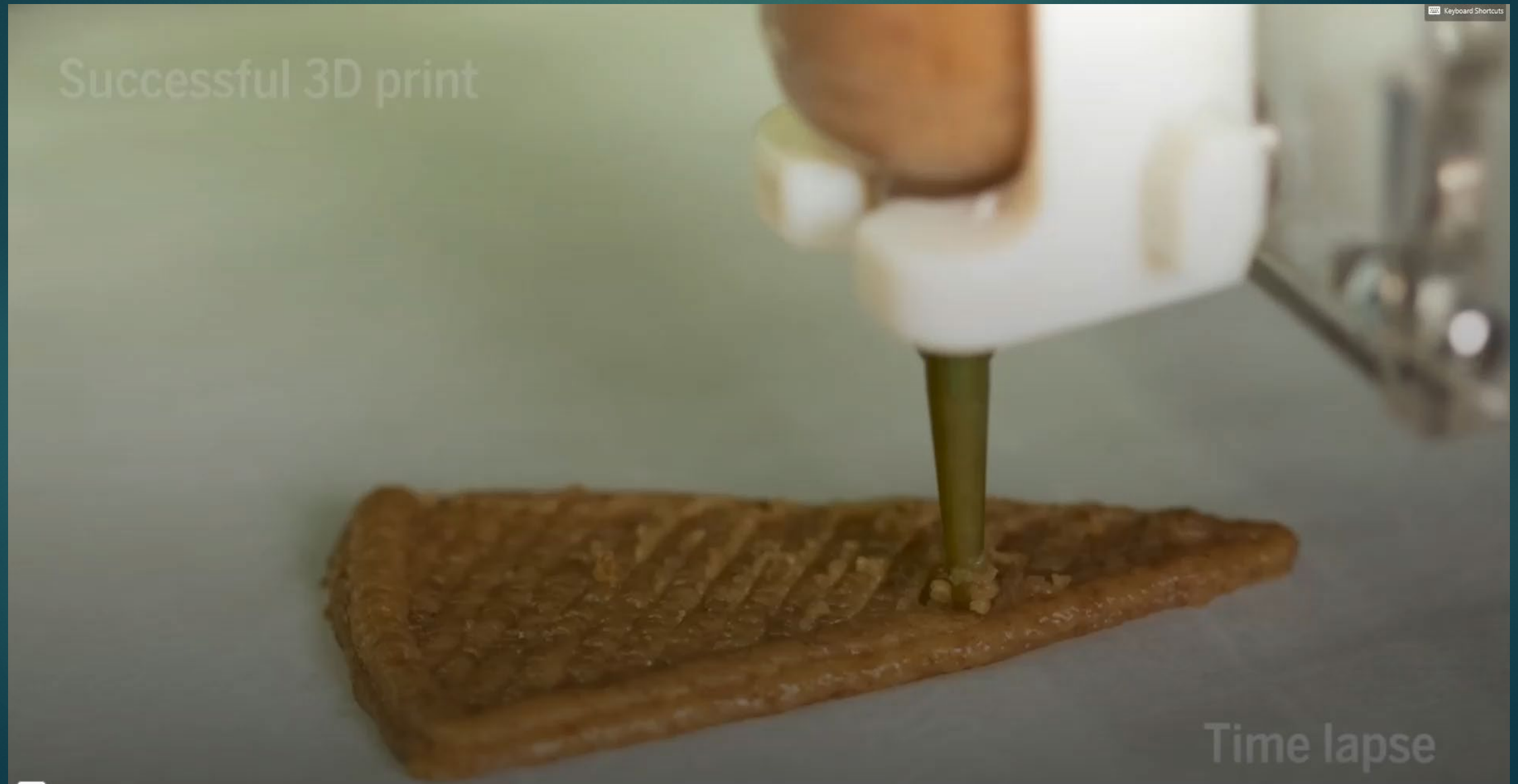
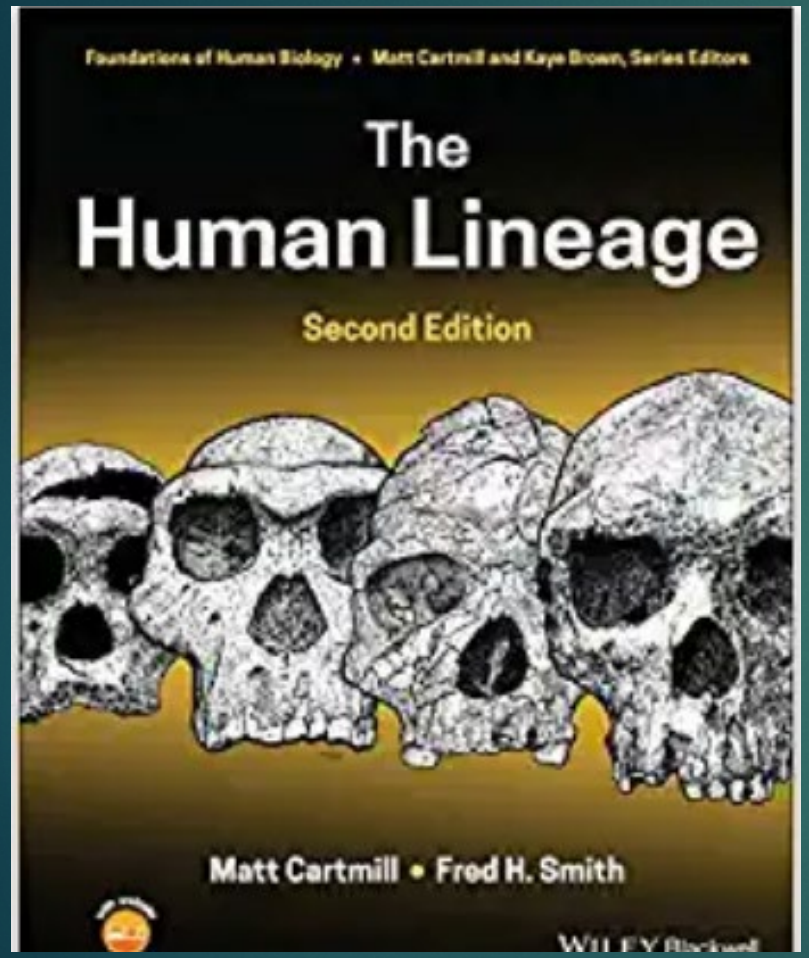
Scientific Update
March 2023

CHARLES J VELLA, PHD, 2023

Soon coming to your kitchen: 3 D cake printing



The Human Lineage, 2022, 2nd ed, by Matt Cartmill & Fred Smith



8 x 11 inch, 611 p; 100 pages of citations; $150
Clearly the most up to date textbook – Kindle version is cheaper

1The Fossil Record
2 Analyzing Evolution
3 People as Primates
4 The Bipedal Ape
5 The Migrating Ape
6 The Big-Brained Ape:
7 Talking Apes: The Neandertals
8 The Symbolic Ape: The Origin of Modern Humans

Cave paintings of mutilated hands could be a Stone Age sign language

▲ Hand stencils with missing digits at Cosquer cave in Marseille, France

Alison George, New Scientist, 2023

A Stone Age sign language

- DEEP inside Gargas cave in the Pyrenees mountains of southern France is something that has puzzled every visitor who has made the journey into its dark inner chambers. Among prehistoric paintings and engravings of horses, bison and mammoths are hundreds of stencils made tens of thousands of years ago by people spitting red and black paint over their outstretched hands. Those in Gargas are especially mysterious because around half of the hands appear to be injured. It's very obvious that some of the fingers are missing.
- Most hand stencils are around 40,000 years old. One, found in Spain, is more than 66,000 years old, leading researchers to conclude a Neanderthal made it
- Study: Gargas's hand stencils reflect a Stone Age sign language

Most common at Gargas: all fingers missing

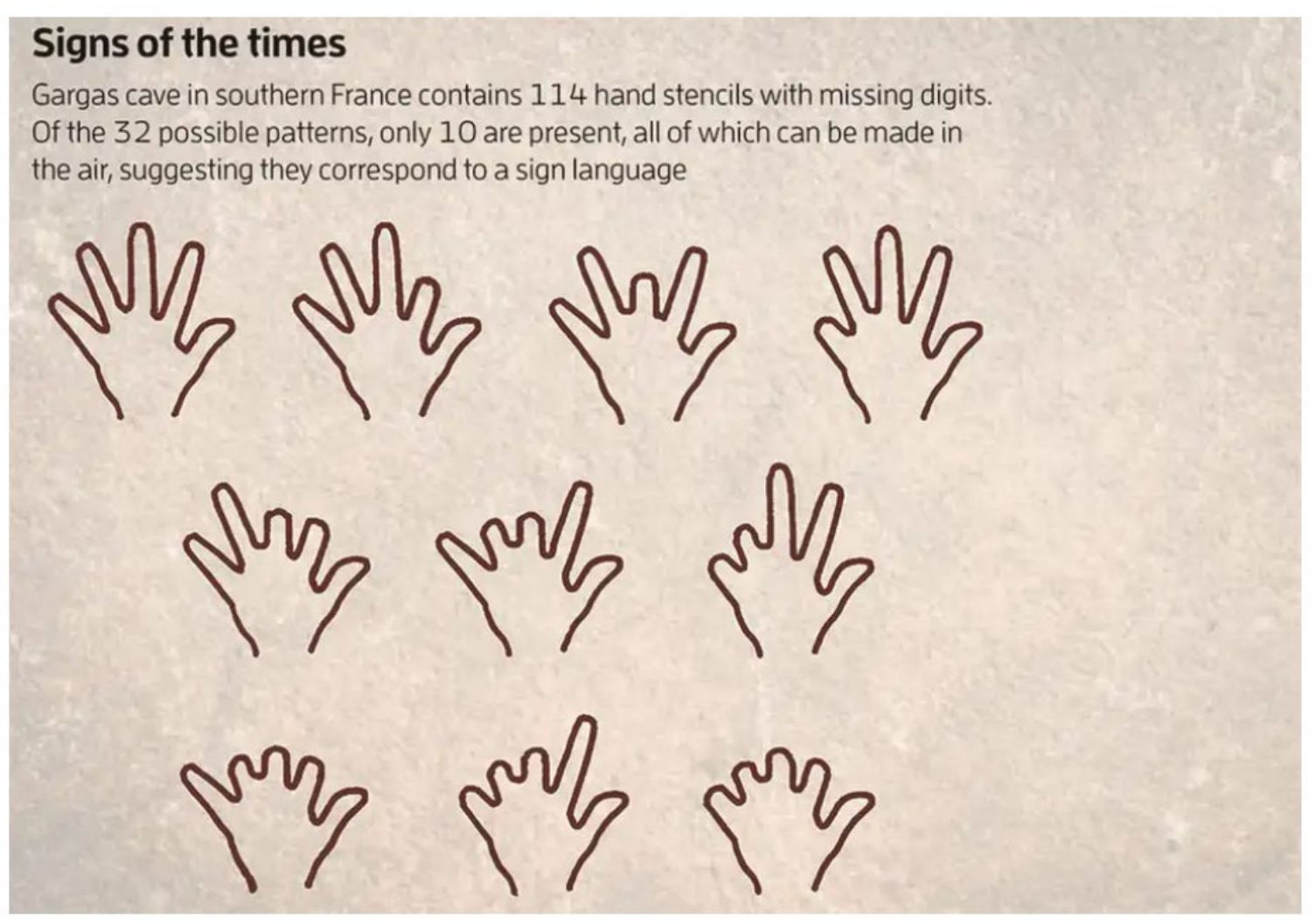
Often found deep in caves in hard-to-reach places, suggesting that they had some special significance

Most common pattern observed in Gargas is an extended thumb with all the other digits displayed as stumps

Missing fingers

- They are most common in Gargas cave, where 114 of the 231 hand images are missing at least one finger segment. They also feature prominently in another French cave, Cosquer in Marseille, where 28 of the 49 hand stencils are missing digits.
- One idea is that Stone Age people deliberately removed their digits. That might sound brutal, but ritual finger amputation is actually a relatively common practice. A 2018 study found it occurring in 121 recent societies – although it is generally limited to the pinkie finger. Amputation might explain some Stone Age hand stencils. In Palaeolithic rock art, the most common hidden finger is only the pinkie.
- There are no missing fingers on any of the positive handprints in prehistoric European cave art

Of 32 possibilities, only 10 present; all can be made in the air; suggesting that they correspond to particular hand gestures



Hand stencils

- Don’t find evidence of hand stencils that would be impossible in sign language
- More than a century ago, anthropologist Walter Roth documented an alternate sign language made by Queensland First Nations communities in Australia, which has parallels with depictions of hands in the rock art of the region. For example, a fist with just the little finger outstretched was the sign for a small caterpillar or grub.
- Could hand stencils be a code to coordinate hunting?
- The Gargas stencils could be an early form of writing (40-27 Ka)
- Cuneiform, our oldest language, arose in Mesopotamia just 5500 years ago
- Next: DNA from the spit that created the stencil?

The Lowly Donkey

At Long Last, a Donkey Family Tree

- In a new study, genetics and archaeology combine to reveal the ancient origins of humanity's first beast of burden. The African wild ass (*Equus africanus*) is the wild ancestor of the donkey.
- Donkeys transformed human history as essential beasts of burden for long-distance movement, especially across semi-arid and upland environments. The donkey is a key, if increasingly marginalized, character in human history. Once venerated, the animal has been an object of ridicule for so long that the word "asinine" means "stupid." Donkeys and donkey work are essential to the livelihoods of people in developing countries, but elsewhere donkeys have all but disappeared.
- Unlike horses, little was known about the origin and domestication of donkeys. Todd *et al*. sequenced the genomes of modern and ancient donkeys and found evidence of an eastern African origin over 7000 years ago, with subsequent isolation and divergence of lineages in Africa and Eurasia. They also reveal the imprint of desertification on divergence among groups and specifics about donkey breeding and husbandry, including selection for large size and the practice of inbreeding.

Evelyn T. Todd, et al., 2023

African Wild Ass: a wild member of the horse family, Equidae

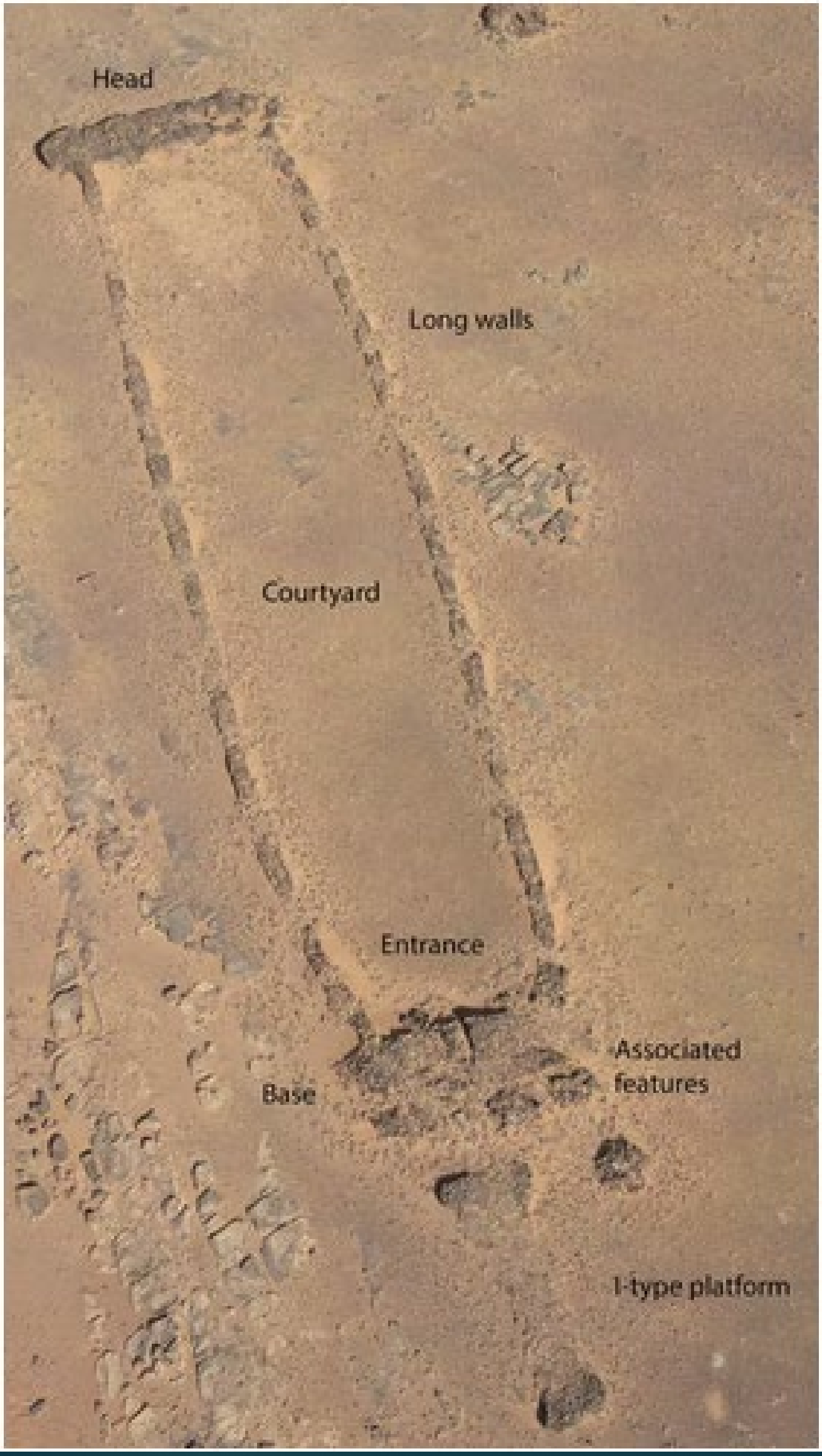
Preference for big donkeys

- The period coincided with one where the Sahara grew larger and more arid. Donkeys are especially resistant to drought and tolerant to water deprivation, which led to them becoming an indispensable conveyance for herders and their wares.
- Genome panel of 207 modern and 31 ancient donkeys, as well as 15 wild equids. Phylogenetic analysis supports a single domestication in Africa ~5000 BCE, followed by further expansions in this continent and Eurasia and ultimately returning to Africa. Uncovered a previously unknown genetic lineage in the Levant ~200 BCE, which contributed increasing ancestry toward Asia. Donkey management involved inbreeding and the production of giant bloodlines at a time when mules were essential to the Roman economy and military.

More than 1,600 mustatils have been documented in Arabia, and they date back around 7,000 years.

7,000-year-old cult site in Saudi Arabia was filled with human remains and animal bones

- Archaeologists in Saudi Arabia have discovered ancient human remains buried near hundreds of scattered animal bones inside a 7,000-year-old desert monument, a ritual site used by a prehistoric cult.
- The remains, those of an adult male approximately in his 30s, were found inside a mustatil, a structure that takes its name from the Arabic word for rectangle. The ruin is one of more than 1,600 mustatils discovered in Saudi Arabia since the 1970s. Mostly submerged beneath sand, the structures were built when the Arabian Desert was a lush grassland where elephants roamed and hippos bathed in lakes.
- Mustatils vary in their appearance, but they are typically long rectangles formed from low rock walls around 4 feet (1.2 meters) high. Excavations have revealed complex structures inside some of the ruins, including interior walls and pillars that give way to central chambers possibly reserved for feasting and ritual sacrifices


Head
Long walls
Courtyard
Entrance
Associated features
Base
I-type platform

- Worshippers entered the mustatils from one end and walked anywhere from 66 to 1,970 feet (20 to 600 m) or more to the other, arriving at a rubble platform called the head. A chamber inside the head housed a beytl — a sacred stone, sometimes originating from a meteorite — that cult members used to commune with their gods.

Removing race from genetics

- Genomics researchers should not use race to describe a population's genetic ancestry and instead should use terms carefully tailored for accuracy, a U.S. national academies panel said this week.
- The National Academies of Sciences, Engineering, and Medicine released the report after the National Institutes of Health requested information on how to describe populations in genomics studies.
- The panel's report concludes that the notion that people belong to genetically distinct races is scientifically invalid. And it recommends using people's ethnicity, such as Latino; geographic location, such as Japanese; or region of ancestry, such as African, only in certain cases.
- Researchers studying disparities in health care may want to use racial categories because they can serve as a proxy for people's experience of structural racism in health settings.
- Studies of disease genes or human evolution should describe populations mainly using "genetic similarity," or how closely members' genes are related to reference genomes drawn from certain populations, such as the Yoruba of Nigeria or Tuscans in Italy.

Those Declining Dementia Rates? It's Not the Plaques & Tangles

- Dementia incidence has steadily fallen by 20 to 25 percent over the past three decades in the U.S., U.K., Sweden, and the Netherlands
- Among 1,550 older Americans born over a 25-year period, all had similar amounts of amyloid plaques at death, (at 90 years).
- If less pathology does not explain falling dementia incidence, then what does? People born in the 1920s had healthier blood vessels in their brains when they died than did those born in the 1900s. They think better cardiovascular health among people born in more recent decades may make them more resilient to AD pathology.
- We are seeing dementia prevention in action via CV Tx. Also higher levels of education

Lower dementia from healthier blood vessels

- About half of those born from 1905 to 1914 had moderate to severe atherosclerosis, while only 22 percent of people born in the late 1920s, did
- ***Healthier Blood Vessels****. The prevalence of atherosclerosis and arteriosclerosis was lower in later birth cohorts*
- All told, the researchers think that the declining prevalence of clinically diagnosed AD may be due to people having more cognitive reserve, which might be a product of better cardiovascular health and more education

Predictive childhood nightmares

- 1958 British birth cohort study, which follows the lives of all children born in England, Scotland and Wales during the week of March 3–9, 1958.

- Children who experience regular bad dreams and nightmares between the ages of seven and 11, may be nearly twice as likely to develop cognitive impairment (the core feature of dementia) by age 50. And they may be up to seven times more likely to be diagnosed with Parkinson's disease by age 50.

- Middle-aged and older adults who experience frequent bad dreams and nightmares could be more than twice as likely to develop dementia or Parkinson's in the future.

