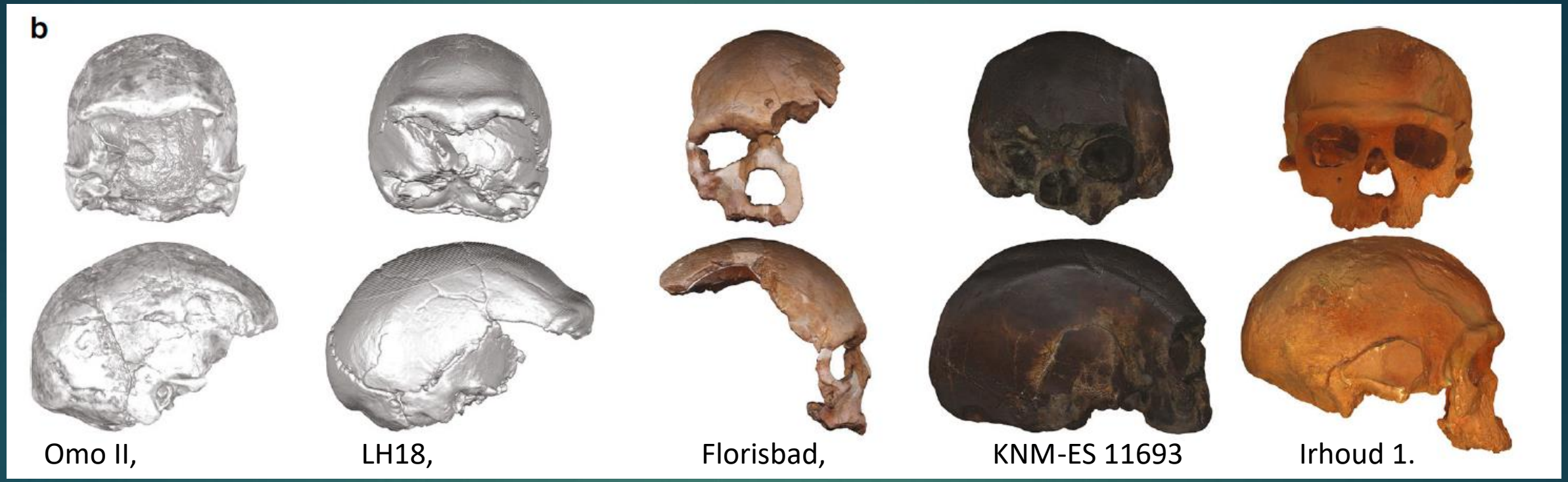
Evolutionary changes in early brain development

- In present-day humans, the characteristic globular shape of the braincase develops within a few months around the time of birth.
- The evolution of endocranial shape within *Homo sapiens* suggests evolutionary changes of early brain development - a critical period for neural wiring and cognitive development.
- Evolutionary changes to early brain development were key to the evolution of human cognition.
- The gradual evolution of modern human brain shape seems to parallel the gradual emergence of behavioral modernity as seen from the archeological record.

Mounier, 2019: Late MP skulls in East Africa

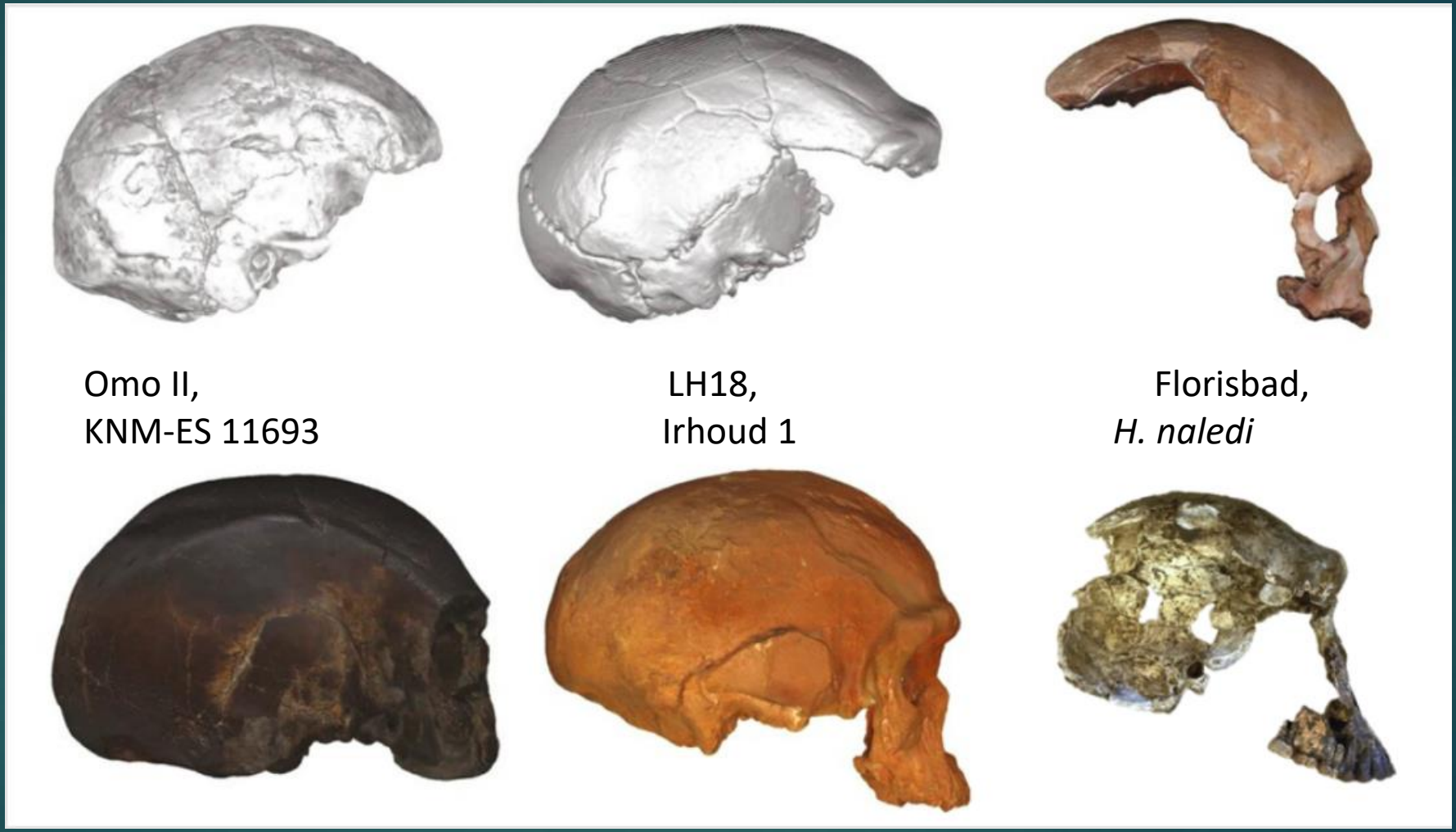
- Well preserved LMP hominins are more numerous in Eastern Africa.
  - In Kenya, the Guomde calvarium (KNM-ER 3884), which lacks most of the facial and frontal bones, has been dated to 270–300 Ka with ɣray spectrometry,
  - The nearly complete Eliye Springs skull (KNM-ES 1169327) on the basis of its morphology, with an age of 200–300 Ka
  - In Ethiopia, the Omo Kibish specimens, Omo I and Omo II, are dated to 200 Ka,
  - Three specimens from Herto, with an estimated date of 160 Ka.
  - The Singa calvarium from Sudan is dated to 133 Ka

Late MP skulls in Africa



From left to right, norma frontalis and lateralis of Omo II, LH18, Florisbad, KNM-ES 11693/Eliye Springs (the norma lateralis view is mirrored), and Irhoud 1.

Same slide with addition of *H. naledi:* lateral view



Frontal views

Modified from figure 3 in Mounier & Mirazón Lahr (2019) - see reference

East Africa

- Ethiopia: Middle Awash (Herto, Aduma), Omo: most convincing as well as earliest dated more fully MH fossils representing early AMH are 3 crania from Herto, Ethiopia; 160-154 Ka; no postcrania

- Herto skull = 1450 cc, long, high cranium; highest breath in parietal area; all 3 Herto skulls defleshed; not quite AMH; with Acheulean and MSA (Levallois)

Origin of *H. sapiens:* East Africa:

- Eliye Springs: (ES-11693) cranium, discovered by tourists, after rapid changes in lake levels at West Turkana, Kenya; Although heavily eroded, the face appears to resemble some late middle Pleistocene African crania in being relatively short, flat and broad; 88 and 130 ka.
- Ngaloba: Laetoli Hominid 18 (LH18) was recovered from the Ngaloba beds in the Laetoli region of Tanzania; does not conform to anatomically modern H. sapiens in overall morphology, despite a suggestive facial and parietal shape.
- Omo Kibish: 195 ka;
  - Omo I has a high, rounded and voluminous cranial vault with an occipital morphology of sapiens configuration, albeit with a wide frontal bone and strong but partitioned brow ridges;
  - Omo II also has a very large braincase, with an endocranial capacity of approximately 1435 cm_3, but is narrower, with parallel-sided rather than superiorly expanded parietals

Late MP skulls: Eliye Springs, KNM-ES 11693

- Eliye Springs, Kenya (1983). Age: 200-300 ka.

- This is a large skull with modern shape in its upper and rear view, very slight supraorbital development and absent transverse occipital torus.

- But it also has some primitive features: flattened and elongated appearance, with maximum width in lower position, presence of sagittal keel and very robust face.

Eliye Springs, ES11693, Turkana, Kenya

Homo heidelbergensis; ES11693

Site: West Turkana, Kenya
Year of Discovery:
Discovered by: Gunter Brauer and Richard Leakey
Age: Between 300 to 200 Ka
Species: *Homo heidelbergensis? Sapiens?*

Like LH18 cranium

Late MP skulls: LH 18

- Ngaloba, Laetoli, LH 18, Tanzania (1976). Age: 120-200 ka.

- Although it is large and quite modern, with some archaic features like a long and oval shape with a low vault, sloping and relatively flattened frontal bone, a significant and continuous supraorbital torus, and very thick bones, combined with a gracile face and a rounded occipital region.

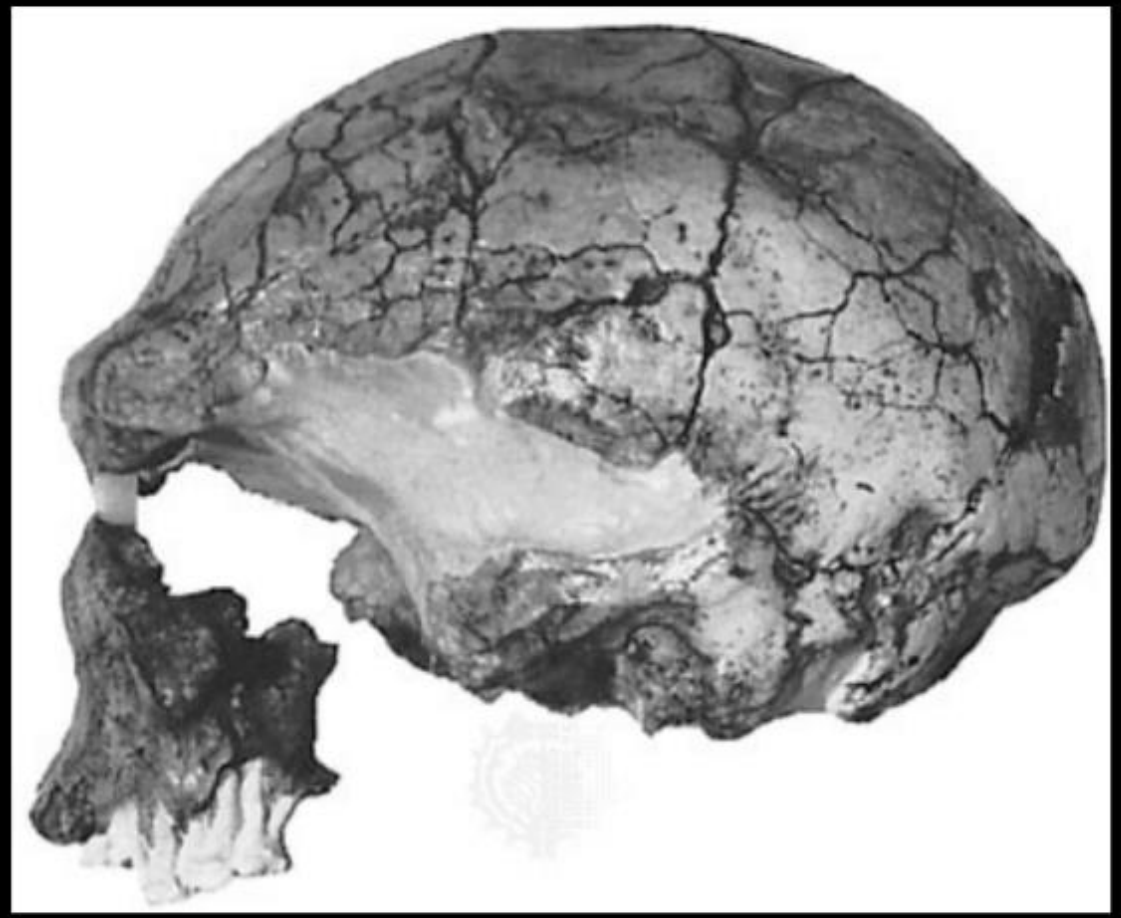
Ngaloba, Laetoli, Tanzania: LH18, 120 Ka

Homo sapiens: Ngaloba
Found: 1976
Discovered by: A team led by Mary Leakey

Dated: ~120 Ka
With MSA artifacts and fauna

Like Kabwe cranium; but facial & nasal reduction, slight postorbital constriction, canine fossa, moderately thickened browridge, greatest breadth is parietal

Laetoli 18
129,000-108,000



Origin of *H. sapiens:* East Africa

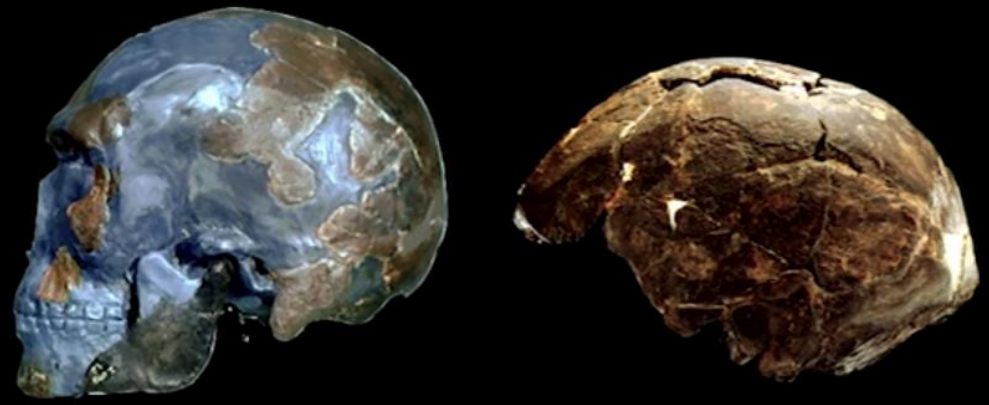
- Guomde Formation of East Turkana - proximal femur fragment KNM-ER 999 and a partial skull KNM-ER 3884; 180 ka

- Herto in Ethiopia: adult skull having a capacity of approximately 1450 cc. The length of the skull is outside the range of over 5000 modern crania, but its high and relatively globular shape conforms to the *H. sapiens* pattern.

- Singa calvaria from dry bed of the Blue Nile in Sudan; strong parietal bosses, but abnormal due to pathology; cranial capacity of about 1400 cc; 131–135 ka

A sub-Saharan origin of extant humans ca. 200 ka?

Herto, Ethiopia (160 ka)



Omo Kibish, Ethiopia (195 ka)

Laetoli H18, Tanzania (120 ka)

“Modern Humans”: Cladistically modern (ancestral to us), but not anatomically modern, nor behaviorally modern

Herto Cranium From Ethiopia

- Herto cranium from Ethiopia, dated 160 – 154 Ka.
- This is the best- preserved early modern *H. sapiens* cranium yet found.

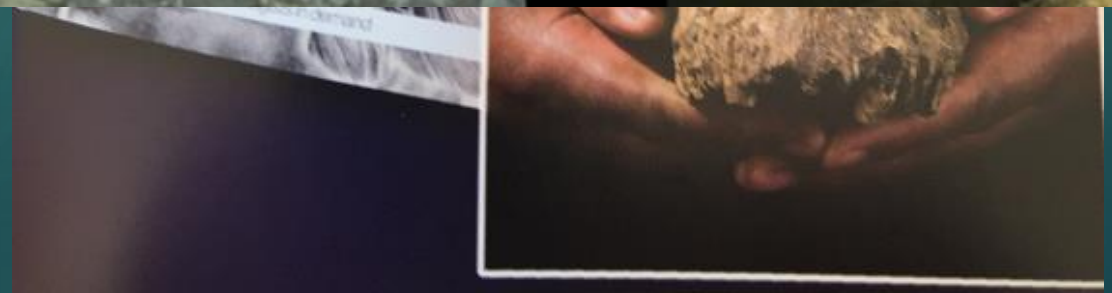
Herto, 160 Ka

- Three individuals are represented by separate fossils:
  - best preserved skull BOU-VP-16/1, a nearly complete adult cranium (skull parts excluding the lower jaw), 1450 cc
  - a less complete juvenile cranium, and
  - some robust cranial fragments from another adult.
  - all have high cranial vault, large frontal & parietal;