Nightmares

- The more regularly the children experienced bad dreams, the more likely they were to develop cognitive impairment or be diagnosed with Parkinson's disease as older adults

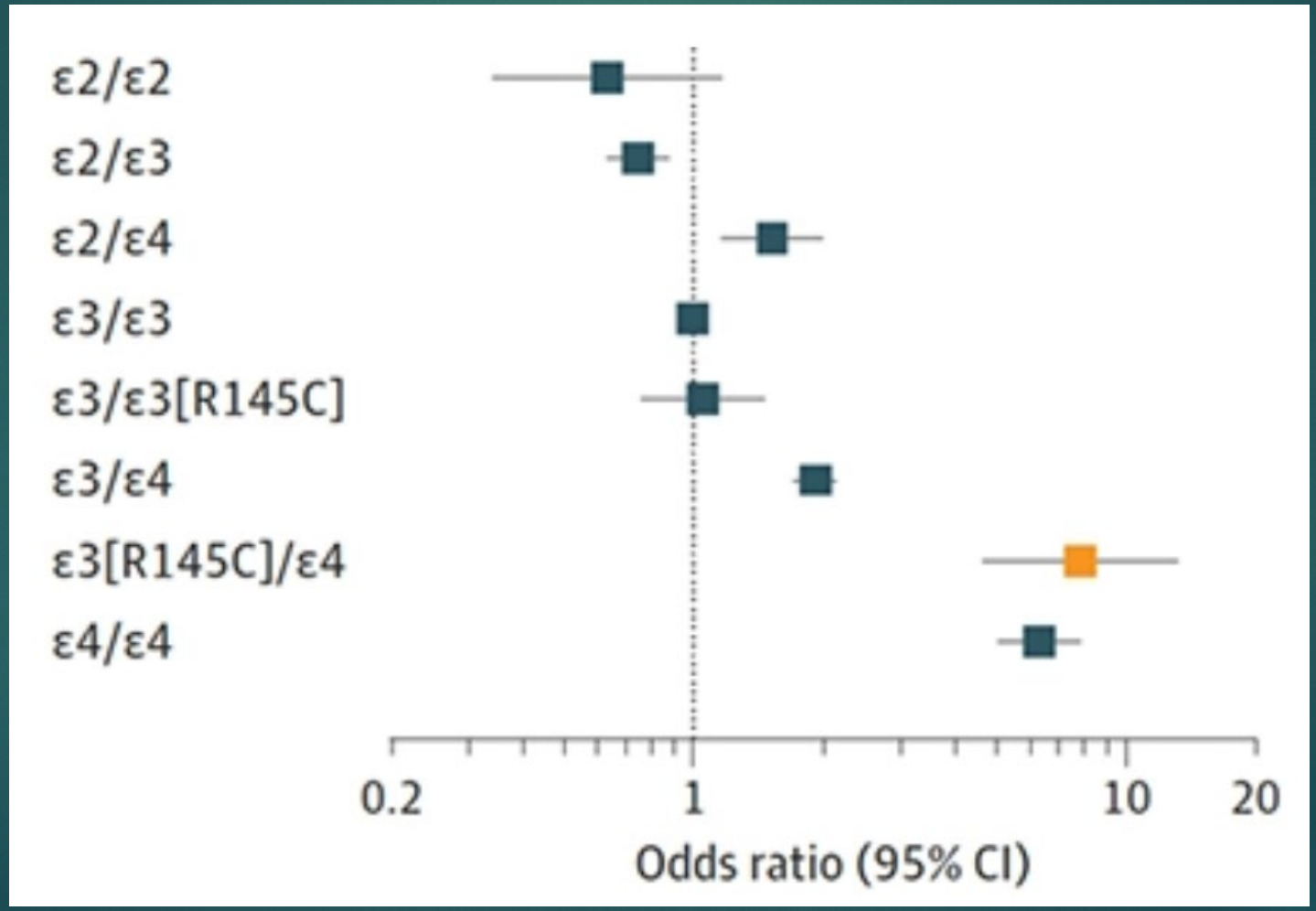
- Remarkably, compared with children who never had bad dreams, those who had persistent bad dreams were 76% more likely to develop cognitive impairment and were 640% more likely to develop Parkinson's. This pattern was similar for both boys and girls.

- Could reducing bad dream frequency during early life be an early opportunity to prevent both conditions.

Luckily, these nightmares are rare

- The frequency with which we experience nightmares as children is to a large degree determined by our genetics.
- And one gene known to increase our risk of having regular nightmares (PTPRJ) is also linked to increased risk of developing Alzheimer's disease in old age. So it's possible that nightmares and progressive brain diseases are both caused by a shared set of genes.
- Only 4% had persistent bad dreams according to their mothers. And only 6% of these had developed cognitive impairment or Parkinson's disease by age 50.

African American Risk for AD. In people of African ancestry, the R145C variant on the ApoE3 allele elevated AD risk, but only among those who co-inherited an ApoE4.



Le Guen et al., JAMA, 2023

ApoE3/E4 in African Americans triples AD risk

- Regarding AD risk, ApoE4 packs less of a punch among people of African ancestry than it does among those of European or Asian descent
- Among people of African descent, the R145 variant of ApoE3 nearly triples the risk of AD, but only among those who also carry a copy of ApoE4
- ApoE3/E4 face equal odds as do ApoE4/E4 carriers.
- 4% of African descendants carry this ApoE3 variant, which is exceedingly rare among Europeans.
- ApoE3 [R145C] lowered the age of AD onset by about five years among ApoE3/E4 carriers; the variant was tied to steeper cognitive decline

More pain, less hippocampus: Link between chronic pain and dementia

- People with chronic pain in multiple parts of the body have a higher risk of dementia and experienced broader and faster cognitive decline

- From records of 355 K people in the UK Biobank cohort, risk of neurocognitive abnormality increased with each additional pain site and was mediated by atrophy in the hippocampus.

- Multisite chronic pain may lead to up to eight years of accelerated hippocampal aging

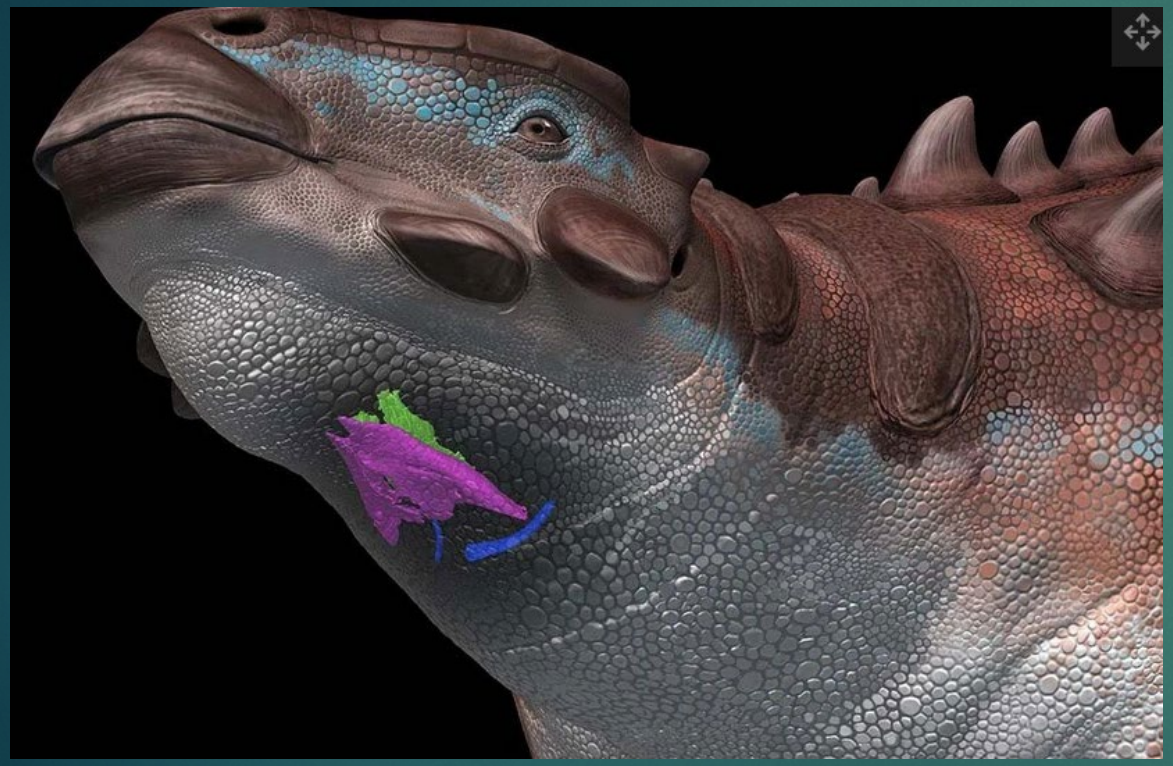
Regular Exercise

- Reported leisure time physical activity at the ages of 36, 43, 53, 60-64, and 69 in 1417 people (53% women) taking part in the 1946 British birth cohort study.
- Any regular leisure time physical activity at any age is linked to better brain function in later life, but maintaining an exercise routine throughout adulthood seems to be best for preserving mental acuity and memory, suggests a long term study
- Being physically active at any time in adulthood, even if participating as little as once per month, is linked with higher cognition.
- But the strongest association was observed for sustained cumulative physical activity and later life cognition, and for those who were most physically active at all ages.

11 minutes of moderate exercise a day cuts early death risk by 20%

- The largest review of its kind finds that just 75 minutes of exercise per week drastically reduces risk of early death, heart disease and cancer.
- Just 11 minutes of moderate physical activity a day could lower the risk of early death by 23%, (based on data from 30 million adults)
- 150 minutes = lowered risk of early death by 31%
- Activities like brisk walking, dancing, going for a gentle bike ride and playing outdoors count towards your 11 minutes a day

'Extremely rare' fossilized dinosaur voice box suggests they sounded birdlike



A fossilized ankylosaur voice box reveals that these beasts may have sported a far more sophisticated vocal range than scientists originally thought.

This anatomical setup likely meant that the ancient herbivore was capable of making a large array of sounds — including rumbles, grunts, roars and possibly even chirps — while also bellowing them out across vast distances

Imagine low, reptile rumbles and grunts and roars with an intricate birdsong-like complexity.

The mice with two dads: scientists create eggs from male cells

- Researchers have made eggs from the cells of male mice — and showed that, once fertilized and implanted into female mice, the eggs can develop into seemingly healthy, fertile offspring.
- Would allow for single-parent or 2 male parent embryos; with the aid of surrogate mothers
- Created eggs using cells taken from an adult male mouse. They reprogrammed these to create stem-cell-like induced pluripotent stem cells. The team grew these cells in culture until some of them had spontaneously lost their Y chromosomes. Looked for cells that were chromosomally female, with two copies of the X chromosome. They then fertilized the eggs using mouse sperm and transferred the resulting embryos into the uterus of a female mouse.
- Out of 630 transferred embryos, only 7 developed into pups. But the pups grew normally and were fertile as adults.
- Proof-of-concept mouse experiment will have a long road before use in humans is possible.

Who gets Long Covid

- Those with COVID-19 infection can experience long-term effects from their infection, known as post-COVID conditions (PCC) or long COVID
- These conditions can last weeks, months, or years.
- Post-COVID conditions are found more often in people who had severe COVID-19 illness, but anyone who has been infected with the virus that causes COVID-19 can experience post-COVID conditions.
- People not vaccinated against COVID-19 and who become infected may have a higher risk of developing post-COVID conditions compared to people previously vaccinated.

Study of n = 800 K

- A new study of more than 800 K people has found that in the U.S., COVID "long haulers" were more likely to be older and female, with more chronic conditions
- Symptoms of long COVID can appear or persist much longer after initial infection than many previous studies had suggested. Most earlier work showed a peak of long COVID symptoms and diagnoses within the first six months of a person's initial COVID-19 diagnosis, but the new research shows another, smaller peak around one year
- Condition has hit one in five adults in the U.S. with sometimes debilitating symptoms including shortness of breath, fatigue, and brain fog.
- The symptoms can involve multiple organ systems and have been thought to last weeks or months after a person's initial infection has cleared.

Long Covid

- The leading risk factors for long COVID included high blood pressure, chronic lung disease, obesity, diabetes, and depression.
- But not pre-pandemic HIV/AIDS, metastatic cancer, and solid tumors without metastasis.
- Best protection vs long covid = get vaccinated.

The absence of any real evidence for club carrying cavemen raises the question: From where, exactly, did the caveman get his club? Were there club welding cavemen?

Archeological evidence for wooden clubs

- Ancient wooden clubs: decayed away save for a handful of cases.
- In the archaeological reports: the oldest possible club was a short heavy piece of wood found at the waterlogged site of Kalambo Falls, Zambia. Thought to be at least 300,000 years old, the stumpy artifact may have armed a pre–*H. sapiens* human ancestor.
- More evidence comes from later periods, especially moorland, lakeshore, and riverside settlements in Europe, which date between 6500 B.C. and 1000 B.C. It seems some of the clubs from this span served as weapons based on their depictions in rock art and the distinct head wounds on skeletons.
- Two 3,000-year-old clubs were found right at a Bronze Age battlefield in northern Germany. One shaped like a baseball bat and the other like a mallet, these clubs were almost certainly weapons of war, considering they surfaced at a battle site.

Wooden Clubs

- Numerous scientists have witnessed chimpanzees, bonobos, gorillas, and orangutans throwing branches or beating other animals with sticks. Since our closest living relatives whack creatures with wood, it's probable our ancestors did too.
- When hunting with clubs, it is difficult to get close enough to game before the creatures run away. And such close encounters are risky. One well-aimed kick or horn thrust could be fatal.
- Descriptions of 57 forager societies = references to wooden clubs in the vast majority of them. But most communities have clubbed sparingly.

Modern Hunter gatherers use clubs

- Hunters chose clubs for particular prey species or as secondary weapons to kill animals that were already captured or wounded. For instance, the San in Southern Africa reportedly have used their 50–100-cm long clubs on animals. East Siberian Nivkhs were observed to have clonked seals and sea lions with clubs, and killed rats, otters, and molting birds with sticks.
- Ethnographic reports say Aboriginal Australians have used clubs, throwing sticks, and boomerangs against animals such as kangaroos and wallabies.
- With clubs, many Indigenous people of the Northwest Coast have whacked beavers, bears, deer, and marine mammals, while several Indigenous groups in South America have used them to clobber armadillos and peccaries, according to ethnographies.
- But clubs found far more use in combat. In ethnographies, 80 percent of societies have used them for interpersonal violence. This is true even when the fighters also had long-range weapons

Fijian Clubs

Not a myth

- In Fiji, the leading warriors reportedly continued to fight with clubs after the musket was introduced in the mid-19th century; killing with a club was the only way to win knighthood.
- Similarly, among Comanches of the southern Plains, striking an enemy with a handheld spear or club merited the highest war honors
- The earliest modern humans likely wielded clubs—probably more often for conflicts than hunting.
- The wooden club in the hands of HGs is not a myth. However, it may have been a much more sophisticated weapon than most people imagine.

Human genetic history on the Tibetan Plateau in the past 5100 years

- The Tibetan Plateau, the highest and largest plateau above sea level, is one of the harshest environments settled by humans. It has a cold and arid environment and its elevation often surpasses 4000 meters above sea level.
- The plateau covers a wide expanse of Asia—approximately 2.5 million square kilometers—and is home to over 7 million people, primarily belonging to the Tibetan and Sherpa ethnic groups.
- Prof. Fu Qiaomei from the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) of the Chinese Academy of Sciences has filled this gap by sequencing the genomes of 89 ancient humans dating back to 5100 BP from 29 archaeological sites spanning the Tibetan Plateau.
- Share a single origin, deriving from a northern East Asian population that admixed with a deeply diverged, yet unsampled, human population.

Hongru Wang et al, 2023

Tibetan genomes – EPAS1

- Occurred before barley and wheat was introduced and was not associated with migrating wheat/barley agriculturalists.

- Previous research has shown that present-day plateau populations possess high frequencies of an endothelial Pas domain protein 1 (EPAS1) variant that is adaptive for living at high altitudes and likely originated from a past admixture event with the archaic humans known as Denisovans.
- The ~5100-year-old Zongri individual from the northeastern plateau harbors two copies of the adaptive haplotype, which indicates that the oldest known modern human on the Tibetan Plateau is homozygous for the EPAS1 adaptive haplotype.

Tibet

- Thus, the arrival of this D variant occurred prior to 5100 BP in the ancestral population that contributed to all plateau populations.
- The adaptive haplotype is detected in 11 of the 17 Zongri individuals (4800 to 3900 years old), with each having one copy of the adaptive haplotype, showing that the adaptive haplotype was at fairly high frequency during the early human occupation of the northeastern plateau.
- Origin of the unsampled, deeply diverged ancestry found in all plateau populations is still unaccounted for.
- In addition, when and where the adaptive EPAS1 allele first entered the ancestral Tibetan population is still unknown.

Why is there junk DNA?

- Noncoding/junk DNA constitutes 99% of human DNA.

- A new model offers an explanation for the huge variety of sizes of DNA in nature. Offers a possible solution to the scientific question of why neutral sequences, sometimes referred to as "junk DNA," are not eliminated from the genome

- The explanation is that junk DNA is often located in the vicinity of functional DNA.

- Deletion events around the borders between junk and functional DNA are likely to damage the functional regions and so evolution rejects them.

The evolutionary dynamics that retain long neutral genomic sequences in face of indel deletion bias

- Insertions and deletions (indels) of short DNA segments are common evolutionary events. Deletions occur more often than insertions in both prokaryotes and eukaryotes. It raises the question why neutral sequences are not eradicated from the genome.

- Because of *border-induced selection*. In shorter neutral segments, deletions are likely to delete adjacent functional segments which are essential for the functioning of the organism, and therefore will be rejected.

- Accordingly, a neutral sequence is bordered between conserved functional regions. Deletions occurring near the borders occasionally protrude to the conserved region and are thereby subject to strong purifying selection. Thus, for short neutral sequences, an insertion bias is expected.

Wild macaques challenge the origin of intentional tool production

- Hefting a potato-size rock, wild long-tailed macaques (*Macaca fascicularis*) in Thailand smash oil palm nuts on stone anvils. As they pound away, sharp flakes sometimes fly off from their hammer stones—flakes that are “almost indistinguishable” from stone tools made by early human relatives more than 3 million years ago. Flaking is unintentional.
- Brazilian white-faced capuchin monkeys also produce stone flakes. 3000 yo stone flakes discovered. First example of long-term tool-use variation outside of the human lineage
- Together, they “show that human manipulative and cognitive skills are not necessary to produce stone tools.”
- Chimpanzees in Ivory Coast have done so for more than 4000 years

Tomos Proffitt, et al., 2023

“How do we know when we’ve found the first intentionally produced stone tools?”

- Burmese long-tailed macaques on Thailand’s Piak Nam Yai Island have been using stones to pry open oysters for at least 65 year.
- Strong negative reaction to study
- The authors of the new study agree that there is an important difference between the macaques’ flakes and those that early humans left behind: The monkeys aren’t flaking the rocks intentionally. Instead, they’re accidental byproducts of nut smashing. Indeed, the animals drop any hammer stone that flakes. For them, it is broken. They look for a new one which is easy to find among nearby cobbles.
- In contrast, early hominins 2.5 million years ago at Olduvai Gorge trekked for kilometers to collect stones that would be good for knapping.
- And the monkeys have no need for the sharp flakes, because they have sharp canines.
- A hypothesis to be tested.

The MH Bottleneck at 60 Ka: 3000-4500 individuals left Africa

- The migration of modern humans out of Africa is thought to be accompanied by a population bottleneck.
- The size of the population(s) migrating out of Africa is estimated to be:
  - ~600 effective founding females (i.e., census size of ~1800 females) on the basis of mtDNA evidence,
  - t~1000 effective founding males and females (i.e., census size of ~3000 individuals) based on the analysis of 783 autosomal microsatellites genotyped in the Center d'Etude du Polymorphisme Humain (CEPH) human genome diversity panel (HGDP), and to be ~1500 (i.e., a census size of ~4500 individuals) based on a combined analysis of mtDNA, Y chromosome, and X chromosome nucleotide diversity data.

The Bottleneck

- These estimates imply that Eurasians must have rapidly expanded to a larger size to account for estimates of a long-term effective population size (N_e) of ~10,000 individuals (census size of ~30,000 individuals) for global populations.

- Indeed, several recent studies indicate a rapid expansion of Eurasian populations within the past ~50,000 years, whereas Africans have maintained a large effective population size.

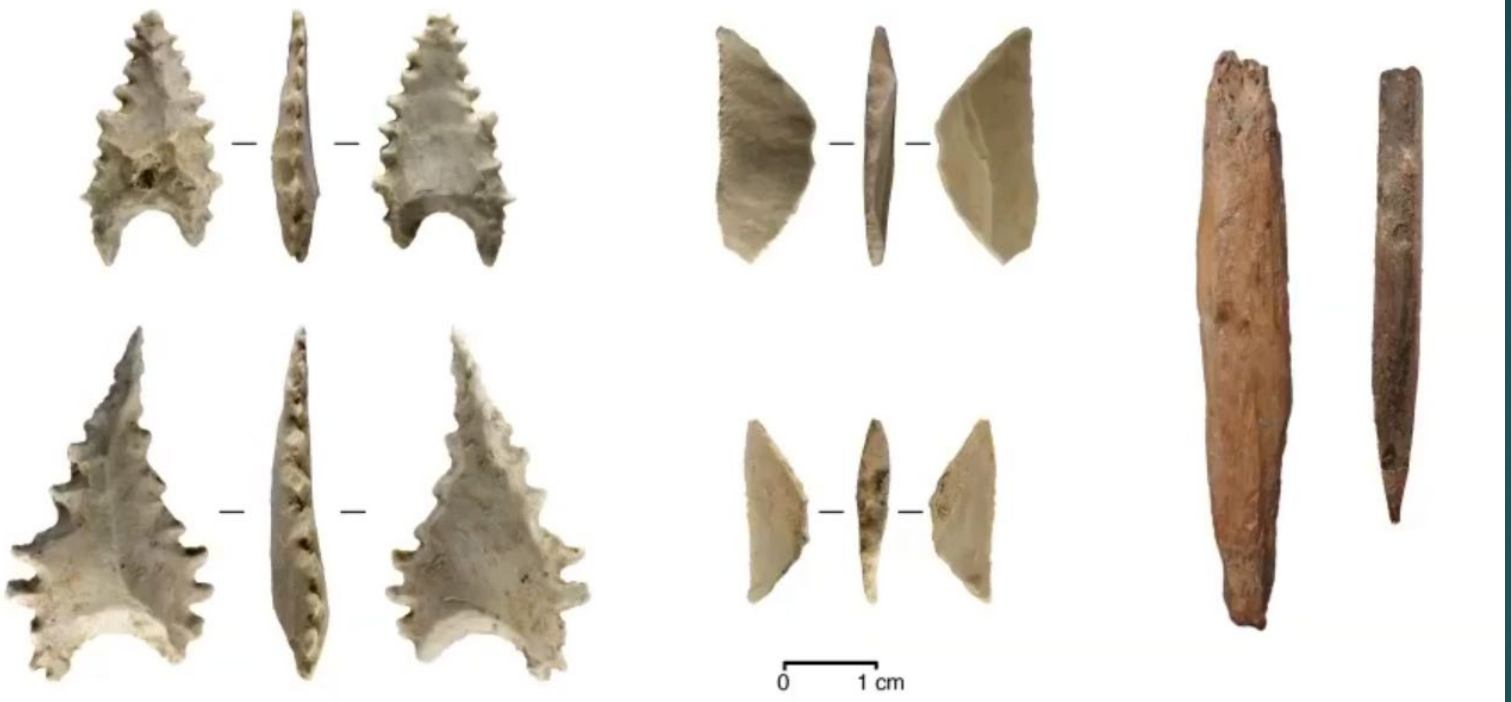

Banda Aceh
MALAYSIA
Kuala Lumpur
SINGAPORE
SINGAPORE
BANDAR SERI BEGAWAN
BRUNEI
MALAYSIA
Anambas Islands
Natuna Islands
Celebes Sea
PALAU
Medan
Nias
Pekanbaru
Sumatra
Padang
Siberut
Jambi
Bangka
Pangkalpinang
Palembang
Bengkulu
Bandar Lampung
Pontianak
Kalimantan
Samarinda
Palangkaraya
Banjarmasin
Greater Sunda Islands
Manado
Gorontalo
Palu
Sulawesi (Celebes)
Sofifi
Halmahera
Molucca Sea
Sula Islands
Ceram
Buru
Ambon
Kendari
Makassar
INDONESIA
Serang
JAKARTA
Bandung
Semarang
Java
Surabaya
Madura
Yogyakarta
Malang
Bali
Sumbawa
Flores
Lombok
Denpasar
DILI
EAST TIMOR
Timor
Kupang
Sumba
Lesser Sunda Islands
Timor Sea
Arafura
Tanimbar Islands
Aru Islands
Christmas Island (AUSTRALIA)
INDIAN
Cocos Islands
Ashmore and

Earliest Human Sea voyages: > 65 Ka

Adam Brumen, 2023

Maros Karsts, Sulawesi

Classic Toalean artefact types (~8000-1500 years ago)



Maros Points

Backed microliths

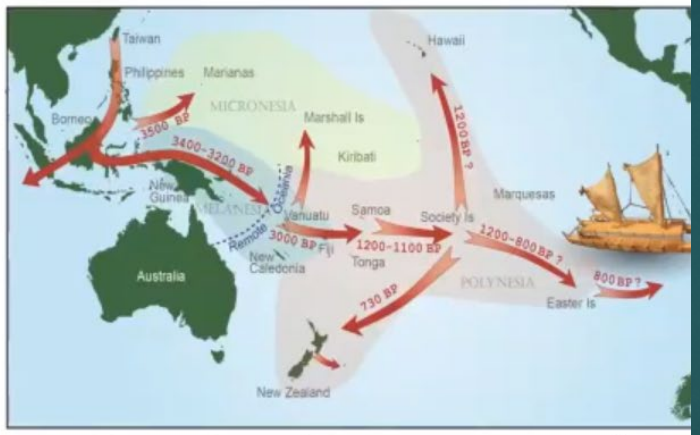
Osseous points

Originally Sulawesi cave art was thought to not be very old

Although first reported 70 years ago, until recently the rock art of Maros was little known outside Indonesia…

Image: Suryatman

Toalean stone projectiles ('Maros Points')



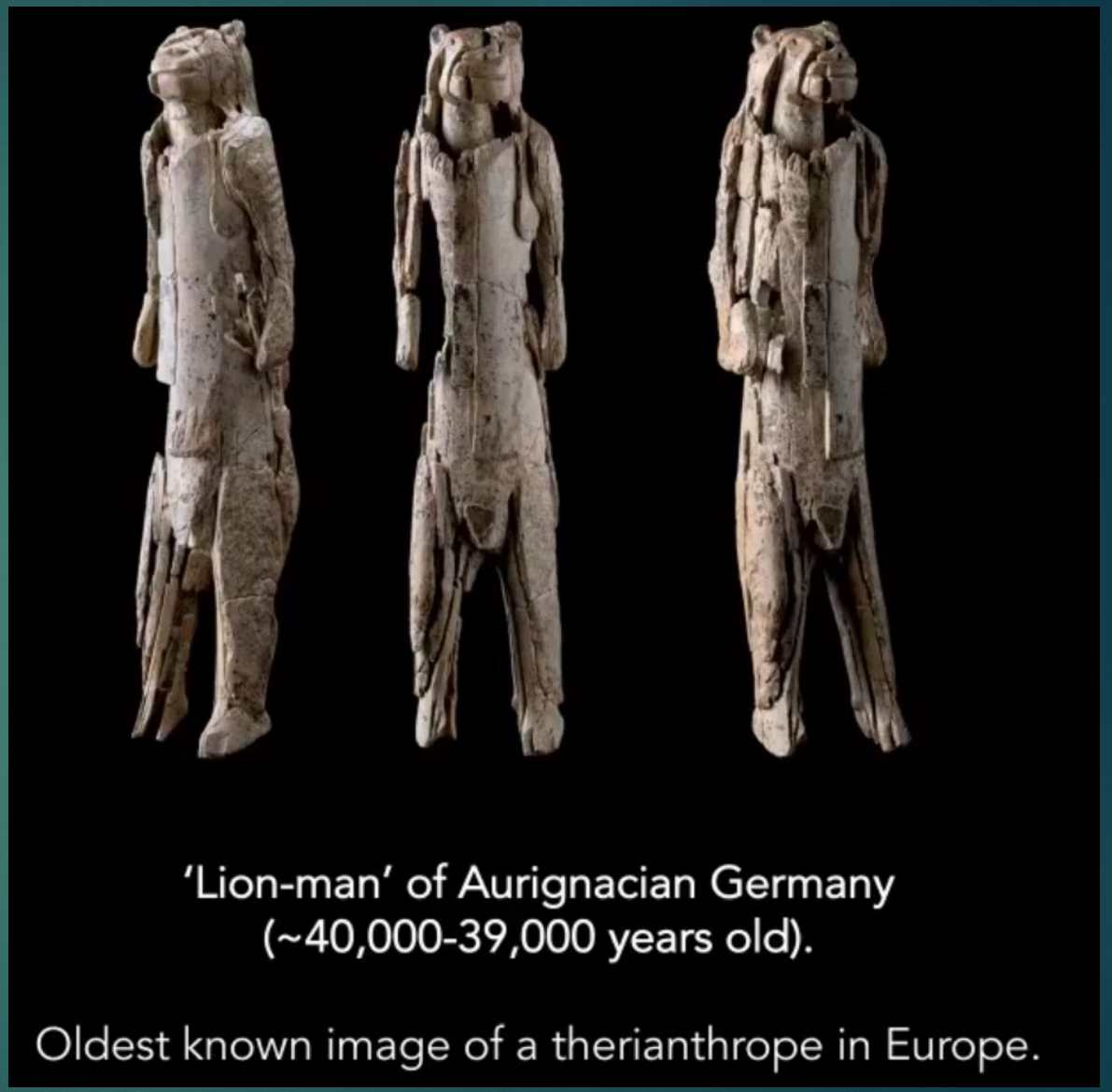
Expansion of Austronesian-speaking 'Neolithic' farming societies

Where the antiquity of this rock art *had* been considered, it was generally assumed to have been created by a localised group of Holocene foragers known as 'Toaleans' (~8000-1500 years ago), or by immigrant 'Neolithic' farmers (Austronesians)

In either case, the received wisdom was that the art was not very 'old'

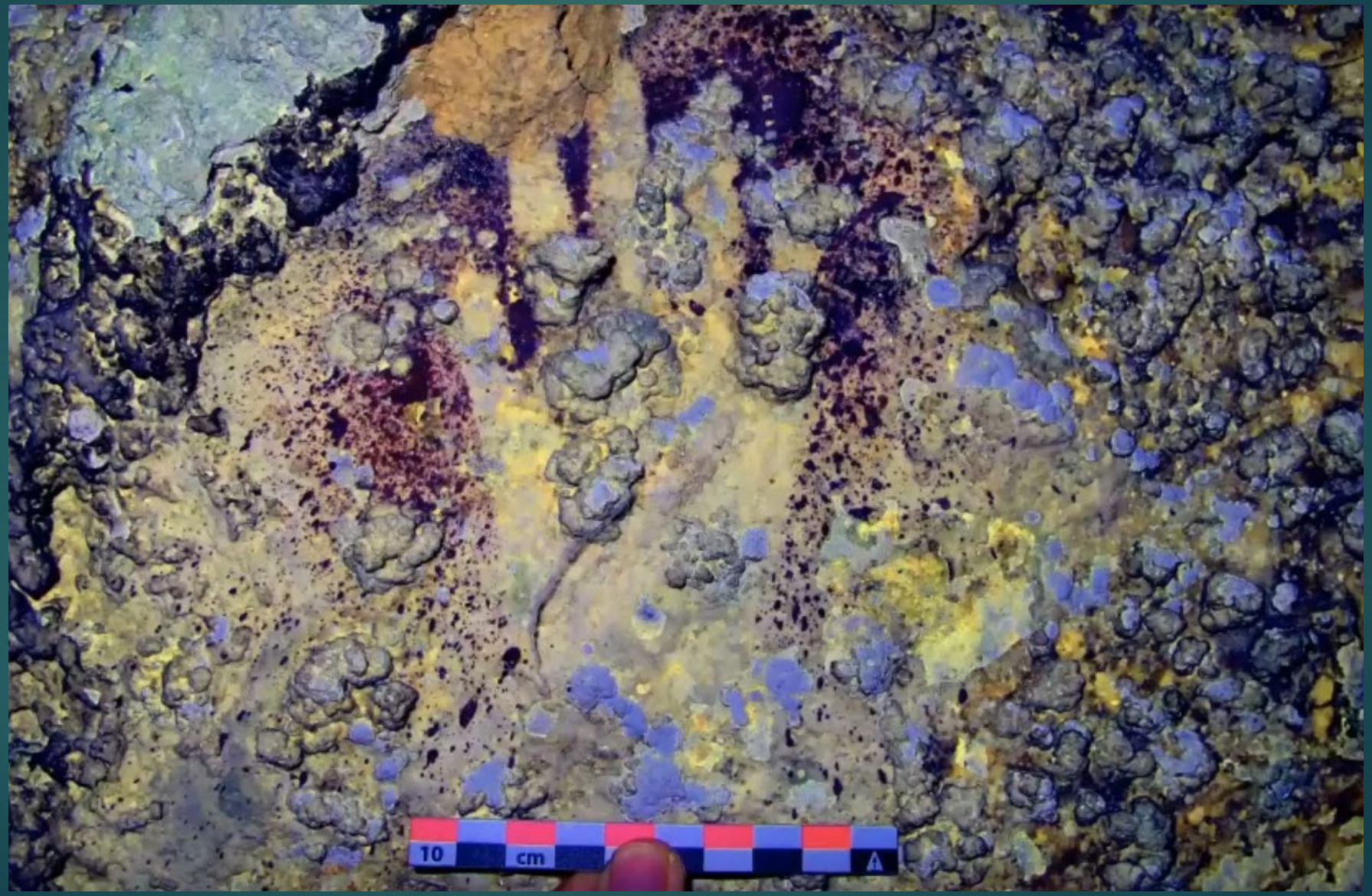
Oldest European artwork

Hunting scene at Lascaux Cave



Therianthrope = animal-man combo

How old is this Sulawesi rock art? Who were the Toaleans?



Oldest representation artwork at 32 Ka

SCIENCE ADVANCES | RESEARCH ARTICLE

ANTHROPOLOGY

Oldest cave art found in Sulawesi

Adam Brumm[1*†], Adhi Agus Oktaviana[2,3†], Basran Burhan[1], Budianto Hakim[4], Rustan Lebe[5], Jian-xin Zhao[6], Priyatno Hadi Sulistyarto[3], Marlon Ririmasse[3], Shinatria Adhityatama[3], Iwan Sumantri[7], Maxime Aubert[2*†]

Indonesia harbors some of the oldest known surviving cave art. Previously, the earliest dated rock art from this region was a figurative painting of a Sulawesi warty pig (*Sus celebensis*). This image from Leang Bulu' Sipong 4 in the limestone karsts of Maros-Pangkep, South Sulawesi, was created at least 43,900 years ago (43.9 ka) based on Uranium-series dating. Here, we report the Uranium-series dating of two figurative cave paintings of Sulawesi warty pigs recently discovered in the same karst area. The oldest, with a minimum age of 45.5 ka, is from Leang Tedongnge. The second image, from Leang Balangajia 1, dates to at least 32 ka. To our knowledge, the animal painting from Leang Tedongnge is the earliest known representational work of art in the world. There is no reason to suppose, however, that this early rock art is a unique example in Island Southeast Asia or the wider region.

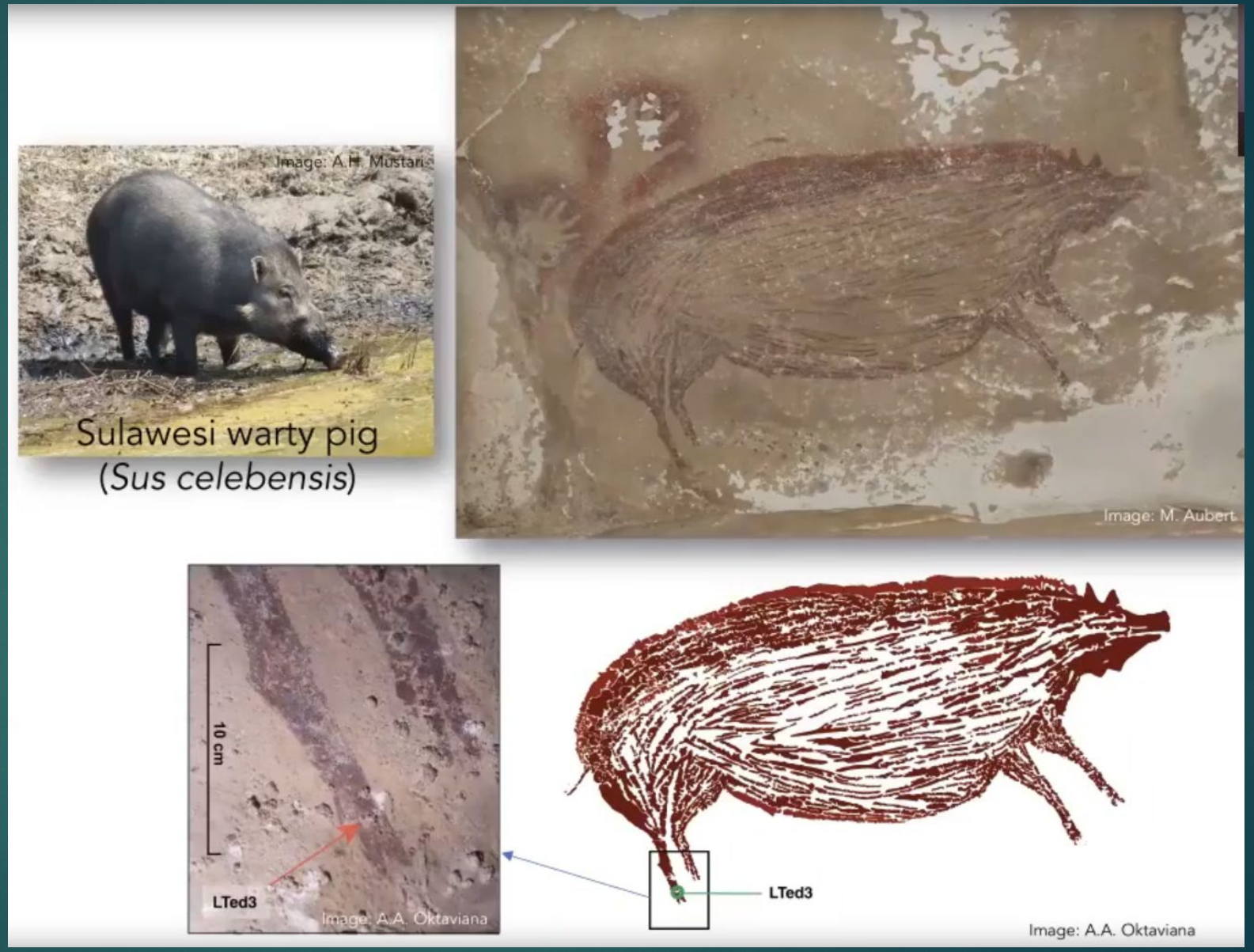
This image from Leang Bulu' Sipong 4 in the limestone karsts of Maros-Pangkep, South Sulawesi, was created at least 43.9 ka

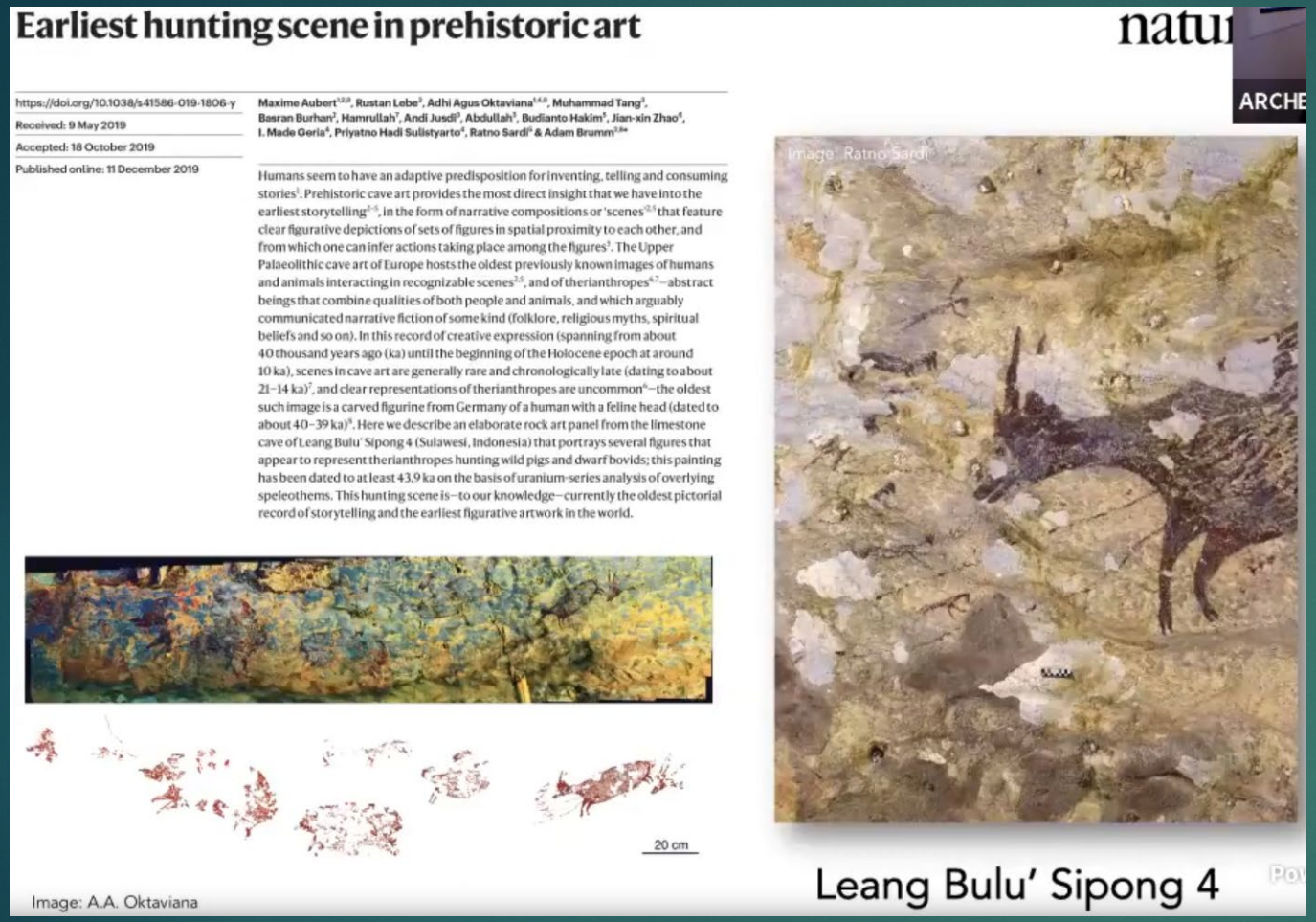
Here, we report the Uranium-series dating of two figurative cave paintings of Sulawesi warty pigs

The oldest, with a minimum age of 45.5 ka, is from Leang Tedongnge. The second image, from Leang Balangajia 1, dates to at least 32 ka.

45,500 years ago
2nd oldest artwork

This is the earliest known representational work of art in the world.





Earliest hunting scene in prehistoric art

https://doi.org/10.1038/s41586-019-1806-y
Received: 9 May 2019
Accepted: 18 October 2019
Published online: 11 December 2019

Maxime Aubert[1,2,3], Rustan Lebe[3], Adhi Agus Oktaviana[1,4,5], Muhammad Tang[3], Basran Burhan[3], Hamrullah[3], Andi Jusdi[3], Abdullah[3], Budianto Hakim[3], Jian-xin Zhao[6], I. Made Geria[4], Priyatno Hadi Sulistyarto[4], Ratno Sardi[4] & Adam Brumm[1,3*]

Humans seem to have an adaptive predisposition for inventing, telling and consuming stories[1]. Prehistoric cave art provides the most direct insight that we have into the earliest storytelling[2–5], in the form of narrative compositions or 'scenes'[2,3] that feature clear figurative depictions of sets of figures in spatial proximity to each other, and from which one can infer actions taking place among the figures[3]. The Upper Palaeolithic cave art of Europe hosts the oldest previously known images of humans and animals interacting in recognizable scenes[3,5], and of therianthropes[6,7]—abstract beings that combine qualities of both people and animals, and which arguably communicated narrative fiction of some kind (folklore, religious myths, spiritual beliefs and so on). In this record of creative expression (spanning from about 40 thousand years ago (ka) until the beginning of the Holocene epoch at around 10 ka), scenes in cave art are generally rare and chronologically late (dating to about 21–14 ka)[7], and clear representations of therianthropes are uncommon[6]—the oldest such image is a carved figurine from Germany of a human with a feline head (dated to about 40–39 ka)[8]. Here we describe an elaborate rock art panel from the limestone cave of Leang Bulu' Sipong 4 (Sulawesi, Indonesia) that portrays several figures that appear to represent therianthropes hunting wild pigs and dwarf bovids; this painting has been dated to at least 43.9 ka on the basis of uranium-series analysis of overlying speleothems. This hunting scene is—to our knowledge—currently the oldest pictorial record of storytelling and the earliest figurative artwork in the world.