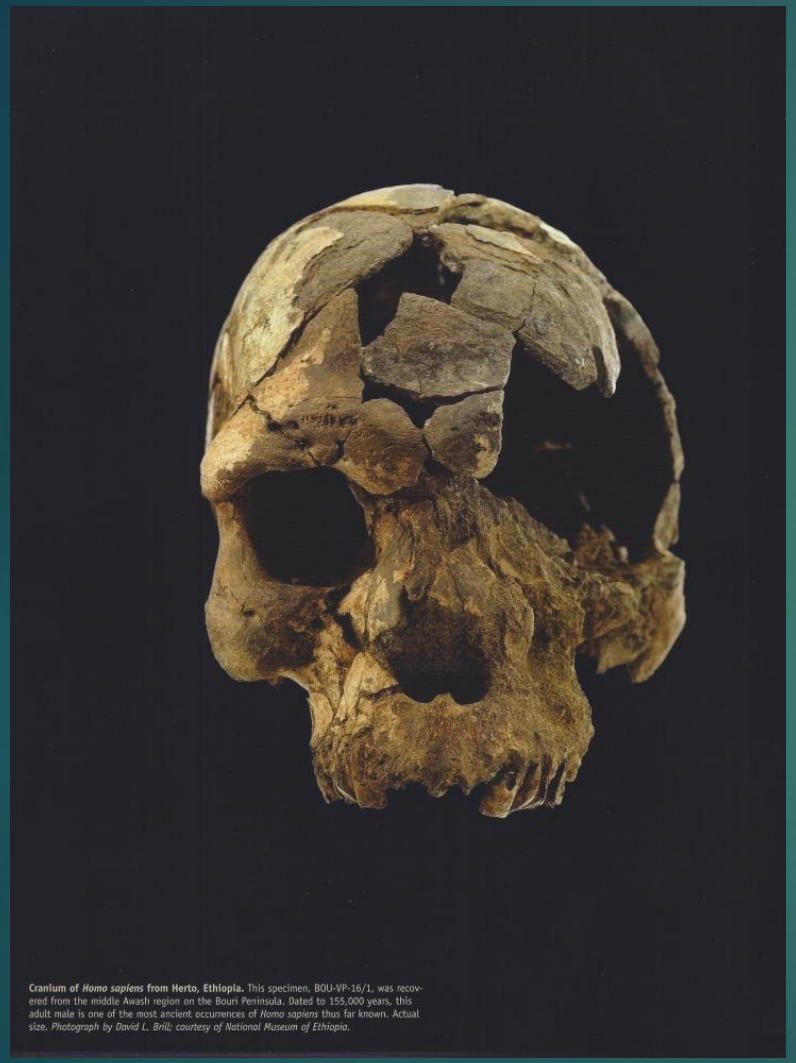
- All display evidence of human modification, such as cut marks, considered to represent mortuary practices rather than cannibalism.

- Associated layers of sediment produced evidence of the butchery of large mammals such as hippopotamuses and bovines, as well as assemblages of artefacts showing an interesting combination of Middle Stone Age and late Acheulean technology.