Image: A.A. Oktaviana

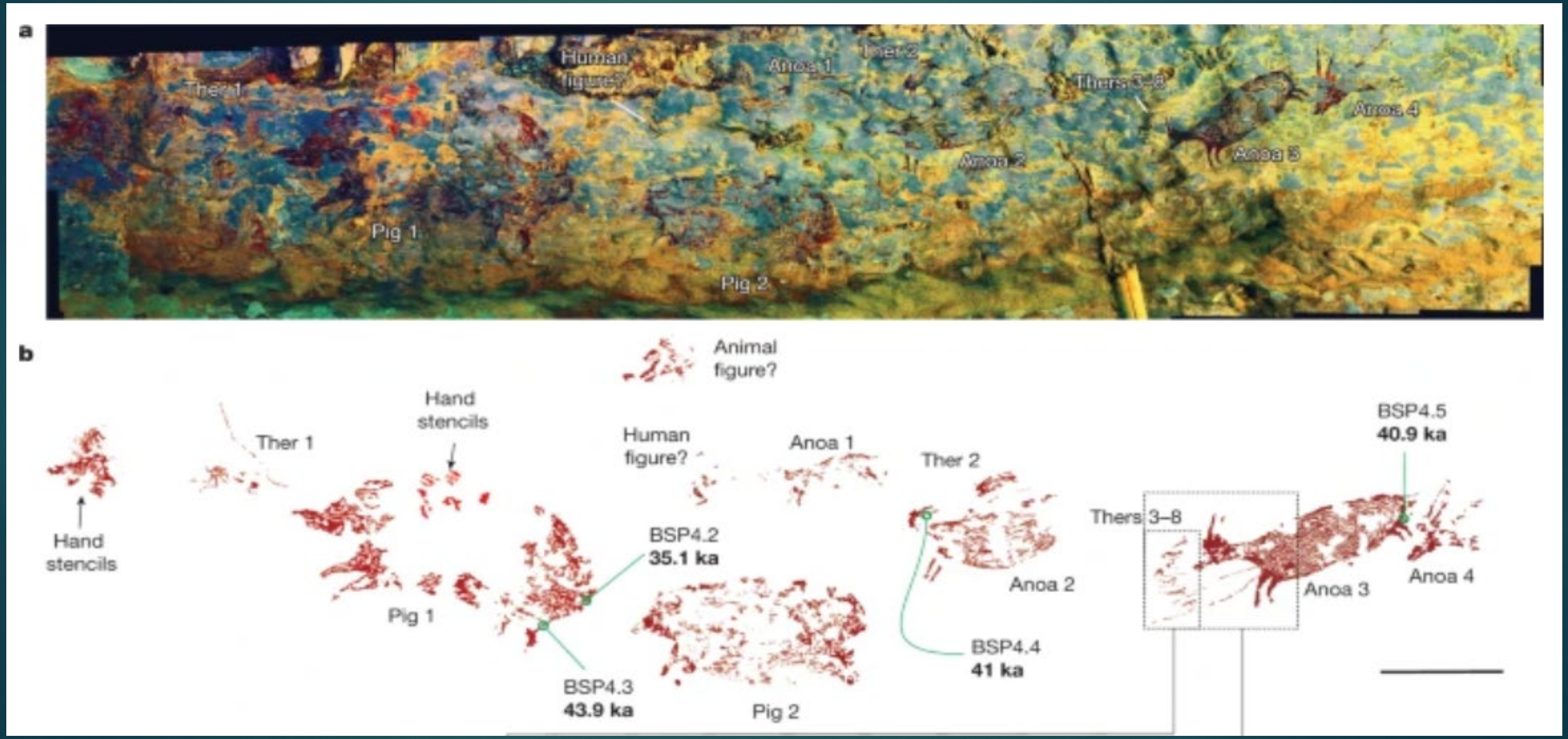
Image: Ratno Sardi

Leang Bulu' Sipong 4

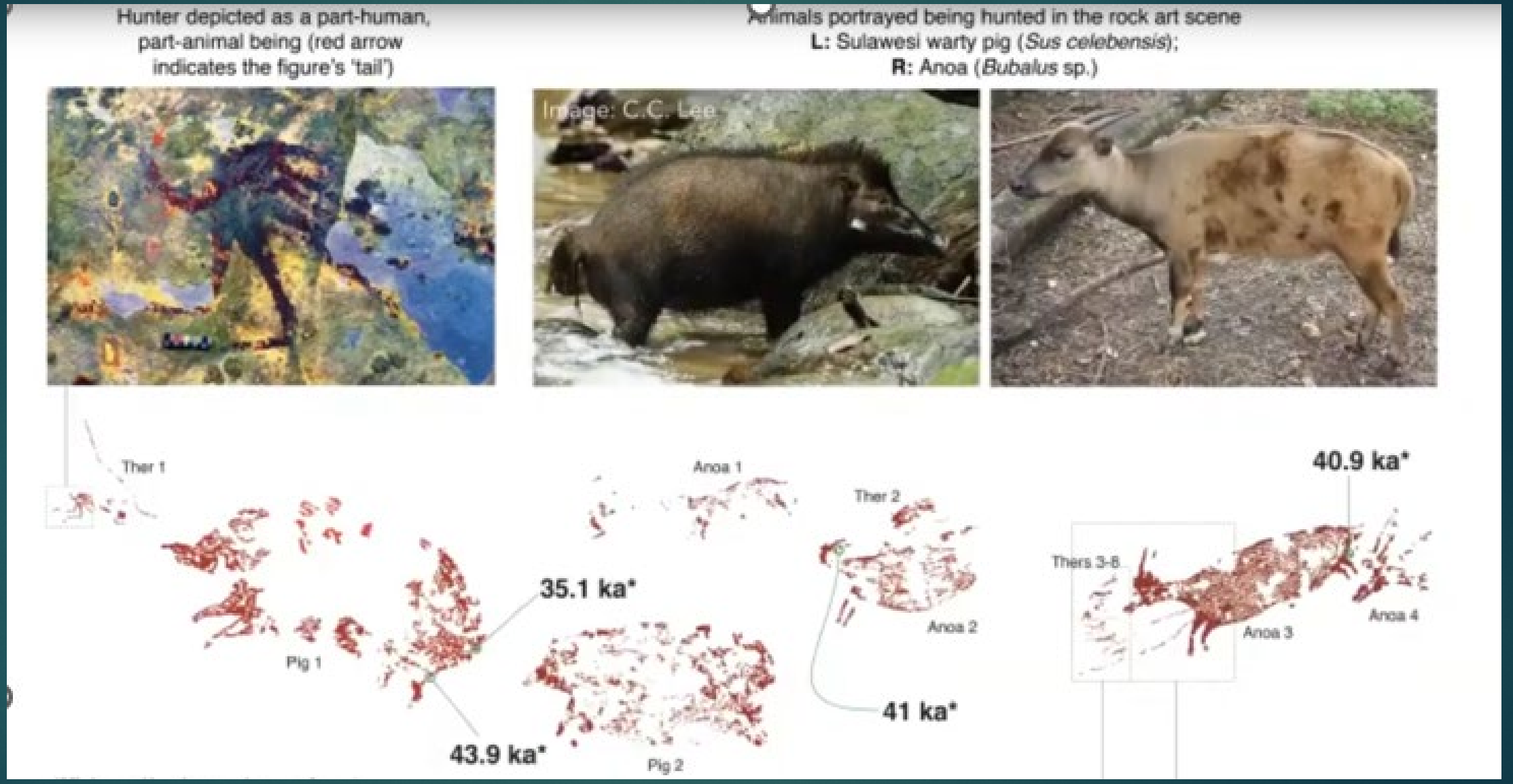
2019: Here we describe an elaborate rock art panel from the limestone cave of Leang Ruiu Mpong4 (Sulawesi. Indonesia) that portrays several figures that appear to represent therlanthropes hunting wild pigs and dwarf bovlds; this painting has been dated to at least 43.9 ka on the basis of uranium series analysis of overlying speleothems. This hunting scene is to our knowledge- currently the oldest pictorial record of storytelling and the earliest figurative art work in the world.

2019: 44 Ka

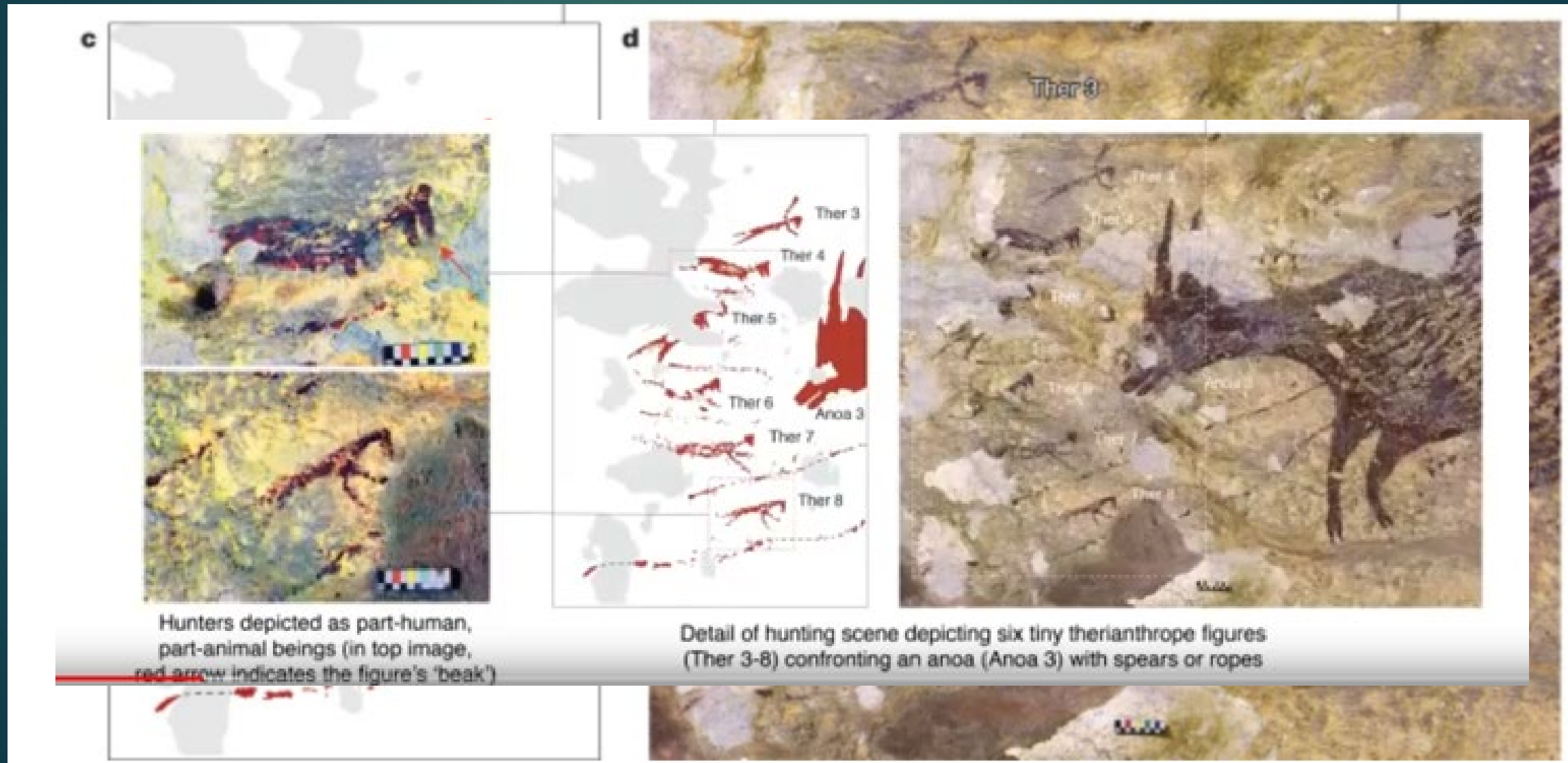
Rock art panel from the limestone cave of Leang Ruiu Mpong4 (Sulawesi. Indonesia): 43.9 Ka; 2x older than Lascaux hunting scene: earliest evidence of creative storytelling.



Oldest hunting scene In the world



Detail of a group of therianthropic (part-human, part-animal) figures confronting an anoa.

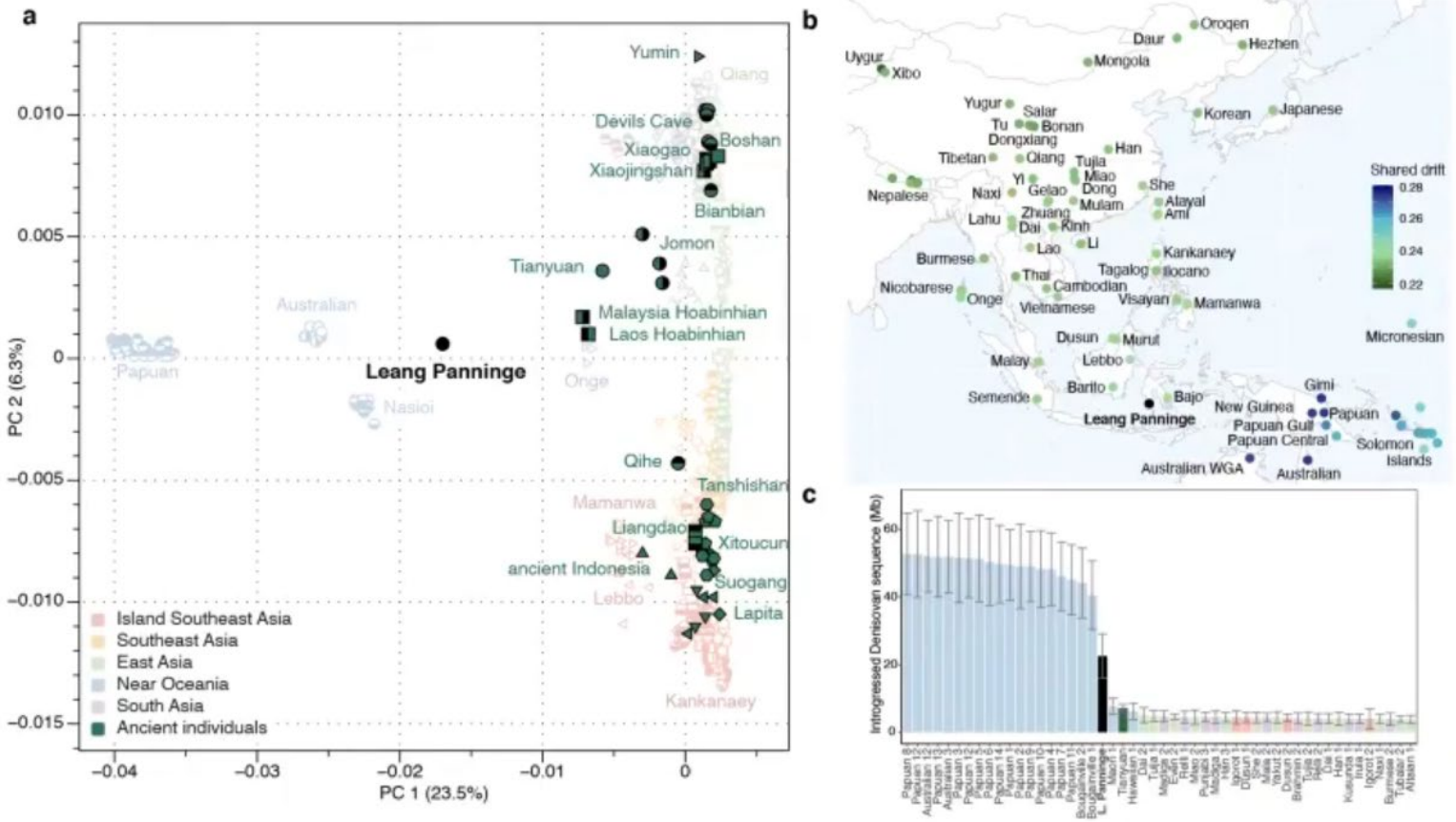


Discovery of Neolithic Toalean woman’s skull

First aDNA genome from Wallacea

a, PCA calculated on present-day individuals from eastern Eurasia and Near Oceania, projecting key ancient individuals from the region

b, Shared genetic drift of present-day groups with the Leang Panninge individual

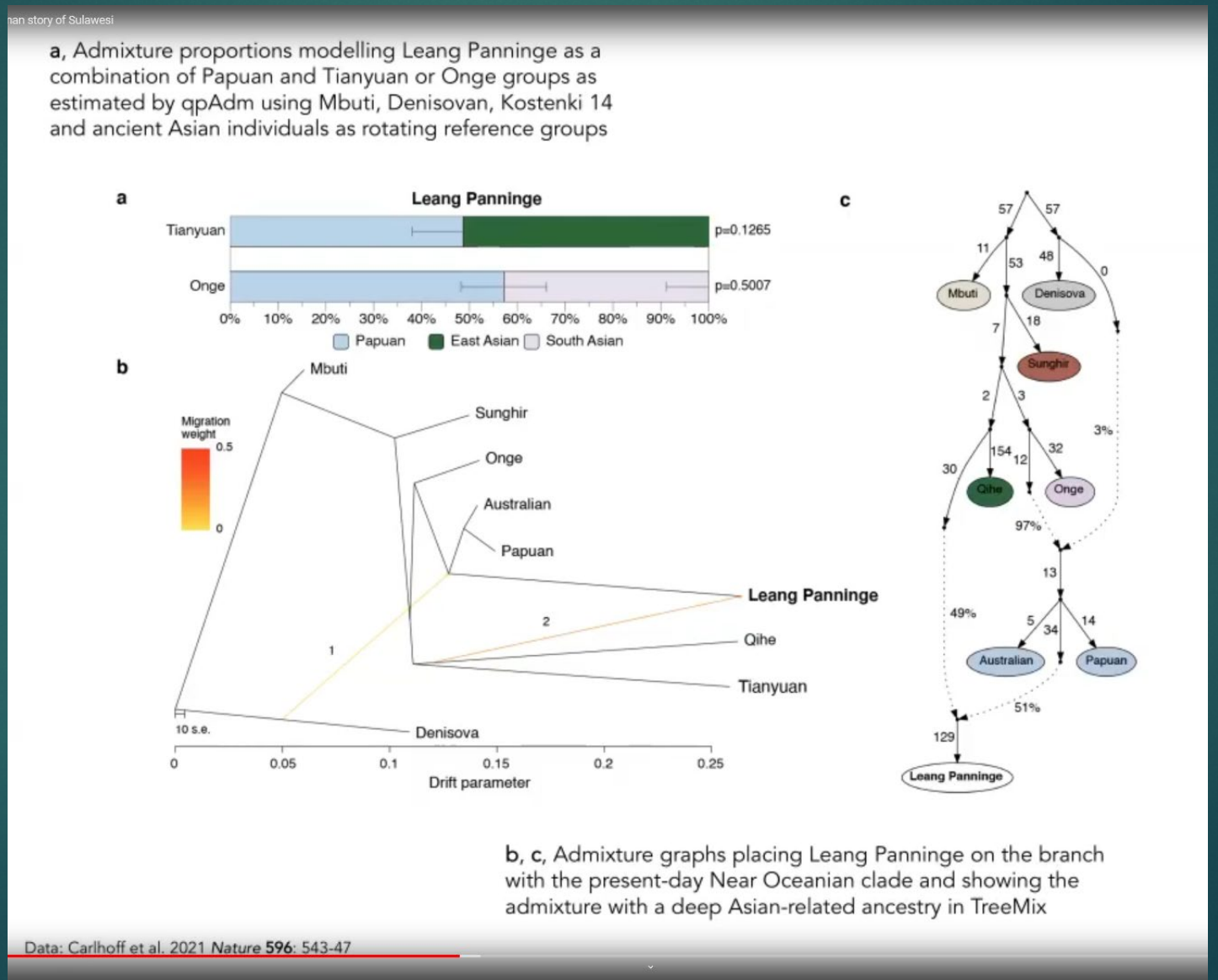


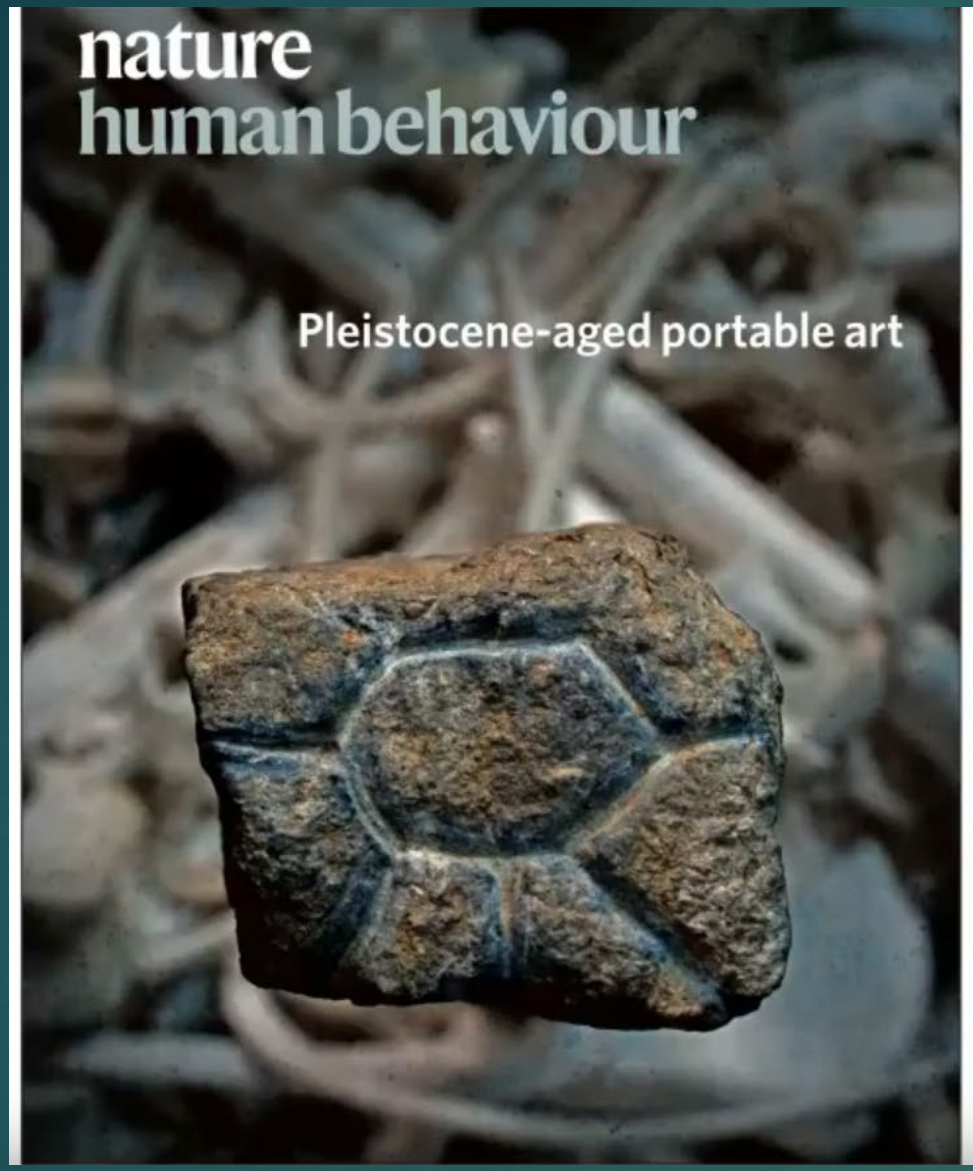
c, Amount of introgressed Denisovan sequence in fragments longer than 0.05 cM in present-day (Simons Genome Diversity Project) individuals and longer than 0.2 cM in ancient individuals (measured with admixfrog).

Data: Carlhoff et al. 2021 *Nature* **596**: 543-47

- From petrous bone of a young female Toalean hunter-gatherer buried 7.3 ka at the limestone cave of Leang Panninge[2] in South Sulawesi, Indonesia.
- Shares most genetic drift and morphological similarities with present-day Papuan and Indigenous Australian groups, yet represents a previously unknown divergent human lineage that branched off around the time of the split between these populations approximately 37,000 years ago.
- Has both D and deep Asian ancestry

Neolithic Toalean woman skeleton: descent from 50 Ka migration which populated Austronesian region; with deep Asian ancestry + Denisovan



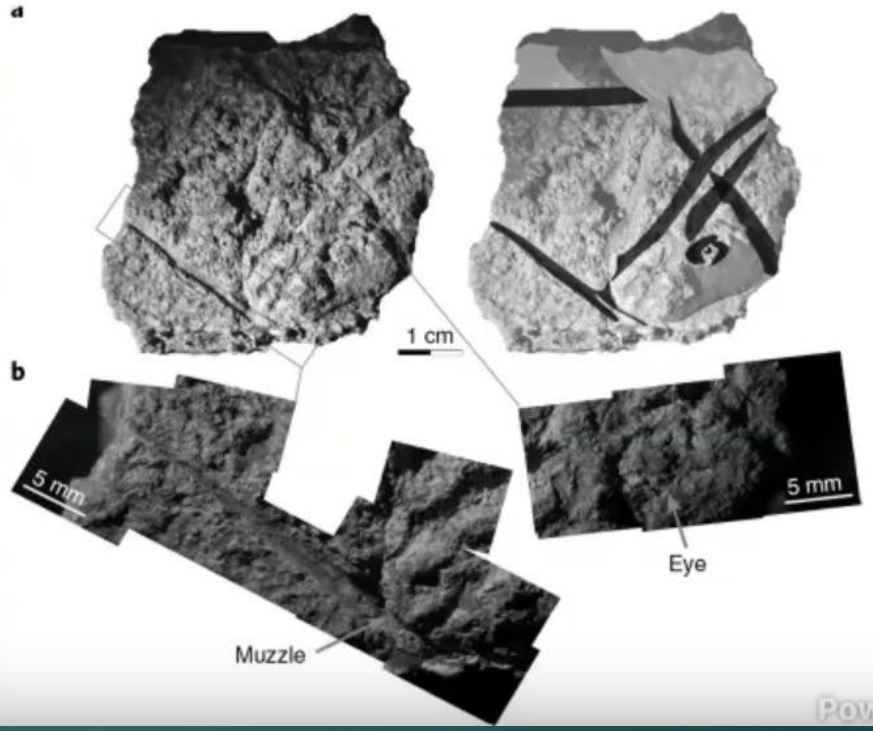


ARCHE

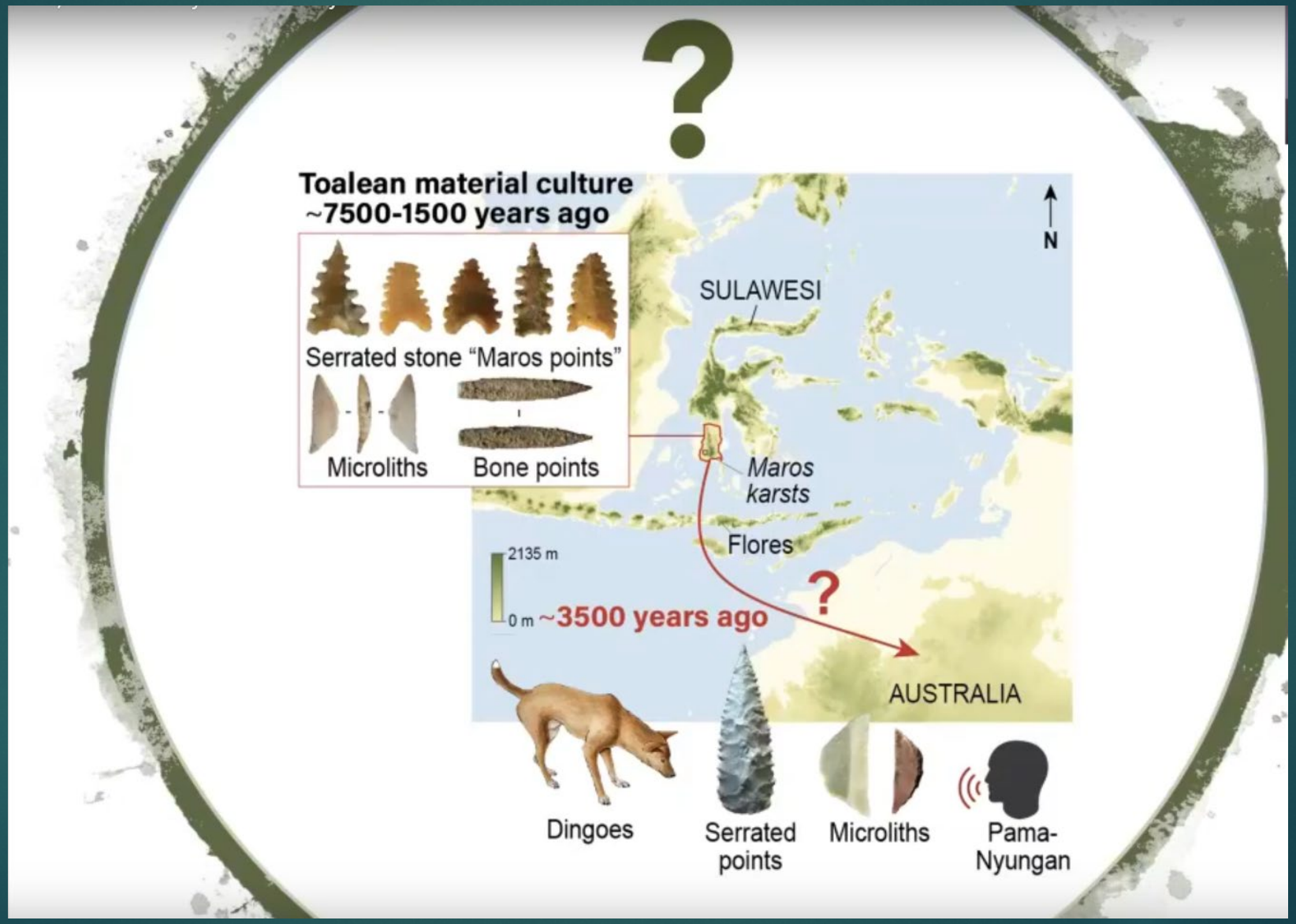
Portable art from Pleistocene Sulawesi

Michelle C. Langley[1✉], Budianto Hakim[2], Adhi Agus Oktaviana[3,4], Basran Burhan[1], Iwan Sumantri[5], Priyatno Hadi Sulistyarto[3], Rustan Lebe[6], David McGahan[1] and Adam Brumm[1]

The ability to produce recognizable depictions of objects from the natural world—known as figurative art—is unique to *Homo sapiens* and may be one of the cognitive traits that separates our species from extinct hominin relatives. Surviving examples of Pleistocene figurative art are generally confined to rock art or portable three-dimensional works (such as figurines) and images engraved into the surfaces of small mobile objects. These portable communicative technologies first appear in Europe some 40 thousand years ago (ka) with the arrival of *H. sapiens*. Conversely, despite *H. sapiens* having moved into Southeast Asia–Australasia by at least 65 ka, very little evidence for Pleistocene-aged portable art has been identified, leading to uncertainties regarding the cultural behaviour of the earliest *H. sapiens* in this region. Here, we report the discovery of two small stone 'plaquettes' incised with figurative imagery dating to 26–14 ka from Leang Bulu Bettue, Sulawesi. These new findings, together with the recent discovery of rock art dating to at least 40 ka in this same region, overturns the long-held belief that the first *H. sapiens* of Southeast Asia–Australasia did not create sophisticated art and further cements the importance of this behaviour for our species' ability to overcome environmental and social challenges.



Were Toaleans the Dingo bringers?



World's 1st horseback riders swept across Europe roughly 5,000 years ago. Pictorial evidence of horsemanship in the Bronze Age (c. 2100 to 1200 BC)

First bioanthropological evidence for Yamnaya horsemanship

- The origins of horseback riding remain elusive. Scientific studies show that horses were kept for their milk ~3500 to 3000 BCE, widely accepted as indicating domestication. However, this does not confirm them to be ridden.

- Equipment used by early riders is rarely preserved, and the reliability of equine dental and mandibular pathologies remains contested. However, horsemanship has two interacting components: the horse as mount and the human as rider.

- Alterations associated with riding in human skeletons therefore possibly provide the best source of information.

Martin Trautmann, et al., 2023

Yamnaya horseman

- Report five Yamnaya individuals well-dated to 3021 to 2501 BC from kurgans in Romania, Bulgaria, and Hungary, displaying changes in bone morphology and distinct pathologies associated with horseback riding.

- These are the oldest humans identified as riders so far.

Yamnaya grave of a horse rider discovered in Strejnicu, Romania. The man, 30 to 40 years old at the time of death, displays skeletal traits typical of "horsemanship syndrome."

Horses, horse milk, and Horsemanship syndrome

- The new analysis came from 217 human skeletons from the Pontic-Caspian steppe, a geographical area that runs roughly from Bulgaria to Kazakhstan. For decades, researchers have debated when horses were domesticated.
- In Kazakhstan, 5,000-year-old horse skeletons show wear on their teeth that could have been from bridles, while others have found possible fenced enclosures.
- In the same time period, horse milk peptides have been detected in the dental plaque of people from Russia.
- Importantly, the geographical explosion of the Yamnaya culture — which expanded across 3,000 miles (4,500 kilometers) over a mere century or two — suggests horses may have assisted as transportation animals.

Horsemanship syndrome

- Collected data on six diagnostic skeletal traits that have been collectively called "horsemanship syndrome."
- Since bone is a living tissue, it responds to stresses placed on it. Consistent horseback riding can cause trauma and spine degeneration, but it can also result in more subtle changes to the leg and hip bones as the human body adapts to regular riding.
- In the skeletons from 39 sites across Eastern Europe, Trautmann and colleagues found that two dozen had at least half of the traits of horsemanship syndrome.

Horsemanship syndrome

- Five Yamnaya culture individuals from what is now Romania, Bulgaria and Hungary as likely equestrians.
- Provides a strong argument that horseback riding was already a common activity for some Yamnaya individuals as early as 3000 B.C..
- Estimate that more than 30% of male adult Yamnaya individuals were riding frequently

The horses

- However, because of the lack of specialized gear and a comparably short breeding and training history, early horses were probably hard to handle.

- As Librado et al. demonstrate, Yamnaya horses were markedly closer to the equid lineage known as DOM2, including all modern domestic horses, than were wild steppe horses from the sixth millennium BCE.

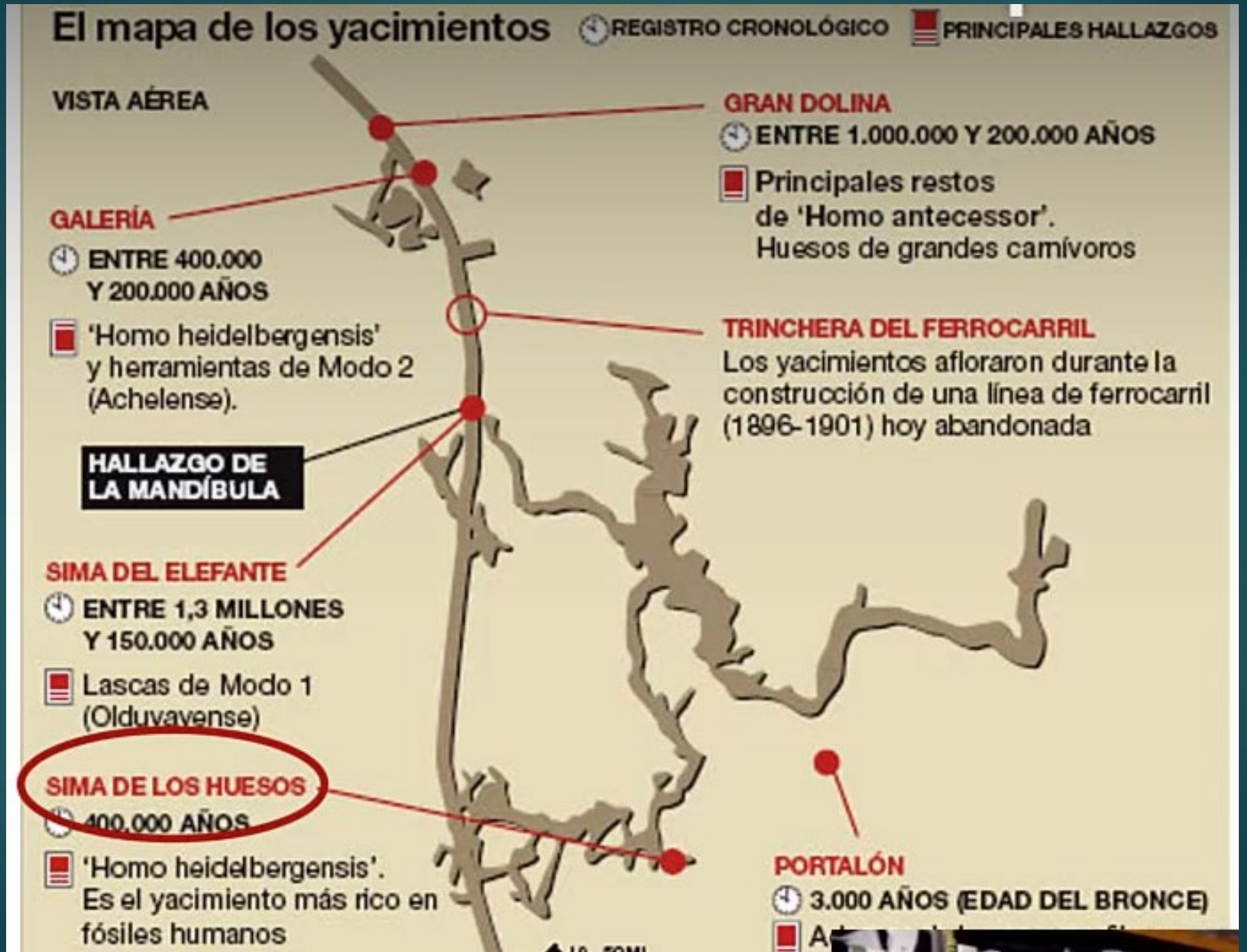
- But genes for reduced anxiety/fear response were selected and retained in all later DOM2 horse breeds. Even DOM2 horses can be highly strung and excitable animals, so a still greater anxiety response in early Yamnaya horses probably made them even more likely to “bolt” from violent or loud actions.

Atapuerca Spain: 1960s railway excavation uncovered a sinkhole into a cave system

Atapuerca, Spain

El mapa de los yacimientos

REGISTRO CRONOLÓGICO — PRINCIPALES HALLAZGOS



Atapuerca

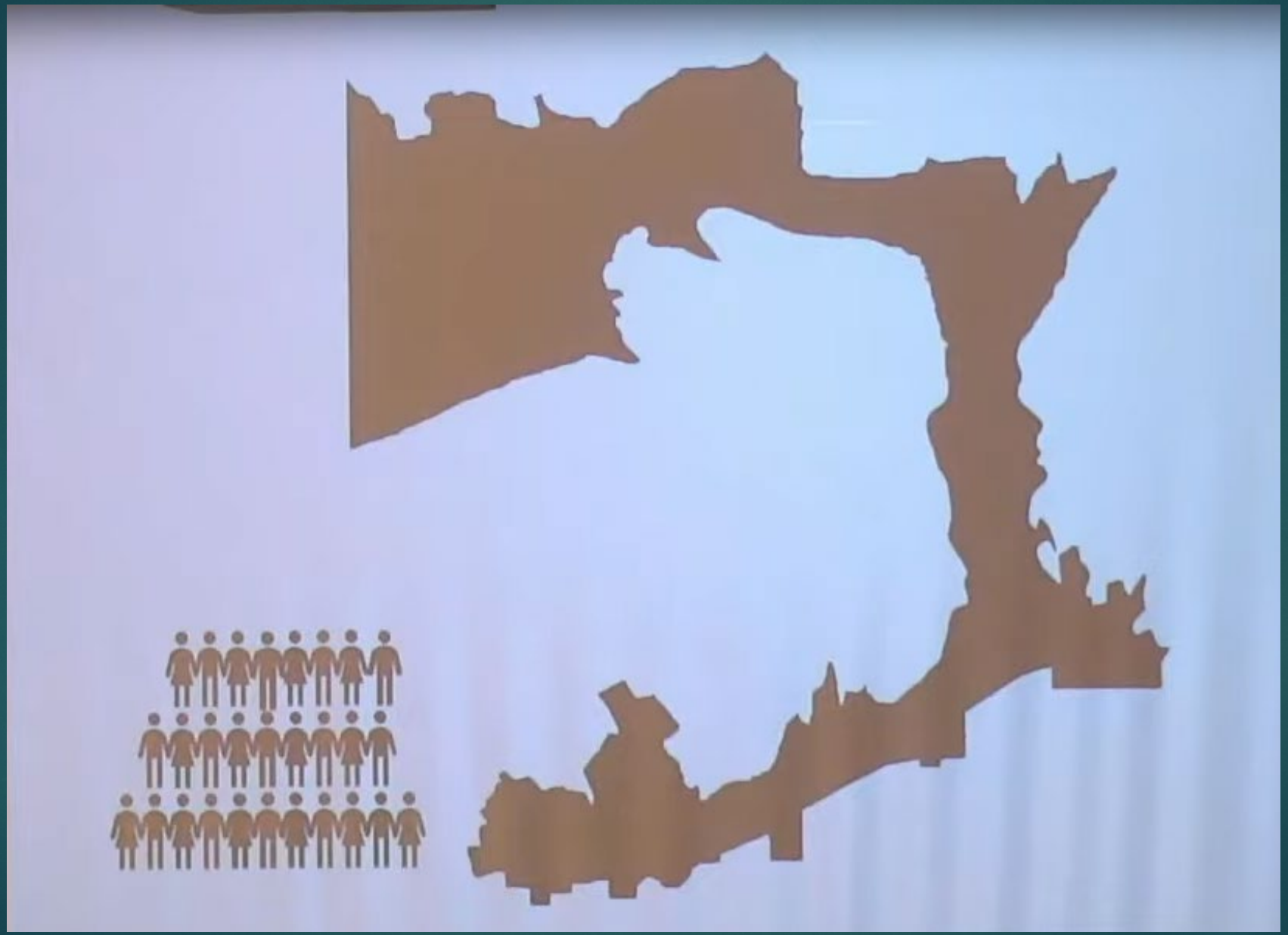
Gran Dolina, Atapuerca: *H. antecessor,* ~900 Ka