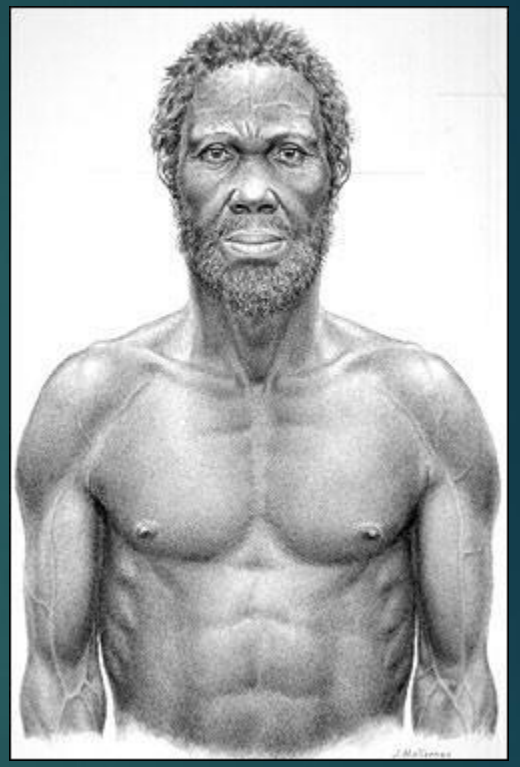
Herto, 160 Ka
Middle Awash



2003: *Homo sapiens idaltu*, 160K, Herto: Tim White & Berhane Asfaw



Herto, Ethiopia; Bou-VP-16-1



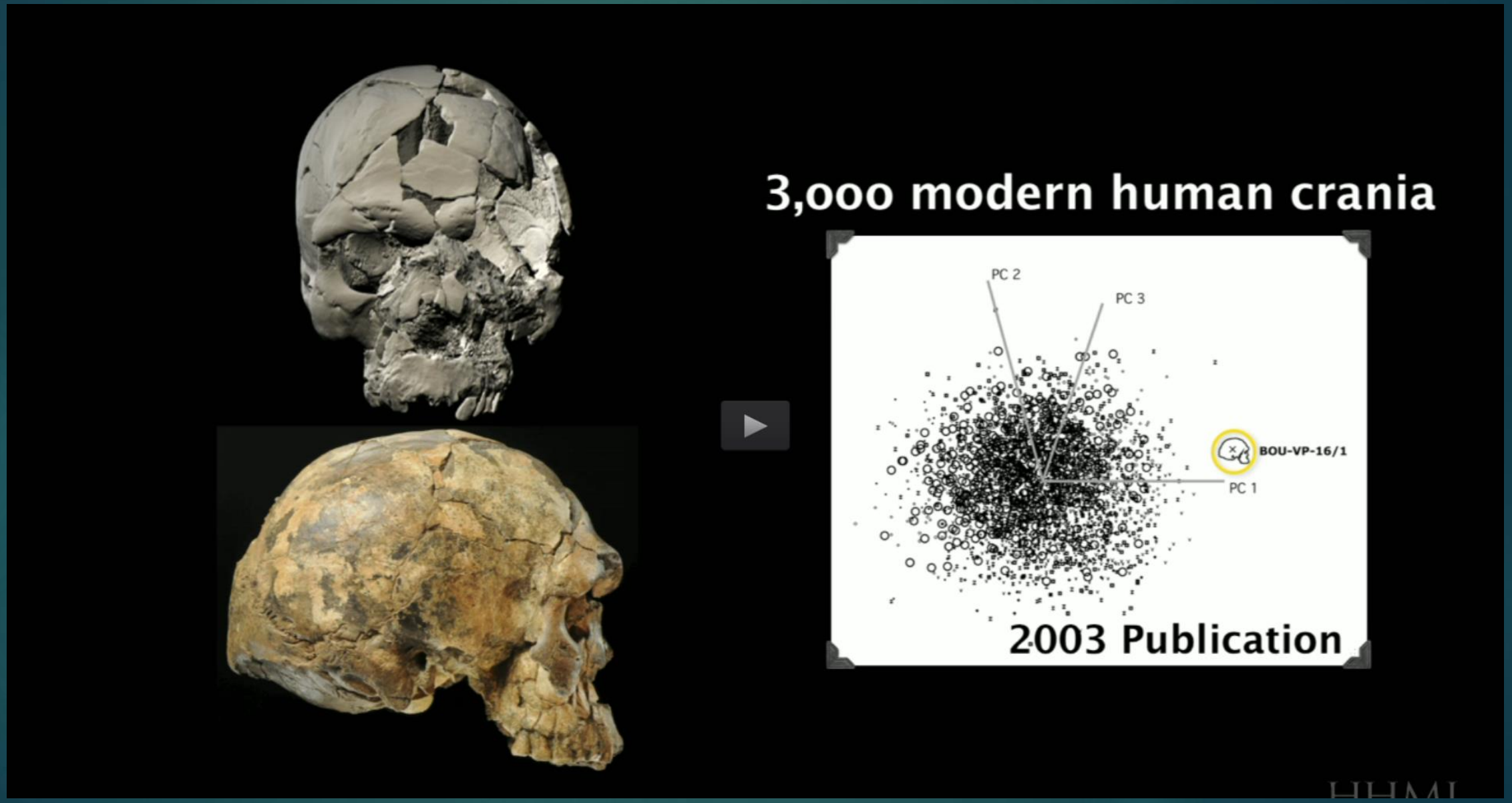
Found with fossils of hippo calves

Tim White & Berhane Asfaw

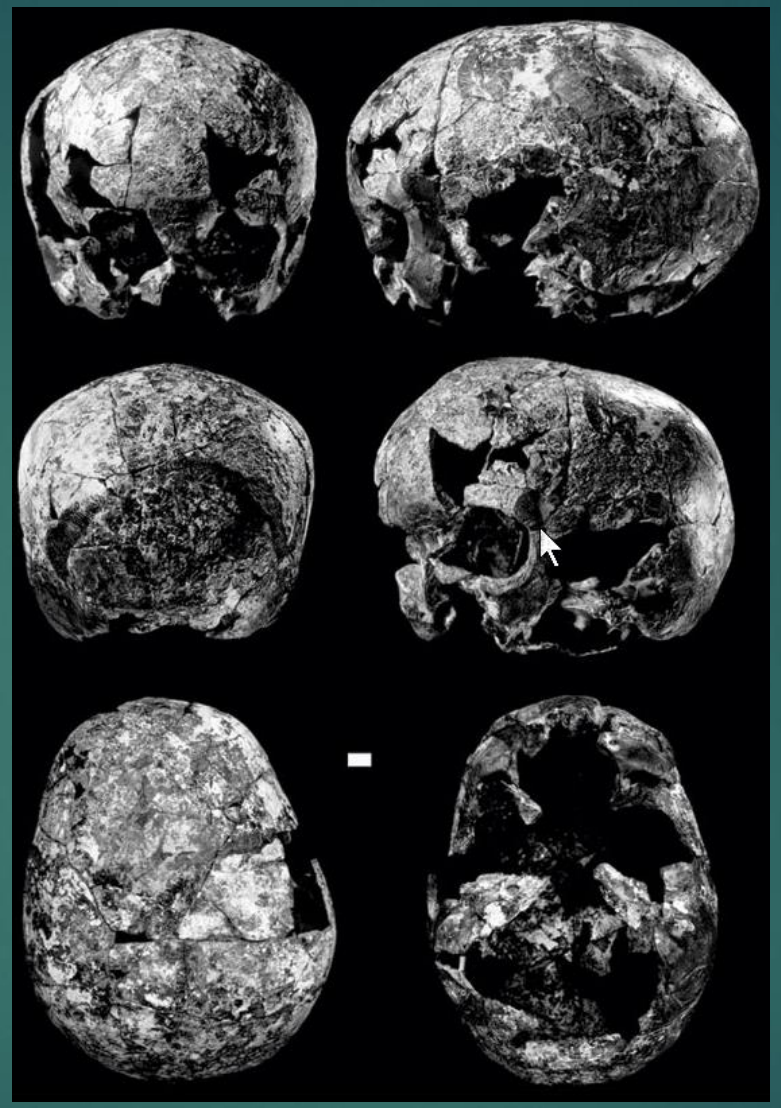
Tim White considers Herto, Ethiopia; Bou-VP-16-1 *Homo sapiens idaltu*

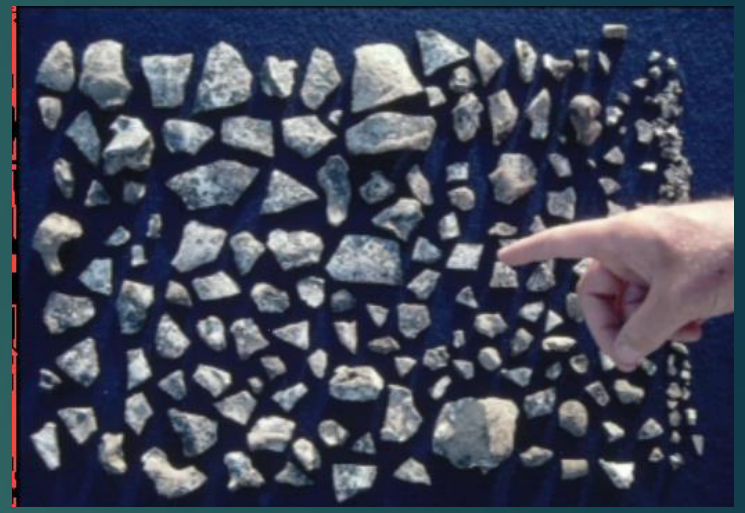
Locality: Herto
Date: 1997

Comparison to 3000 MHs



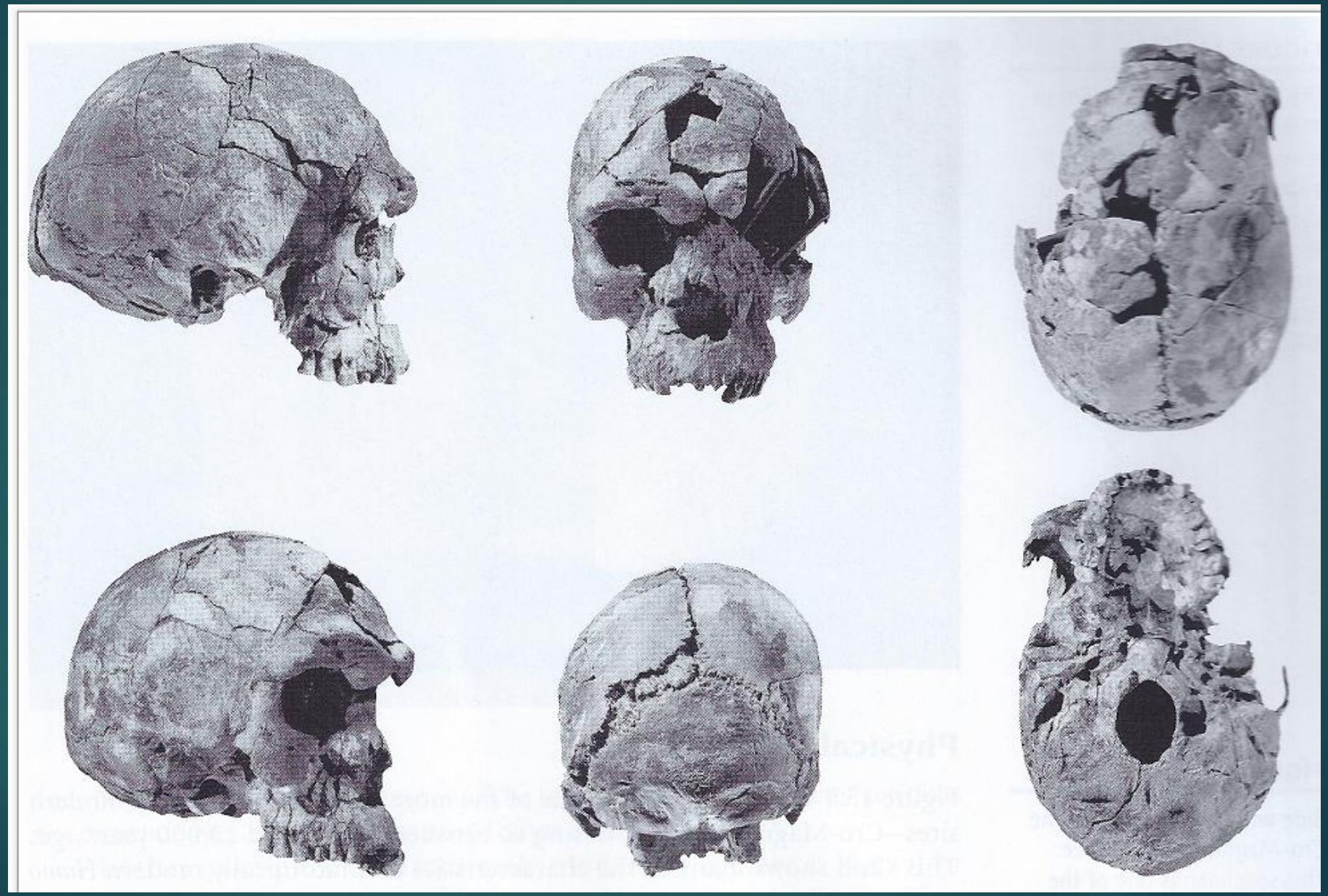
Herto, Ethiopia; Bou-VP-16-1





Bou-VP-16-5, 7 yo, child
180 fragments

Herto: BOU-VP 16-1



Aduma, Ethiopia, 105-79 Ka

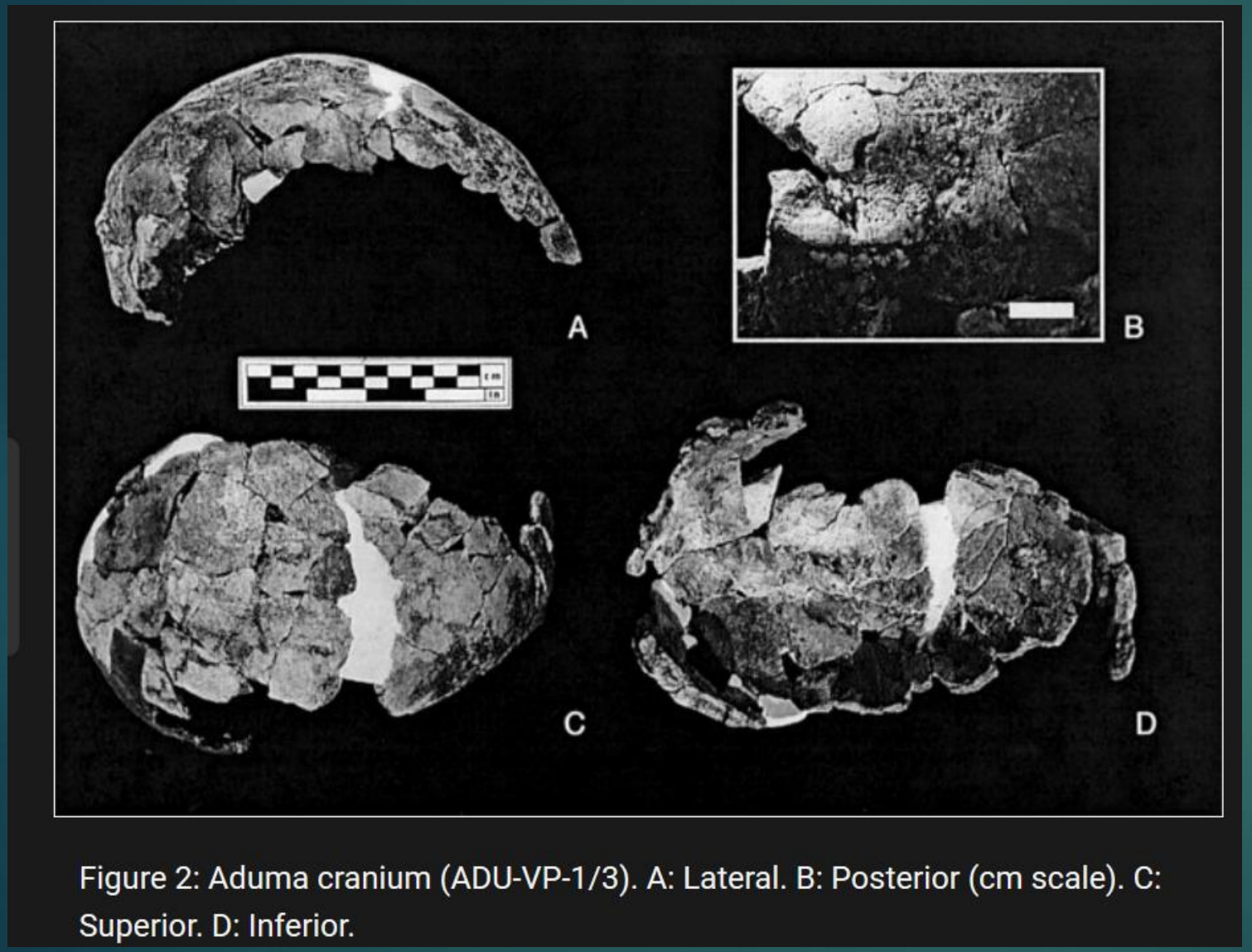
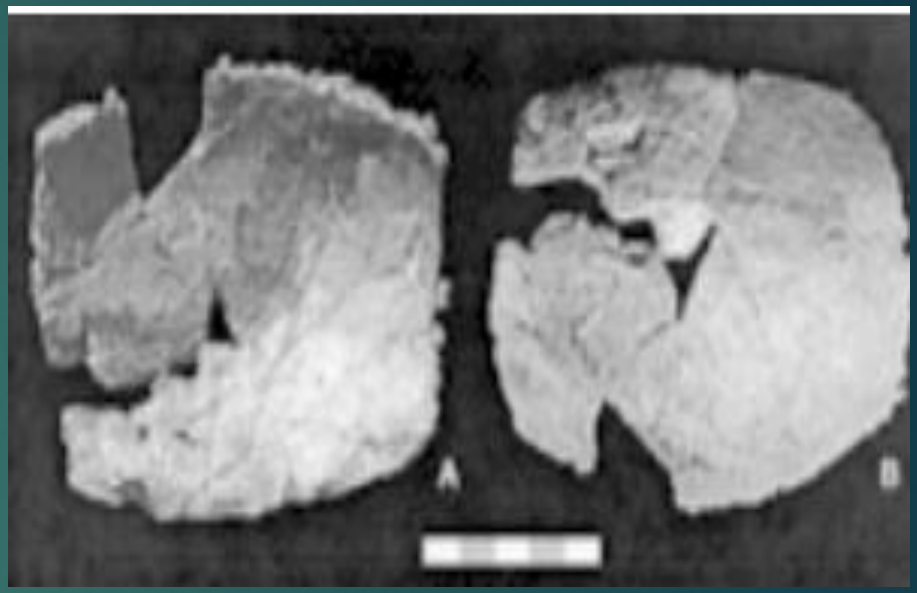


Figure 2: Aduma cranium (ADU-VP-1/3). A: Lateral. B: Posterior (cm scale). C: Superior. D: Inferior.



High vault, rounded occipital, curved parietal, & large size

Haile-Selassie Y, Asfaw B, White TD, 2004

East African MHs: Omo

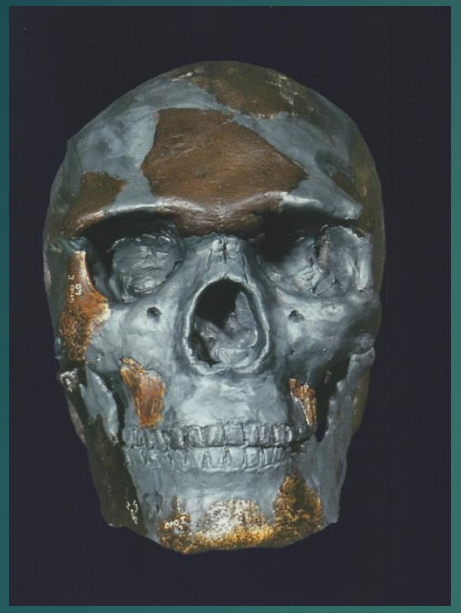
- Earliest clearly AMH comes from Kibish Formation in Ethiopia's Omo region

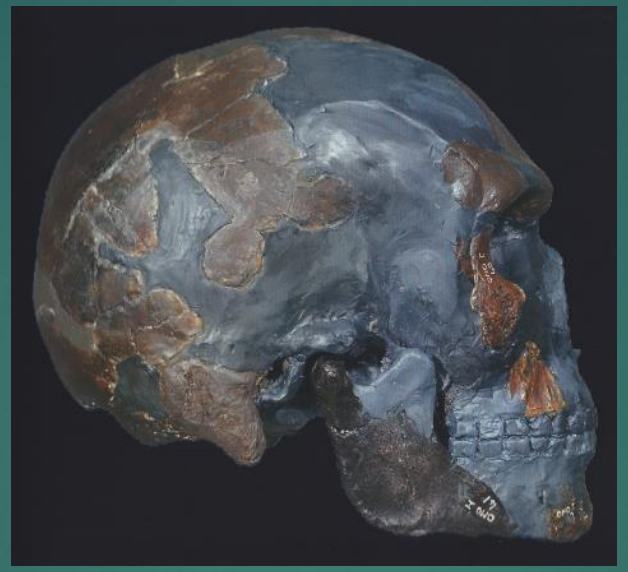
- Omo I: numerous cranial, dental & mandibular fragments; & much of postcranial skeleton; Omo I skeleton is fully modern, but some primitive features that are shared by Ns and Qafzeh;

- Omo II: is nearly complete cranium, which has long low braincase & curved occipital; Omo II may represent different populations; both skulls dated to 196 Ka

- With stone MSA tools: Lavallois cores, handaxes, foliate bifaces

1967: 2nd oldest *Homo sapiens,* Omo Basin, 196 Ka: Curved parietal, high forehead, chin





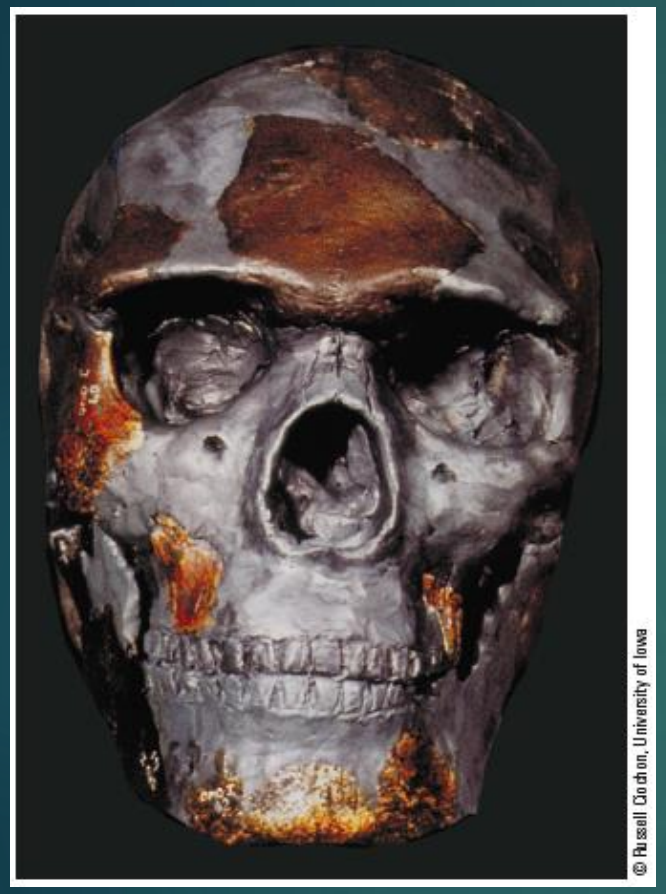
Homo sapiens, Omo II

Homo sapiens
(Omo I)
Discoverer:
Kamoya Kimeu
Date: 1967
Locality: Kibish,
Omo Basin, Ethiopia
Age: 196K

At 196 Ka, 2nd oldest known modern human fossil

Omo I, Ethiopia

Omo I



- Reconstructed skull of Omo I, an early modern human from Ethiopia, dated to 195 Ka
- Note the clear presence of a chin.