Miquelon: most famous Skull 5 of Atapuerco: originally *H. heidelbergensis*

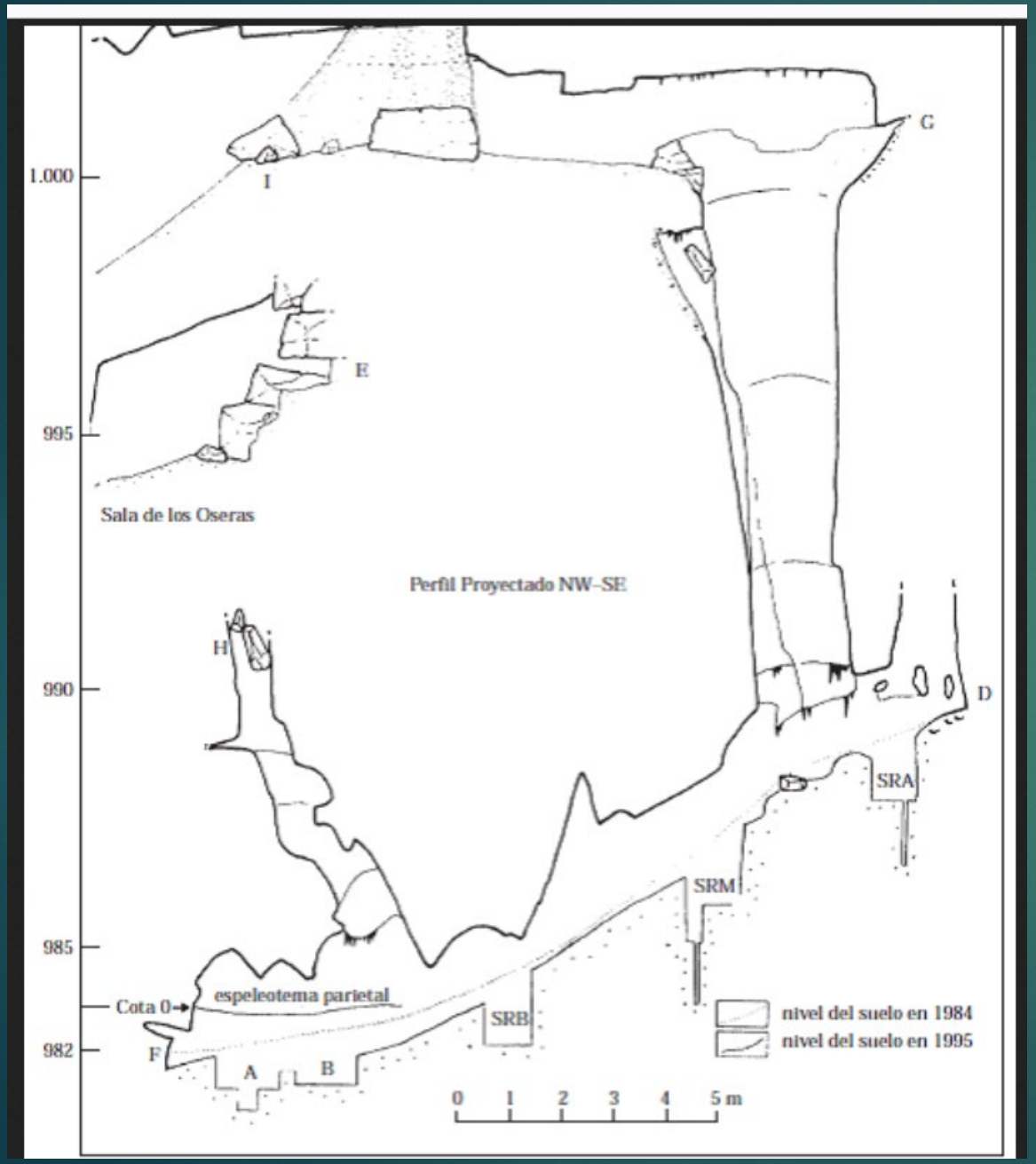
Deep cave

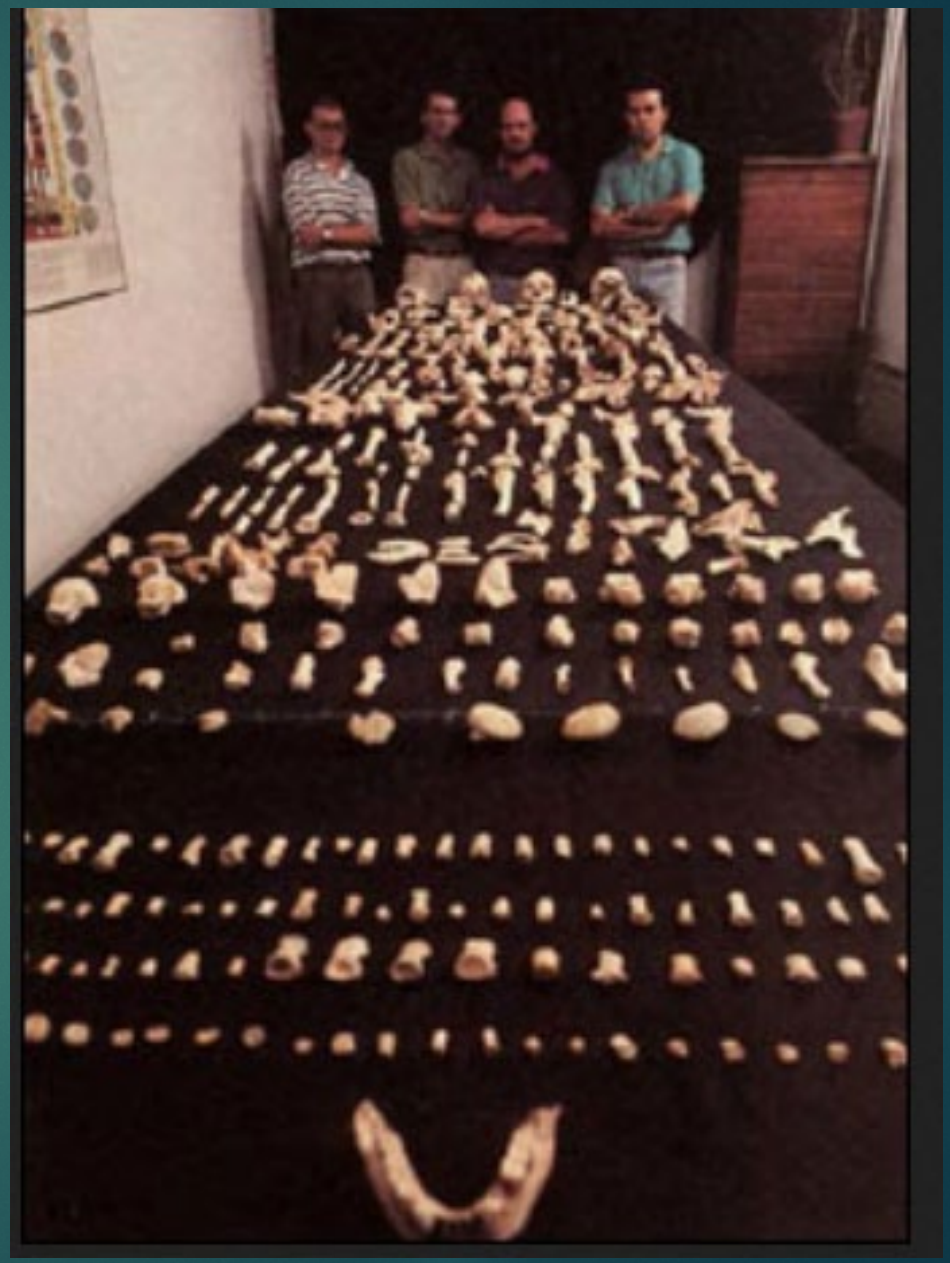
43 foot pit is 1/3rd of a mile in the cavern

Sima de los Huesos chimney, 43 feet down, 28 fossils

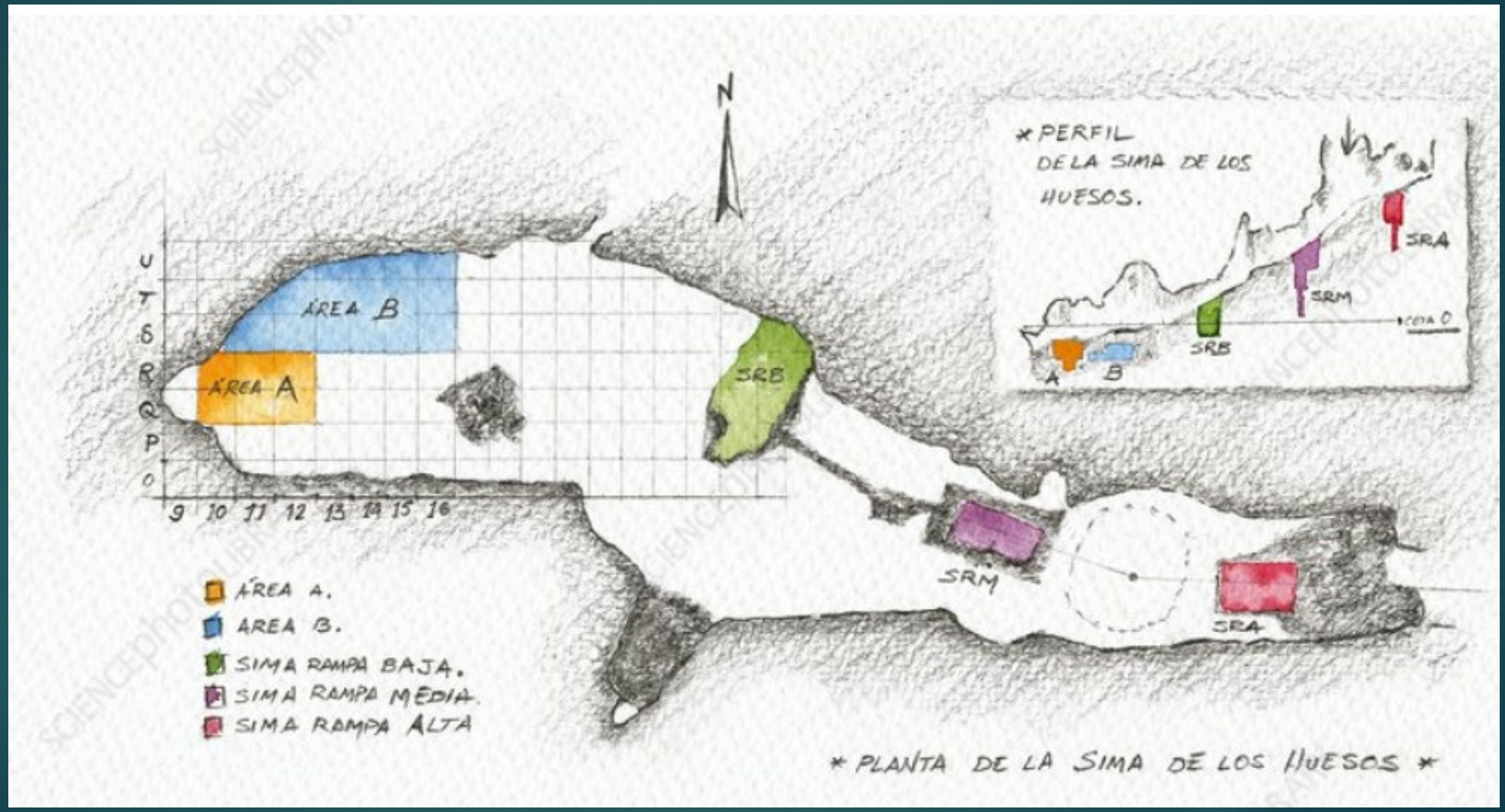


Sima de los Huesos: 1/3rd of a mile inside cave





SH excavation areas



Sima de los Huesos: 166 bears at 300 Ka; 28 hominins at 430 Ka

- The actual chamber is at the end of a 40-foot ramp, leading up to the base of a 43-foot vertical shaft, 1500 feet from any cave entrance. It is, literally, a dead end.
- This chamber has had only one entry—the 43-foot vertical shaft. It is highly unlikely that anything that dropped or fell down that shaft could ever climb back up.
- To date, scientists have examined less than half of the fossil-bearing layers of cave sediments.
- There are tens of thousands of bones in the chamber, most belonging to 166 cave bears (~300 Ka). No prey herbivores. There are many gnaw marks on the cave-bear bones. Bears fell in.

SH - Hominins

- But buried well below the animal bones is a more significant discovery: more than 7000 hominin bones representing at least 28 individuals (~430 Ka). Expect fossil number to double with more excavation

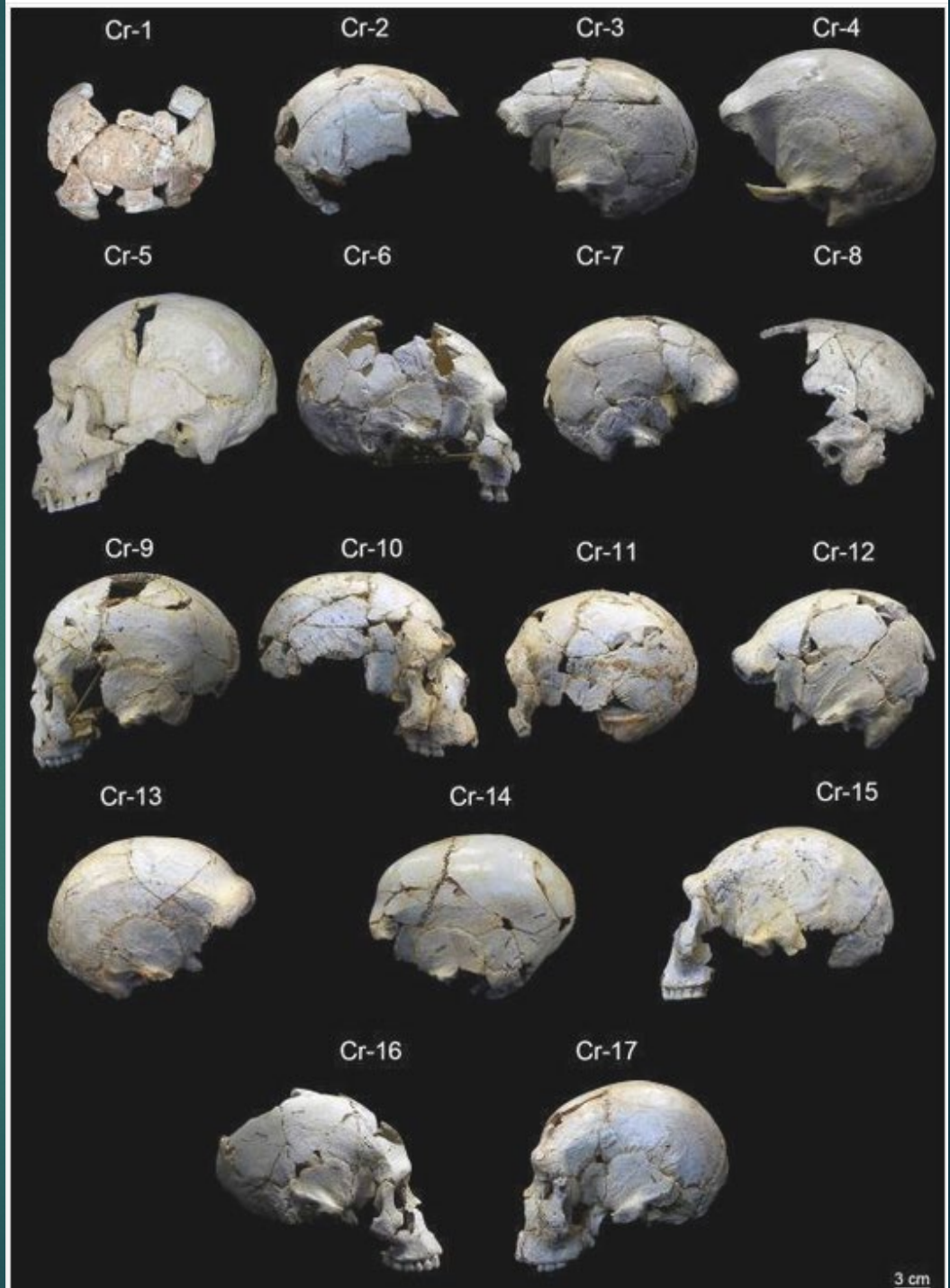
- The nature of these deposits points to an environment with very little disturbance over time and gradual accumulation.

- The hominin bones have been found in the deepest sediments that fill the pit. Most of the hominin bones are beneath the other carnivore bones, with a few hominin bones mixed with carnivore bones. Only 4% of hominin bones have carnivore evidence.

100 feet down

7000 hominin bones

17 of 28 SH skulls



Size: Male - 5’7”, 170 lbs; Female – 5’2’, 125 lbs

1992: Skull 5

Why where they down there?

Excalibur = only stone tool found in the Pit of the Bones

Sima de los Huesos

A mitochondrial genome sequence of a hominin from Sima de los Huesos

Matthias Meyer[1], Qiaomei Fu[1,2], Ayinuer Aximu-Petri[1], Isabelle Glocke[1], Birgit Nickel[1], Juan-Luis Arsuaga[3,4], Ignacio Martínez[3,5], Ana Gracia[3,5], José María Bermúdez de Castro[6], Eudald Carbonell[7,8] & Svante Pääbo[1]

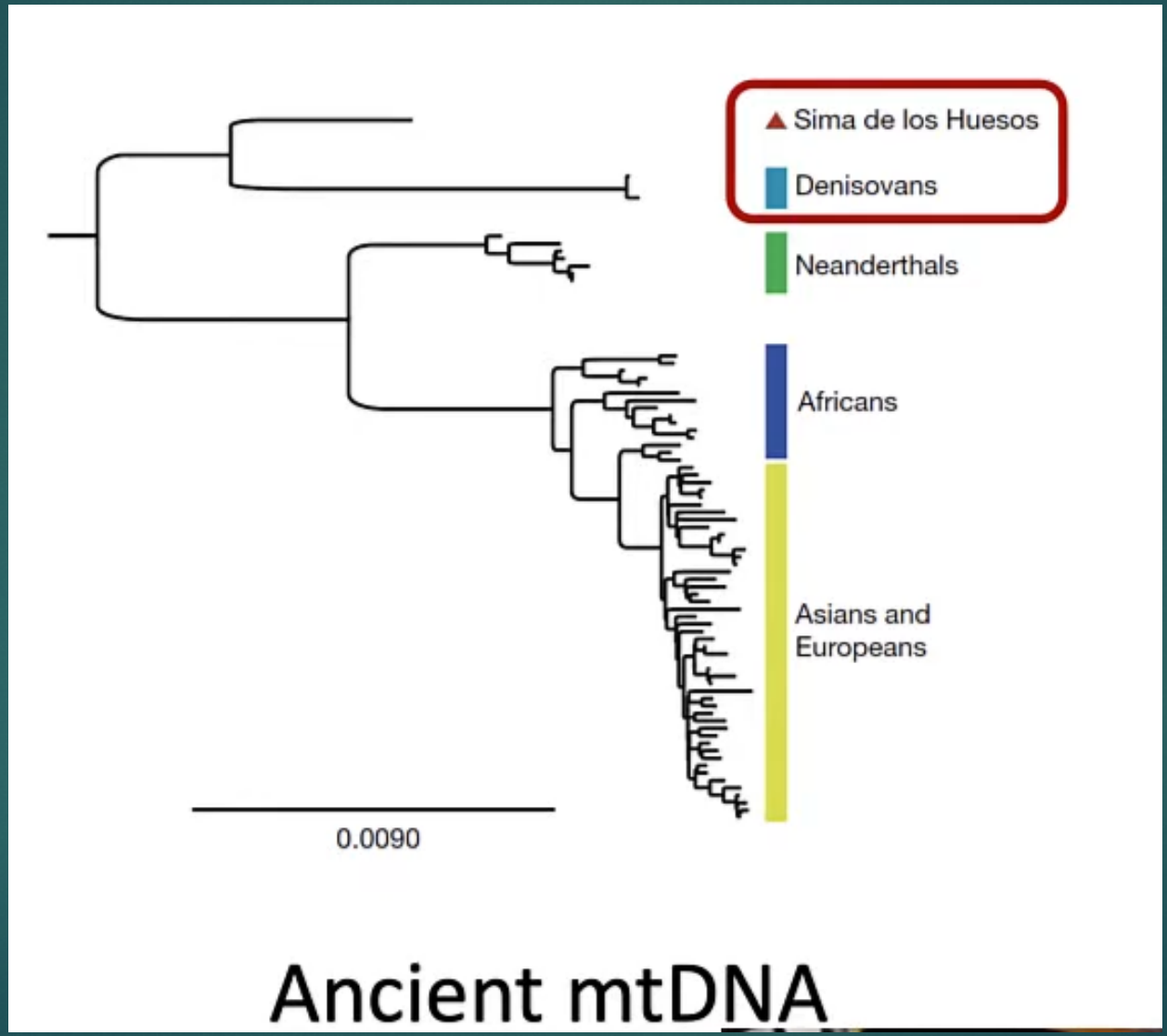
2014

Nuclear DNA sequences from the Middle Pleistocene Sima de los Huesos hominins

Matthias Meyer[1], Juan-Luis Arsuaga[2,3], Cesare de Filippo[1], Sarah Nagel[1], Ayinuer Aximu-Petri[1], Birgit Nickel[1], Ignacio Martínez[2,4], Ana Gracia[2,4], José María Bermúdez de Castro[5,6], Eudald Carbonell[7,8], Bence Viola[9], Janet Kelso[1], Kay Prüfer[1] & Svante Pääbo[1]

2016

Sima de los Huesos: mtDNA = Denisovan



Sima de los Huesos

- The SH site has yielded an extraordinarily large sample of Middle Pleistocene (c. 430 kya) hominin fossils belonging to the Neandertal clade and corresponding to a minimum of 28 individuals. Largest known collection of skulls and jaws in the whole of human paleontology, found at the Sima de los Huesos site (Atapuerca, Burgos),

- During the time the hominin bones accumulated at the SH site, the only possible access route to the site were through a deep (13 m) vertical chimney.

- Given the skeletal part representation in the collection, it is likely that entire bodies were deposited at the site.

- There are no cutmarks on any of the 6700+ hominin bones recovered to date, and carnivore manipulation (tooth marks) of the bones is rare (4%).