Omo I and II

Omo Kibish II

M. Day + C. Stringer reconstruction of Omo I

Replicas of Omo Kibish II (left) and Day+Stringer reconstruction of I (right). Both sapiens lineage from Ethiopia and dated -196 Ka, but Omo I (which has been directly dated) shows much clearer modern sapiens features

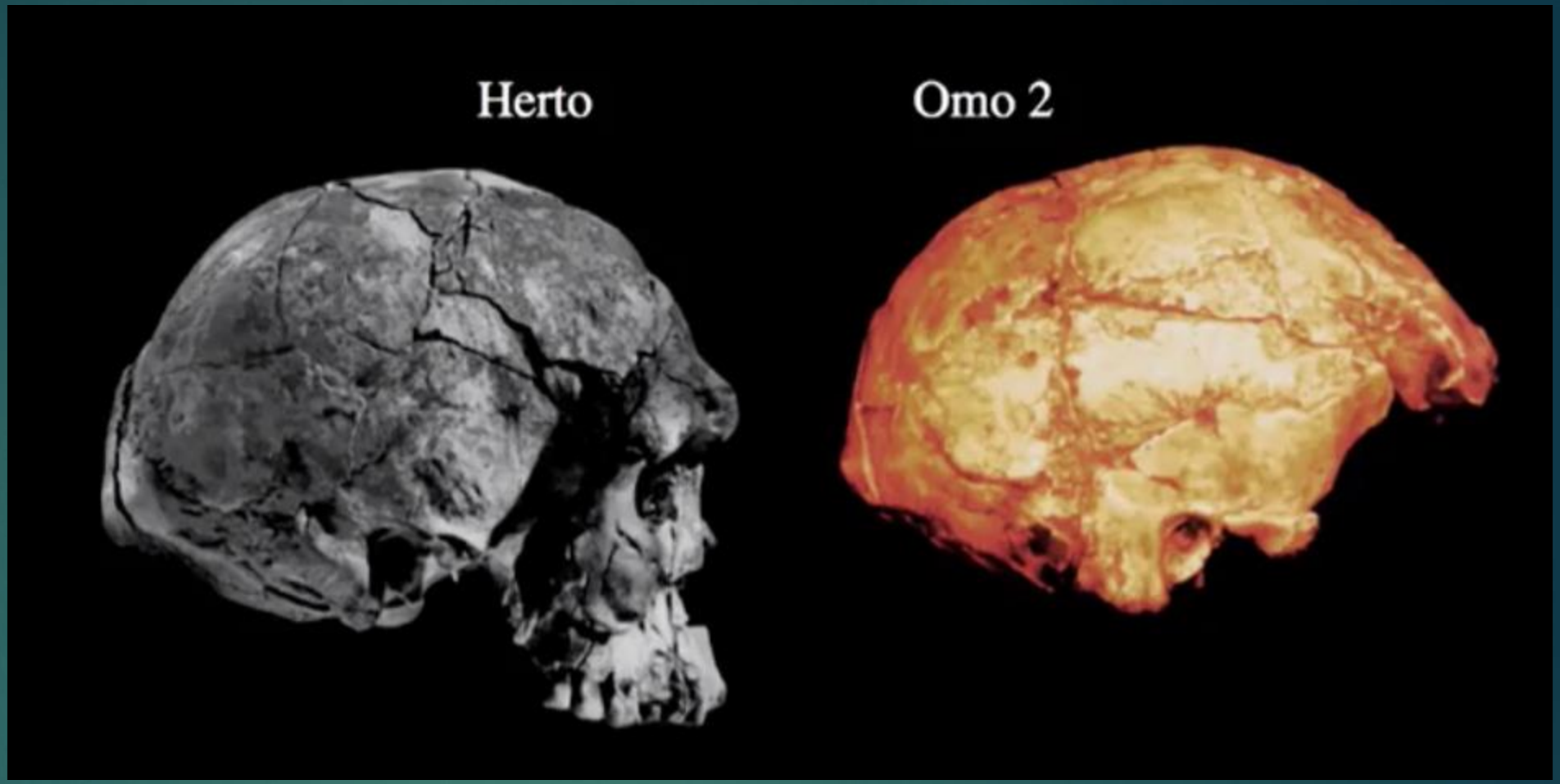
Omo II: 2nd Oldest *Homo sapiens* Skull

- Discovered 1967 near Omo River in Ethiopia
- 2005 better dating = 196 Ka

Late MP skulls: Omo II

- Kibish rock formation, Omo River Valley, Ethiopia (1967). Age: 190-200 ka.
- This cranium is quite different from the other one found at the same location: Omo I was thought to be the earliest *Homo sapiens* fossil until the reassessment of the Jebel Irhoud materials in 2017, which predated that record.
- However, Omo II is less rounded, longer and narrower than Omo I. Similarly to Jebel Irhoud, many features are outside the variation of modern humans while others are fully modern.
- This mosaic makes it really difficult to classify this cranium and shows the variability of the African Middle Pleistocene human groups. Many of them probably become extinct.

Herto & Omo



- Herto is very large; huge cranium; but still prominent browridge & zygomatics & projecting lower face
-
- African variability: While in Herto we have a bit of frontal bossing in terms of a vertical forehead, in Omo II we have a much more Southeast Asian-like condition in terms of a long, sloping forehead going directly from the supraorbital torus up to the bregma (sutures meet), as opposed to the projection of the supraorbital torus and then the frontal bossing that we see here in Herto.

Singa, Sudan: 150 Ka

Singa
Site: Singa, Sudan
Year of Discovery: 1924
Discovered by: W.R.G. Bond
Age: Between 150,000 and 120,000 years old **Species:** *Homo sapiens*

Guomde, East Turkana: 160 Ka: skull fragments

South Africa

- Southern Africa fossils: Die Kelders Cave, Equus Cave, Border Cave, Klasies River mouth, ca 130-60 Ka; more modern

- S. Africa: earliest art – red ocher (100 Ka), engraving (80 Ka) at Blombos cave; but scant hominin findings

- Florisbad (hyena-gnawed anterior partial cranium), 259 Ka; Florisbad cranium: found in 1931 – frontal, parietal piece and incomplete right side; an archaic part of the *H. sapiens* clade; *H. helmei?*

Die Kelders Cave, 60-70 K & Equus Cave, 103-10 K

- Die Kelders: at SW coast of S Africa; Both MSA and LSA tools; 71-57 Ka; MSA exploited less dangerous animals (eland, penguins, no fish); parts of 10 individuals (Twenty-seven human fossils: 24 isolated teeth, a mandibular fragment, and two manual middle phalanges). The vast majority are children.

- Equus cave: 500 meters from Taung; extensive late Pleistocene fauna from hyenas; both MSA and LSA; 103 Ka and <10 Ka; modern hominin specimens: – 12 teeth, left mandibular corpus with 2 molars

South Africa

- Border cave in Natal: partial adult upper face and cranial vault, 2 mandibles, complete infant (4-6 m) skeleton; MSA period; only grave known in MSA in S Africa; unclear if AMH; also a Howiesons Poort artifact, at 45-75 Ka; a composite tool (like UP in Europe) - association with perforated Conus shells and red pigment

- Klasies River Mouth caves: best evidence for AMH in Late Pleistocene; 130-118 Ka; MSA level; 7 mandible/maxilla, facial, cranial vault and postcranial elements, 10 bones; 10 individuals; modern humans; some evidence of cannibalism
- First inhabited c 120 Ka, abandoned c 60 Ka
- What differentiates late archaic from early modern human? Some of late archaics like Florisbad, Ngaloba, Irhoud 1 had small faces that would fit with mandibles of Klasies River

South Africa

- Klasies River: Many Howiesons Port and late MSA artifacts
- Some robust some gracile, male and female; some chin, some not
- Association of morphological trend characteristic of MHs with MSA artifacts as early as 100 Ka (as with 100 Ka at Skull and Qafzeh; and earlier in Ethiopia)

Late MP skulls: Florisbad

- Florisbad, South Africa (1932). Age: c. 259 ka.

- This cranium shows a modern, high frontal bone although its roundness attenuates laterally and has a sagittal depression. It also shows a large supraorbital development, and the face is broad.

- Its discoverer Thomas F. Dreyer assigned it to a new species *Homo helmei* (1935), to distinguish it from *Homo sapiens* and *Homo heidelbergensis* .

Florisbad, S. Africa, 259 Ka

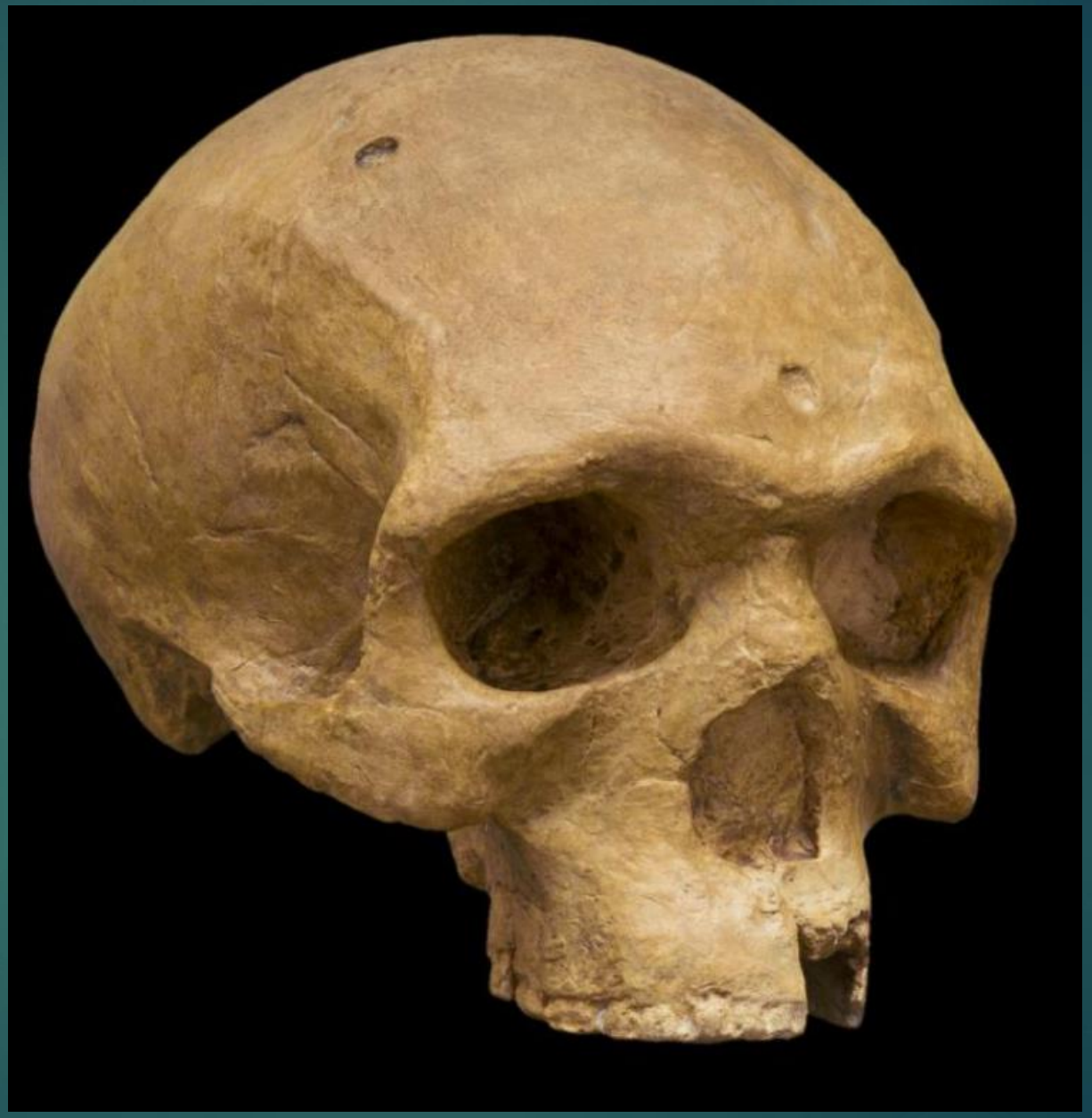
- A partial skull from Florisbad, South Africa, also clearly not modern human, but with a few humanlike features.

The partial skull from Florisbad might be in this time range, but the date depends on a tooth that may not be the same context or individual.

Florisbad,
Zambia, 1400 cc

Early MSA,
259 Ka

Early
Homo sapiens
or *Homo helmei*
or *Homo heidelbergensis*



Florisbad

Klasies River Mouth

Border Cave, Natal, 175-76 K

- MSA Fossils: partial adult cranial vault, 2 mandibles, complete skeleton of 5 m old baby, in grave with perforated shell; some postcranial fragments

- Howiesons Poort artifact assemblage (replaceable bits or inserts for hafting composite tools); 45-75 K

Border Cave

Late MP skulls: *H. naledi*, LES 1

- *H. naledi,* Lesedi chamber, Rising Star cave, South Africa (2013). Age: 241-335 ka.
- The skull of *Homo naledi* looks primitive, with features that resemble to those in *Homo habilis*, *suggesting a very deep origin of its lineage*. The cranial capacity is 610 cc. The teeth are also primitive in the increasing size towards the back of the tooth row, but modern in their small size and structure, as in the gracile mandible.
- The most modern features of *Homo naledi* are found in the post cranial skeleton.
- Interestingly, Jebel Irhoud, Florisbad and *Homo naledi* were contemporary humans; the last two perhaps living in close proximity in the same region.

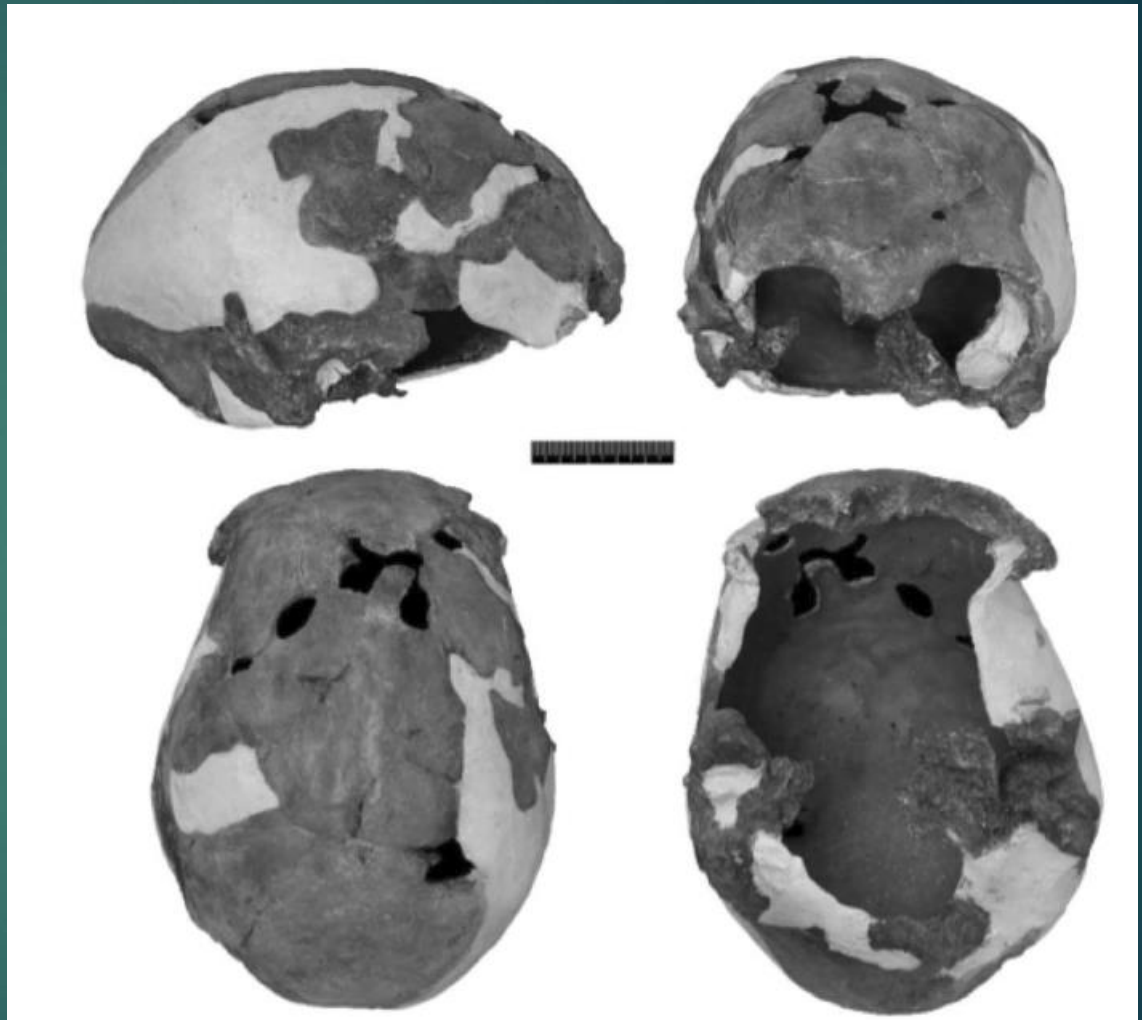
Homo naledi: 236-335 kya

West Africa: Iwo Eleru (Nigeria)