Nohemi Sala, Juan Luis Arsuaga, et al. 2015

Sima de los Huesos

- The origin of the accumulation has been highly debated, and four different hypotheses have been proposed:
  - carnivore activity,
  - transport by geological agents,
  - accidental falls, and
  - intentional accumulation of bodies by hominins: burials

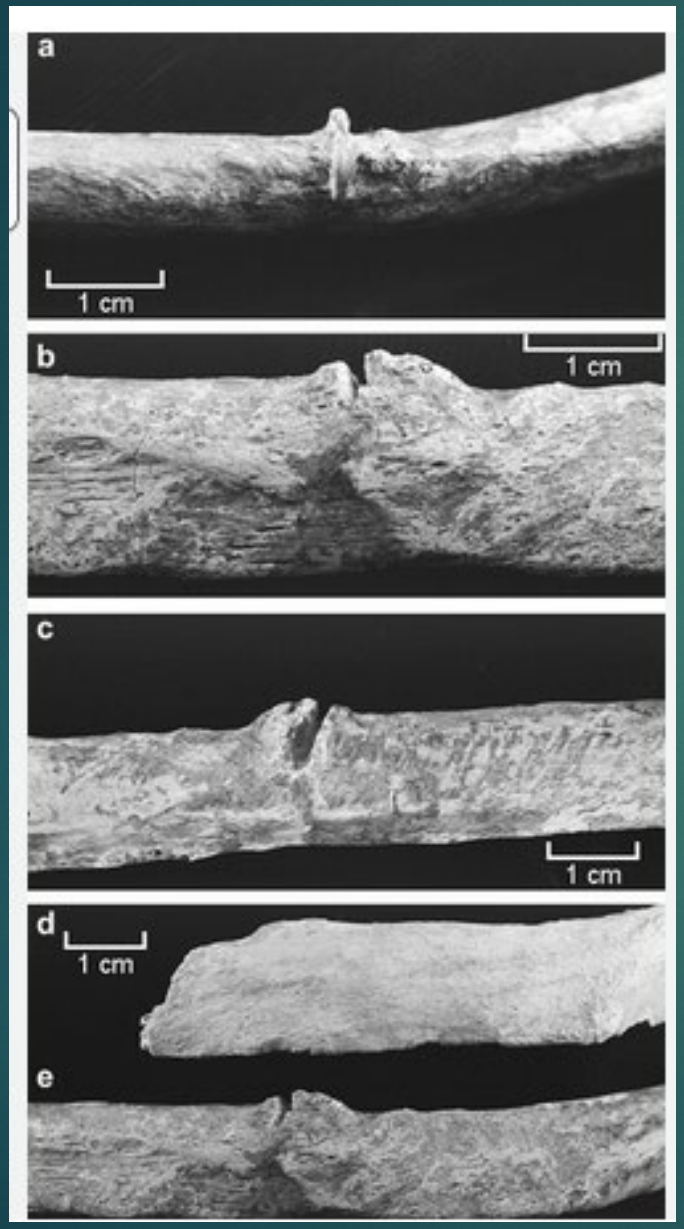
- Recent taphonomic studies have ruled out carnivores and geological processes as accumulation agents

Fossil evidence of Interpersonal violence

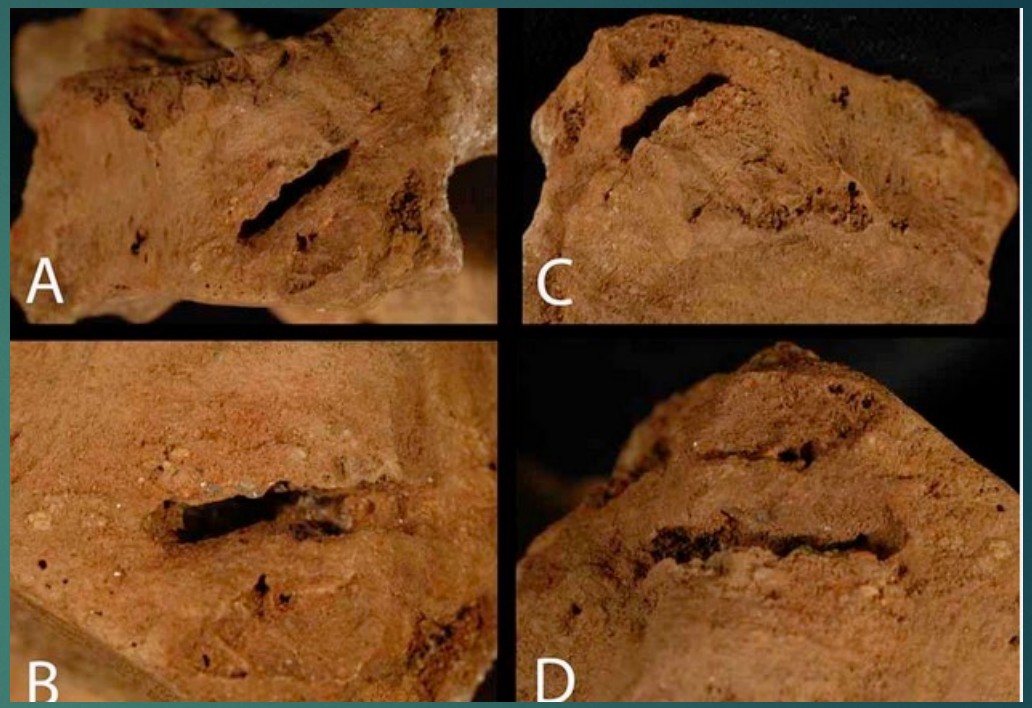
- Currently, there are only two examples in the fossil record that are tentatively considered cases of lethal interpersonal violence.

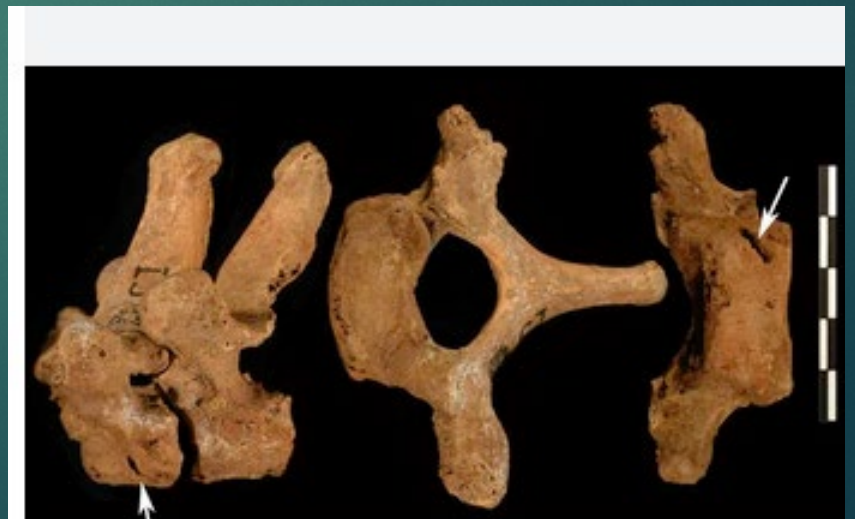
- The Shanidar 3 Neandertal shows a penetrating lesion to the left ninth rib consisting of a parallel-sided groove with exostoses along its margins. Nevertheless, some bone remodelling is apparent, suggesting this individual survived for several weeks after the lesion, and it is not clear that the final cause of death was related to the rib injury.

Shanidar 3 (40 Ka)



Sunghir 1 (26 Ka)





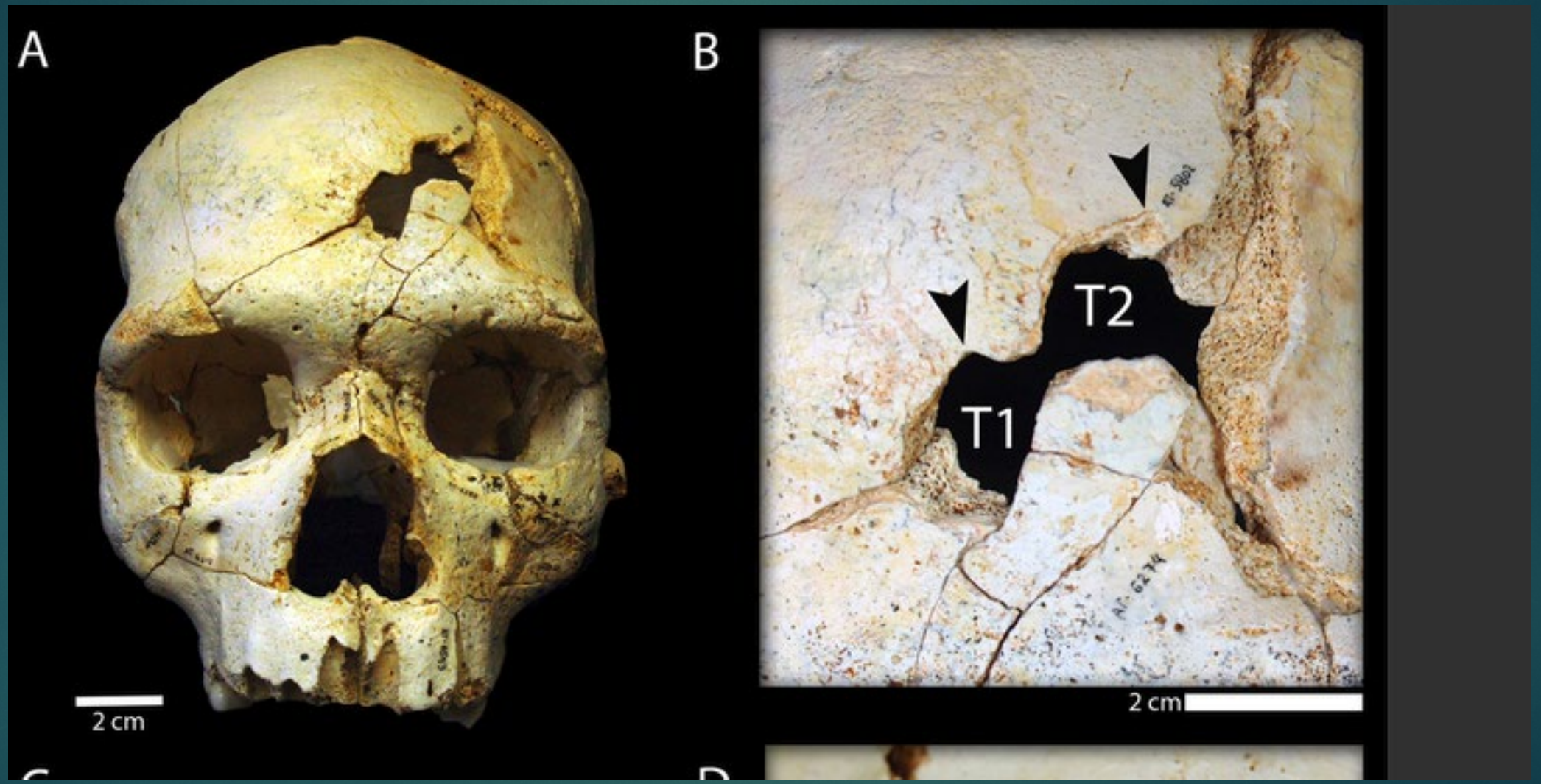
Sunghir 1

- The Upper Paleolithic *Homo sapiens* individual Sunghir 1 shows a perimortem incision in the ventral–lateral first thoracic vertebra (T1) body, most likely from a sharp blade or point and the probable cause of death. Context indicates that the trauma was most likely from a hunting accident or social altercation

- While this would seem to represent a relatively clear case of lethal interpersonal violence, the authors did not rule out the possibility of a hunting accident.

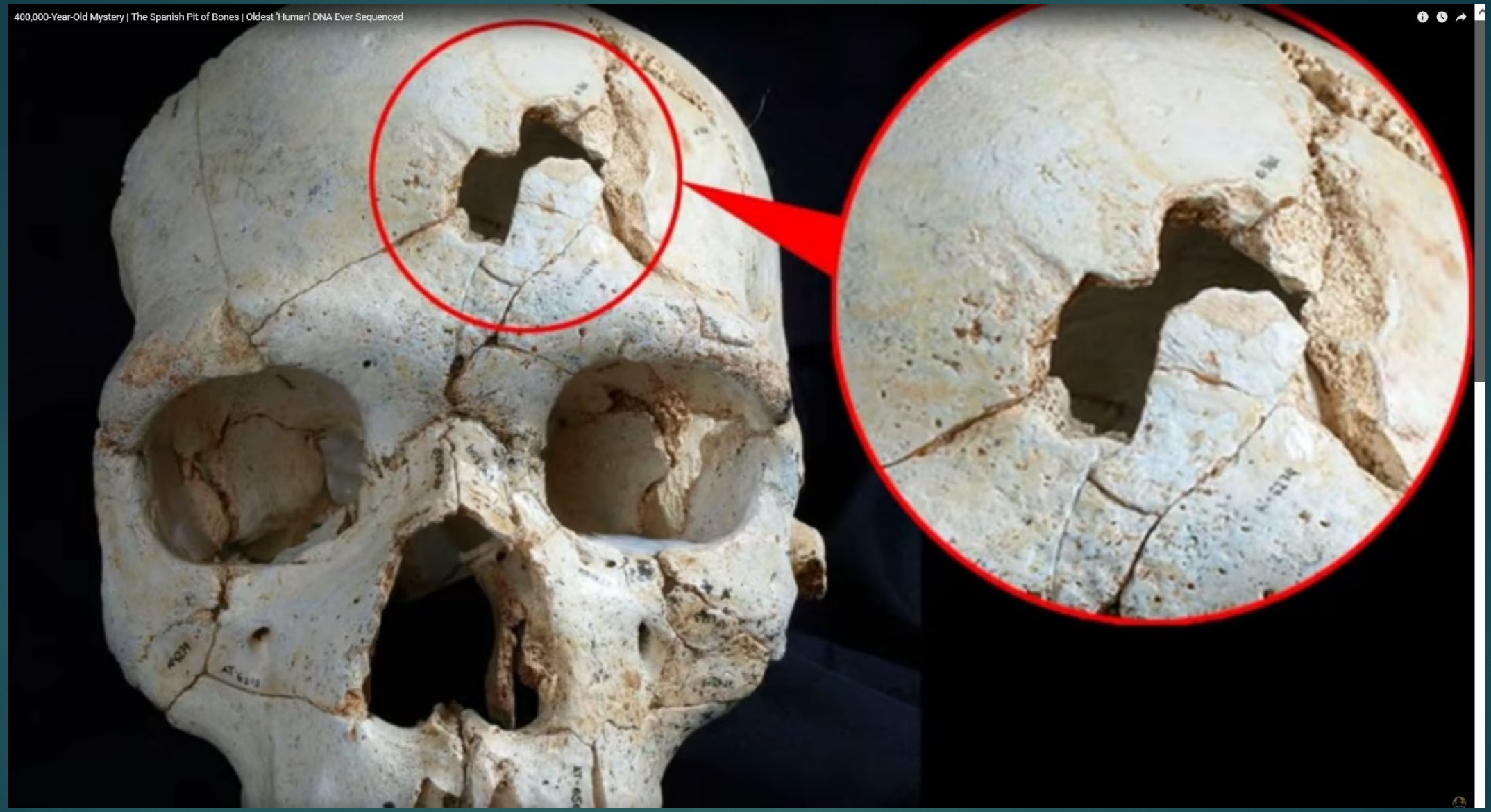
- Here report on the presence of perimortem lethal cranial traumatic lesions in a Middle Pleistocene individual from the Sima de los Huesos (SH) site, a singular case in the hominin fossil record.

Murder at Sima de los Huesos: Skull 17



SH Skull 17: Interpersonal violence

- The earliest evidence of lethal interpersonal violence in the hominin fossil record.
- Cranium 17 recovered from the Sima de los Huesos Middle Pleistocene site shows two clear perimortem (at or near time of death) depression fractures on the frontal bone, interpreted as being produced by two episodes of localized blunt force trauma.
- The type of injuries, their location, the strong similarity of the fractures in shape and size, and the different orientations and implied trajectories of the two fractures suggest they were produced with the same object in face-to-face interpersonal conflict.
- Given that either of the two traumatic events was likely lethal, the presence of multiple blows implies an intention to kill.


400,000-Year-Old Mystery | The Spanish Pit of Bones | Oldest 'Human' DNA Ever Sequenced

Taphonomic evidence

- Strong evidence that the SH fossils were not subjected to long-distance transport, but likely accumulated *in situ* at the SH conduit.

- The pattern of postcranial fractures in the assemblage indicates that the vast majority occurred after burial, and were caused by the overlying sediment pressure.

- Nevertheless, a low proportion (around 4%) of postcranial perimortem fractures were found and several cases of antemortem healed cranial injuries are also present in the SH sample

Cranium 17: right-handed violence

- Multiple cranial depression traumas in the frontal region above the hat brim line are compatible with interpersonal violence injuries. From their consistent size and shape, the Cr-17 blunt force traumas clearly are not unintentional, but, rather, they appear to have been produced by the use of a tool of standardized size and shape.

- The location of the lesions just to the left of the midline of the frontal squama in Cr-17 is also consistent with the general pattern documented among recent humans, with most individuals showing lesions on the left side of the skull reflecting the predominance of right-handedness during face-to-face conflict.
- Interestingly, the Sima de los Huesos population is considered mainly right-handed

Cranium 5

Lethal act of violence & funerals

- Thus, the most plausible explanation for the perimortem fractures on Cr-17 is as the result of intentional and repeated blows during a lethal act of interpersonal violence. This represents the earliest clear case of deliberate, lethal interpersonal aggression in the hominin fossil record, demonstrating that this is an ancient human behavior.

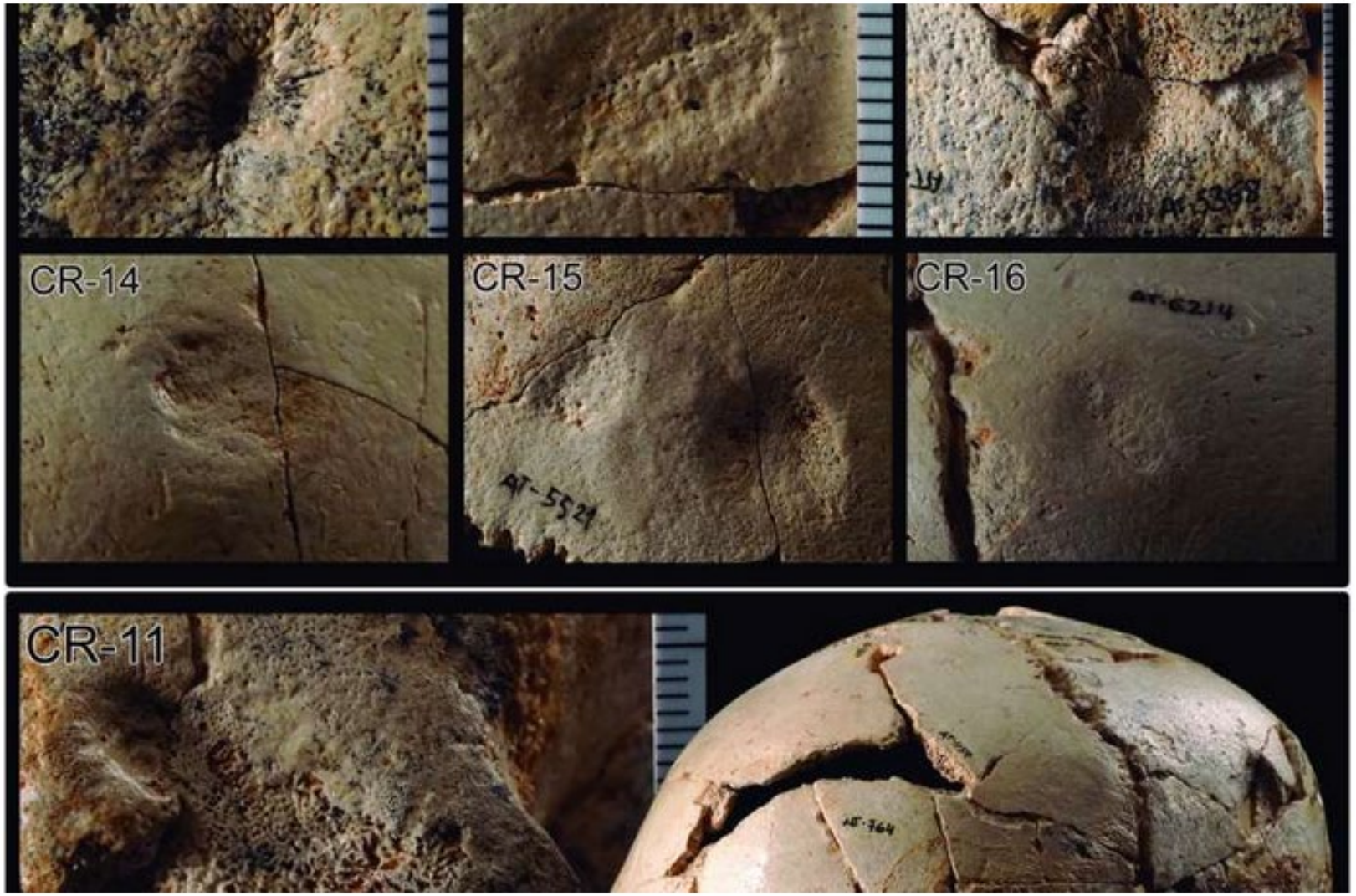
- The present study has established that the individual represented by Cr-17 was already dead before their arrival at the site, and it is possible to rule out an accidental fall as a possible explanation for the arrival of this individual to the SH chamber. The only possible manner by which a deceased individual could have arrived at the SH site is if its cadaver were dropped down the 43-foot shaft by other hominins.

SH as a funeral site

- Thus, the interpretation of the SH site as a place where hominins deposited deceased members of their social groups seems to be the most likely scenario to explain the presence of human bodies at the site.

- This interpretation implies this was a social practice among this group of Middle Pleistocene hominins and may represent the earliest funerary behavior in the human fossil record.

Healed skull trauma



Examples of healed trauma in the Sima de los Hueso skull collection. Credit: Sala et al., 2022, Javie...

Male & Females; One crippled older male

Injuries: Rodeo Riders?

- Signs of injury can be found on almost every well-preserved adult Neanderthal skeleton (Trinkaus 1995; Berger and Trinkaus 1995)
  - concentrated in the head and neck, producing an uncommon pattern of injury that may have
  - resulted from hunting strategies requiring proximity to large prey animals (Berger and Trinkaus 1995),
  - or interpersonal aggression? (e.g., Churchill et al. 2009).
- Berger & Trinkaus: all of the Neandertal injury distributions provide a close match to the Rodeo traumatic lesion pattern, primarily as a result of a high incidence of head & neck trauma; similarity to the Rodeo lesion distribution suggests frequent close encounters with large ungulates unkindly disposed to the humans involved.

Injuries: Rodeo Riders?

- The majority of injuries are healed or partially healed, therefore suggesting that
  - Neanderthals showed some level of compassion:

- *** Update: Most recent comparisons to MHs show that MHs had very similar injuries.
- Trinkaus has now rejected Rodeo hypothesis. Traumas identified in Neandertal skeletal remains are no different from same period MHs or extant hunter-gatherers.

A taphonomic-forensic analysis of the skulls from the Sima de los Huesos site

- Catalogs of processes before death (antemortem), at moments close to death (perimortem), and after death (postmortem), for about twenty individuals.

- This collection consists of more than 2,000 fragments that have been recovered progressively every summer for more than thirty years, during the excavation campaigns in the Sierra de Atapuerca.
- Also 175 bears from other areas of cavern

Blunt force trauma

- A total of 57 cranial lesions with signs of healing have been documented in 20 individuals at the Sima de los Huesos, which means that these injuries definitely happened before death.

- These lesions of circular morphology, which affect the cranial vault in nearly all the individuals (17 of the 20 specimens), have been interpreted as blunt force traumas that caused depression of the bone in the different skull regions. Affected individuals of all ages and sexes

- This group was exposed to generalized episodes leading to nonfatal impacts in the cranial region.

Right-handed attackers

- There are now nine individuals with evidence of cranial traumas that could have been lethal. One of the best-known cases is that of skull 17

- Of the nine individuals with perimortem traumas, six had penetrating fractures (circular holes of a similar size) in the left nuchal region. This pattern is so recurrent that it leaves little room for interpretation. The location is not what would be expected for accidental traumas, and is more compatible with intentional lesions, so these injuries are interpreted as possible cases of violence, just as with skull 17.

Dead on arrival in cave

- Finally, postmortem modifications were documented and it was possible to show that, following these individuals' deaths, only alterations characteristic of cave interior environments were produced: fracturing due to sediment pressure and precipitation of minerals (calcite and oxides of iron and manganese).

- No marks attesting to long-distance transport of the remains inside the cavity have been documented.

- Study interpreted this to mean that the skeletons arrived at the cave complete, and shortly after death.

Common lesions

- The high incidence of trauma with signs of bone regeneration in the cranial bones of almost all the individuals is noteworthy.
- This type of nonfatal lesion is relatively common in the Paleolithic fossil record
- The cranial injuries are compatible with trauma before death, produced by blunt impacts causing the depression of the external table of the crania.
- Affected all age groups and both sexes.