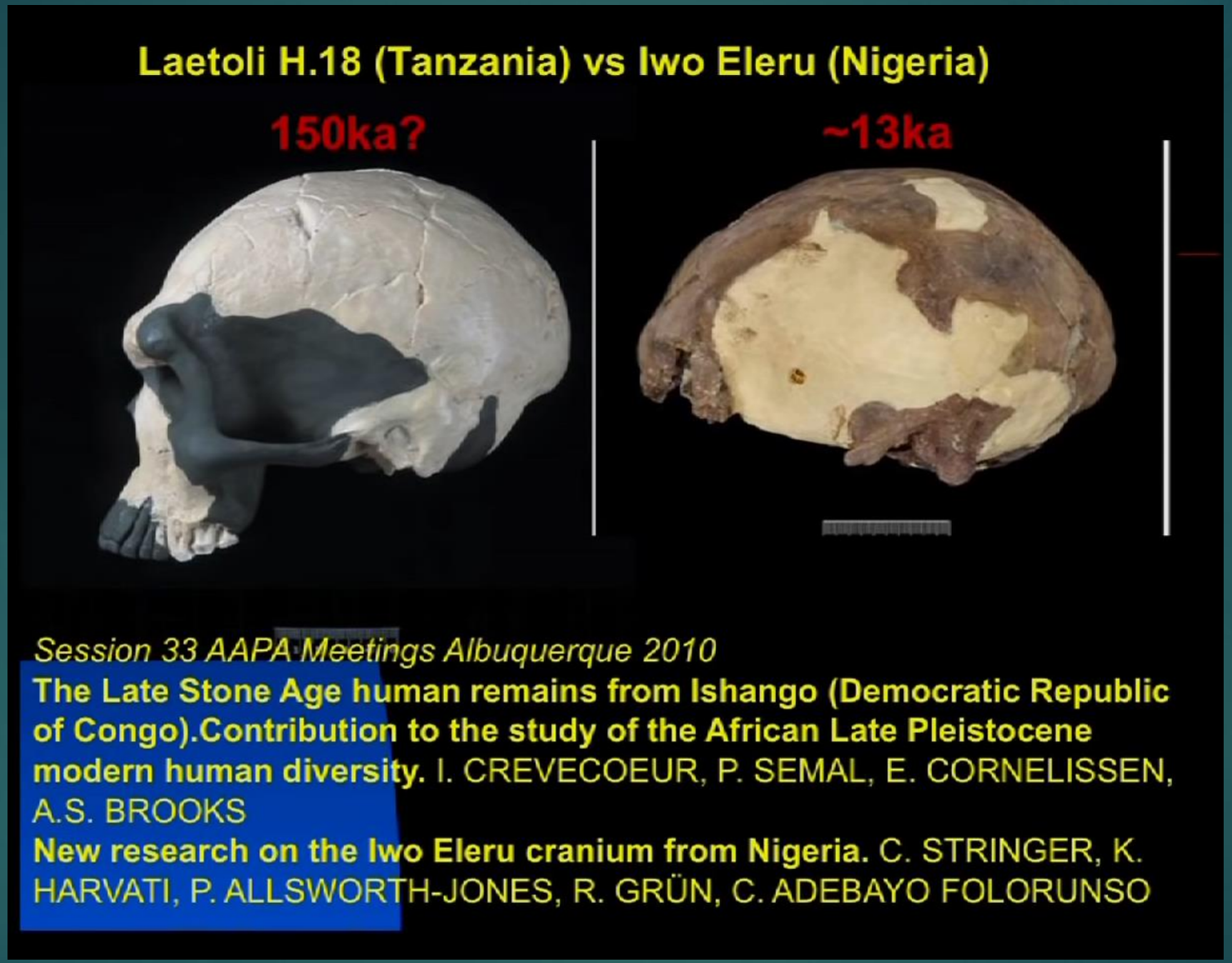
- This is the skull of Iwo Eleru (Nigeria), discovered in 1965 by Thurstan Shaw and his team.
- In 2011 Katerina Harvati and others published a review of this fossil and its uranium series dating (the result being 11,700 to 16,300 years).
- This skull morphology differs greatly from that of other recent modern humans from Africa. Iwo Eleru has primitive features despite its relatively short tenure: it is more elongated and lower, and has a prominent supraorbital arch.
- In fact, compared to other older and more modern African specimens, to which most resembles it is Ngaloba skull in Laetoli (Tanzania), which is 100,000 years older (140 ka). It also has similarities to Jebel Irhoud (280-350 ka!) and the group of Qafzeh-Skhul materials Levante (90-130 ka).

Iwo Eleru, Nigeria skull, 13 Ka

One archaic-looking human skull, found from Iwo Eleru, Nigeria, even existed during this latest part of the Pleistocene when the last signs of mixture have been identified.



Skull from Iwo Eleru, Nigeria. Photo credit: Katerina Harvati and colleagues CC-BY



Iwo Eleru, Oldest West African Fossil = only 13 Ka

But similar to Laetoli H. 18

These two show similar geomorphometrics

Iwo Eleru

Ngaloba, LH18

Above: Iwo skull Eleru (credit: Harvati K et to the, 2011). Bottom: skull Ngaloba LH 18, with left side inverted (credit: MH Day, Leakey MD & Magori C, 1980)

Qesem teeth

Dated to between 400,000 and 300,000 years ago, the teeth were from an age when Neanderthals and modern humans were not supposed to have existed yet, at least beyond their points of origin in Europe and Africa respectively.
At both ends of the possible range, neither Neanderthal nor modern humans were supposed to be in the Middle East yet.

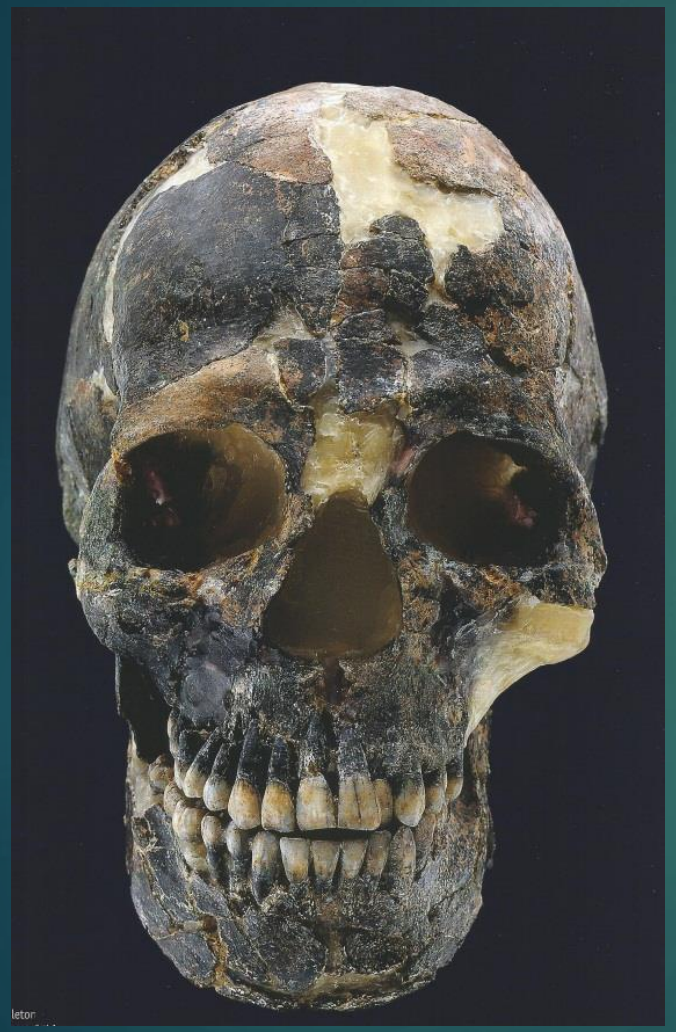
~1925: *Homo sapiens*, Skhul 5, Israel, 90 Ka

Homo sapiens
(Skhul V)
Discoverers:
Theodore McCown
& Hallum Movius Jr.
Locality: Skhul cave
Mount Carmel, Israel
Date:1932
Age: 90K

Skhul/Qafzeh robust *H. sapiens* possess brow ridges, no chin, and a projecting facial profile, similar to the Neanderthals.


Qafzeh

Homo sapiens, Qafzeh, Israel, 90 Ka



Homo sapiens
(Qafzeh IX, female, 13 yo)
Discoverer: Bernard Vandermeersch
Locality: Qafzeh cave, Israel
Date:1969
Age: 90-100K