Evidence of Violence at Atapuerca

- Cases of intergroup violence at Atapuerca have been previously documented in older chronologies.
- Members of *Homo antecessor* engaged in intergroup conflicts between different communities.
- However, the mortuary behavior in these two hominins seems to be quite different.
- Unlike *H. antecessor*, which consumed the dead individuals after the conflict, the SH hominins accumulated corpses in a natural pit.

Carnivores did not participate in the accumulation of human remains at the Sima de los Huesos site

- A taphonomic analysis of the bone alterations confirmed that carnivores did not participate in the accumulation of these human remains.
- The excellent state of conservation of the anatomical elements that could be consumed by carnivores, together with the patterns of bone modification, have definitively ruled out the intervention of these animals in the transport and accumulation of human bodies inside the cave, with their activity being relegated to sporadic scavenging, "probably by bears that fell into the cavity by accident
- Have not found defensive fractures in the ulnas
- Concluded that carnivores (probably bears) had limited access to the hominin bones and complete bodies were probably placed in the site.

Ns at Shanidar Cave, Iraq

c.740 m asl,
south-facing

spring

summer

Graeme Barker,
2022

Goatherders in winter; he dug 14-meter rectangular trench in middle of cave

Summary of Solecki sequence: dug to limits of radiocarbon dating

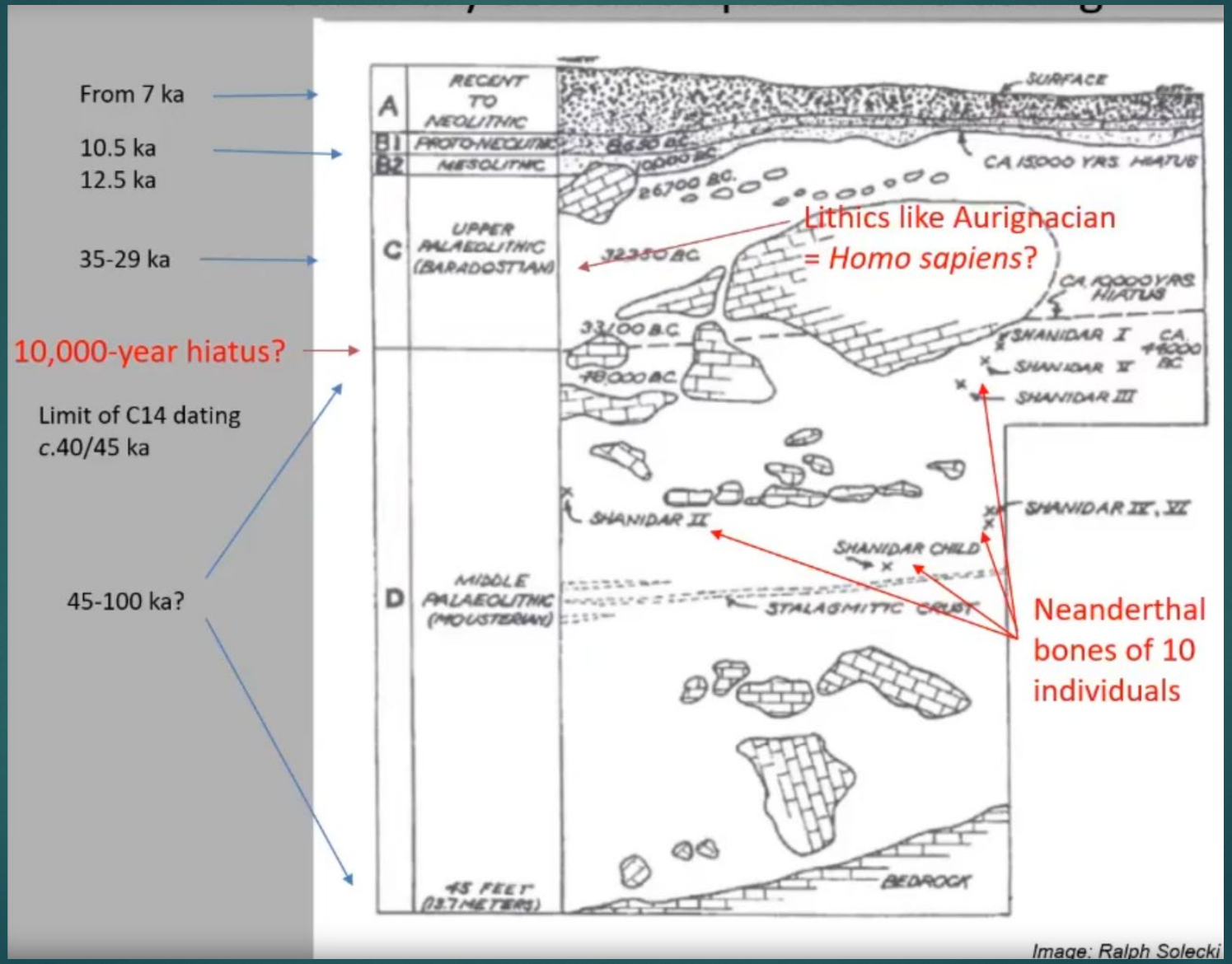


Image: Ralph Solecki

The Shanidar Cave Neanderthals: injuries, compassion, burial?

Trinkaus and Villotte (2017). *PLOS ONE* 12(10): e0186684.

Tim Evanson/Hall of Human Origins, Smithsonian Museum of Natural History

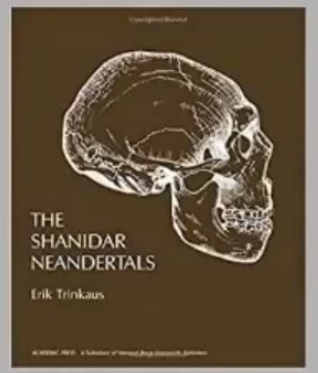
Shanidar 1

Churchill et al. (2009). *Journal of Human Evolution* 57(2): 163-178.

Solecki (1971). Alfred Knopf, Inc

Solecki: some natural deaths by rockfall, some true burials, grave markers

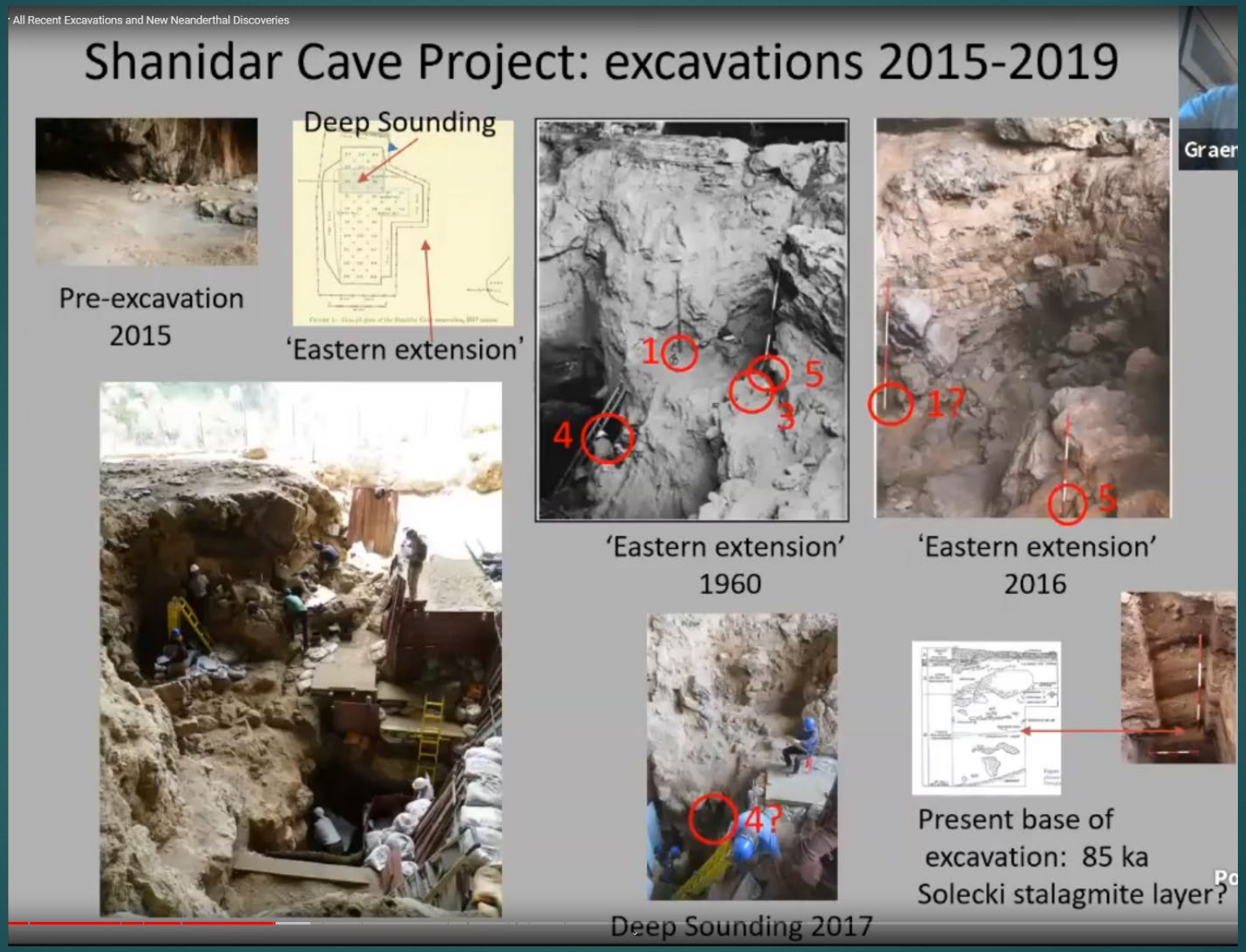
Injured and cared for



Trinkaus (1983). Academic Press.

Reconstructions of Shanidar 4, the 'Flower Burial' from clumps of pollen found by Arlette Leroi-Gourhan in sediments close-by

2023 Data: Down another 10 meters to 85 Ka, 2015-2019



Application of new analytic field techniques

Field methods

Section cleaning, recording , sampling

C14 and OSL dating

micromorphology

sampling for eDNA

sample columns

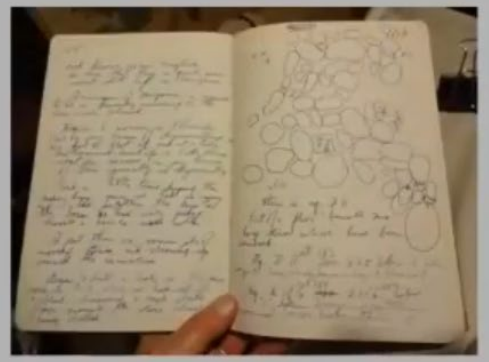
area excavation

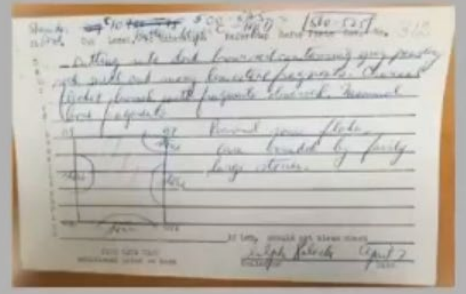
flotation tanks

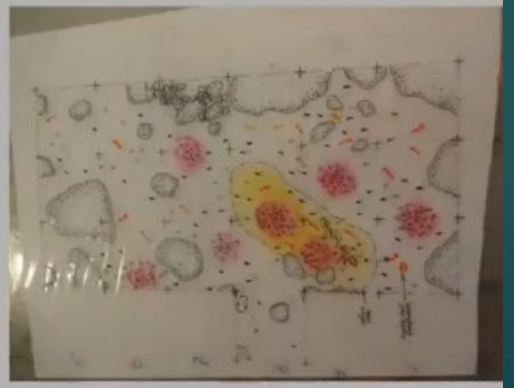
sorting washed residues

recovery of finds of 2 mm and above

Archive studies with Ralph and Rose Solecki



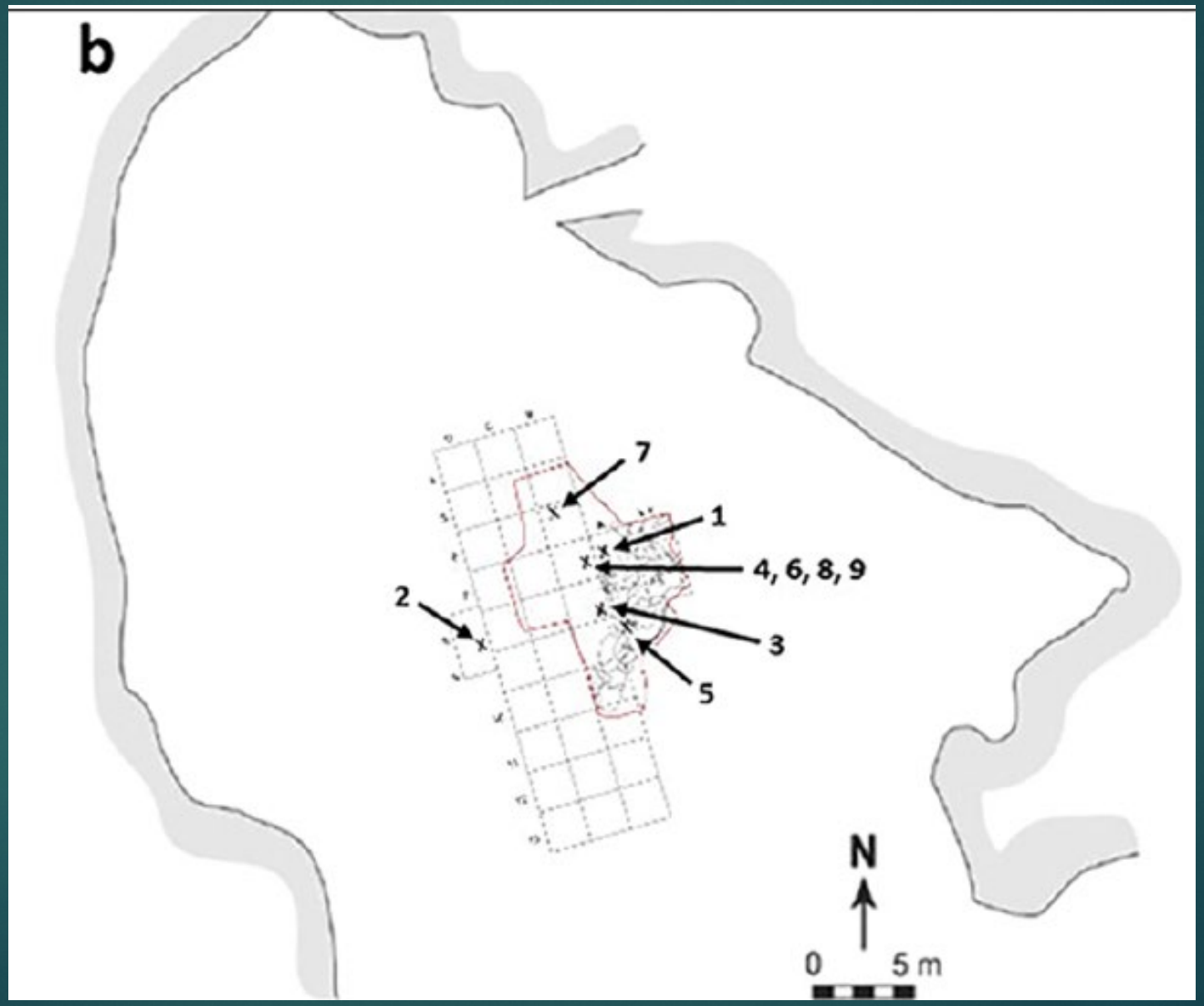




Ralph Solecki

- Ralph S. Solecki, who died in March 2019 aged 101. His work at Shanidar Cave had a profound impact on our understanding of Neanderthal biology and behavior.
- Not only did he and his team uncover remarkable evidence of 10 Neanderthal men, women and children at Shanidar Cave that provides key data on Neanderthals in Southwest Asia, but Solecki's subsequent discussion of how they lived and died did much to change perceptions of Neanderthals in general.
- Perhaps most famously, he argued that Shanidar 4 had been buried with flowers, based on palynological work by Arlette Leroi-Gourhan.
- He also argued that the Shanidar 1 skeleton provides evidence of compassion and care for the sick and infirm, and for intentional burial with accompanying ritual activities for several of the Shanidar individuals.
- While the 'flower burial' and some of his other arguments remain controversial, Solecki did much in his writings to 'humanize' Neanderthals and emphasize the similarities to our own species in their thinking and actions, in contrast with widespread conceptions of Neanderthals as brutish cavemen.

Shanidar Cave and 9 Ns



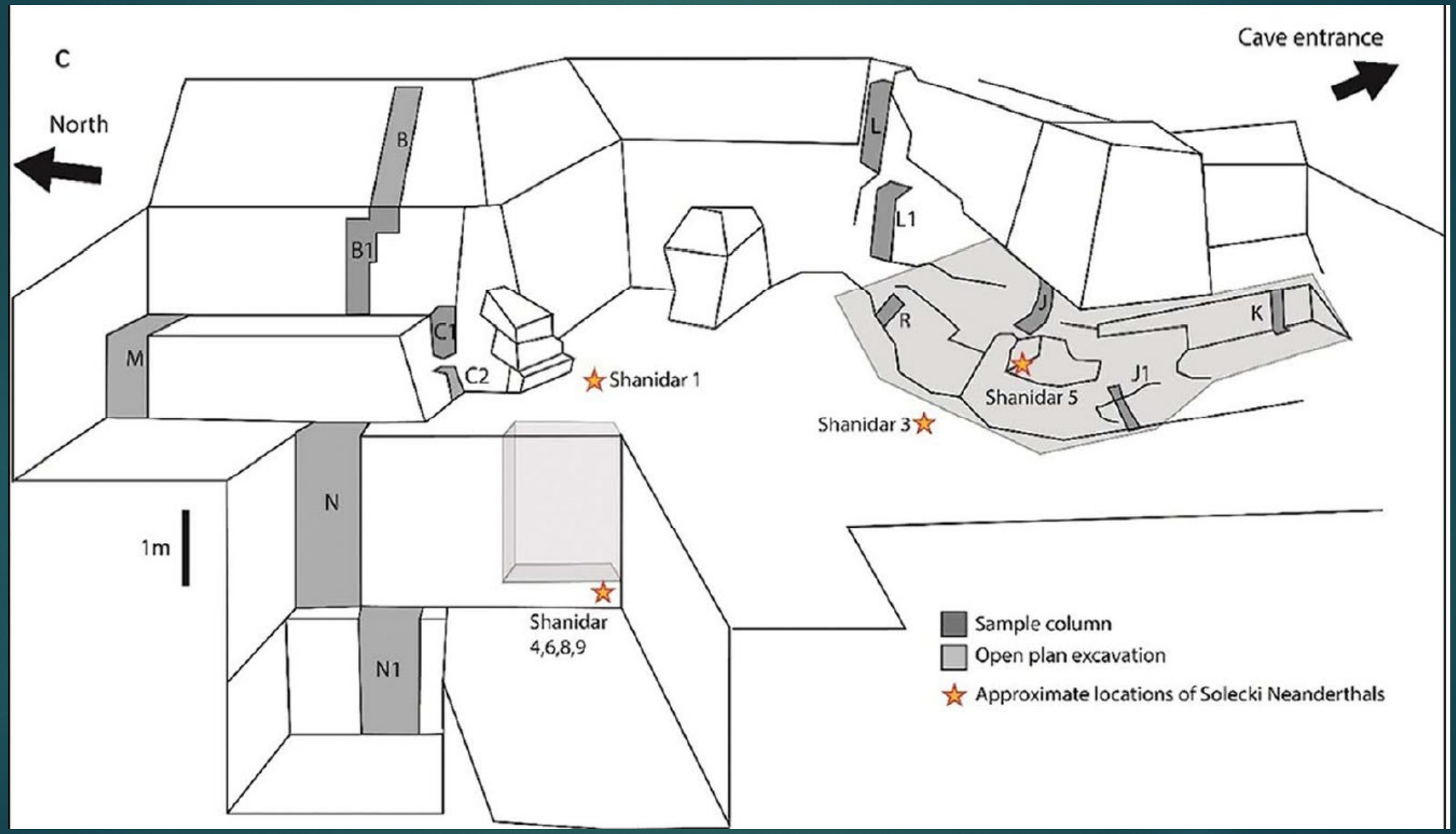
Importance of Shanidar Ns: compassion, violence, burials

- Although the 'flower burial' hypothesis was subsequently questioned (Gargett 1999; Sommer 1999), the Shanidar individuals play a central role in shaping our understanding of Neanderthal biology and behavior.

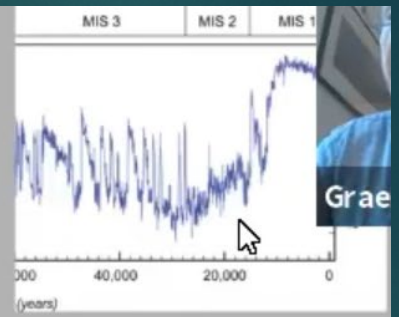
- The disabling injuries exhibited by Shanidar 1, for example, suggest care for group members, while the puncture wound to Shanidar 3's ribs suggests interpersonal violence.

- The assemblage continues to feature heavily in debates over Neanderthal mortuary practice and the evolutionary origins of intentional burial, as well as Pleistocene hominin behavior, diet and morphology.

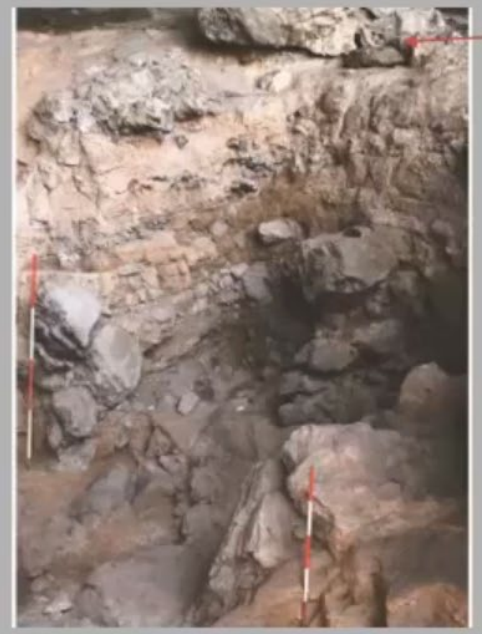
Shanidar N fossils and locations

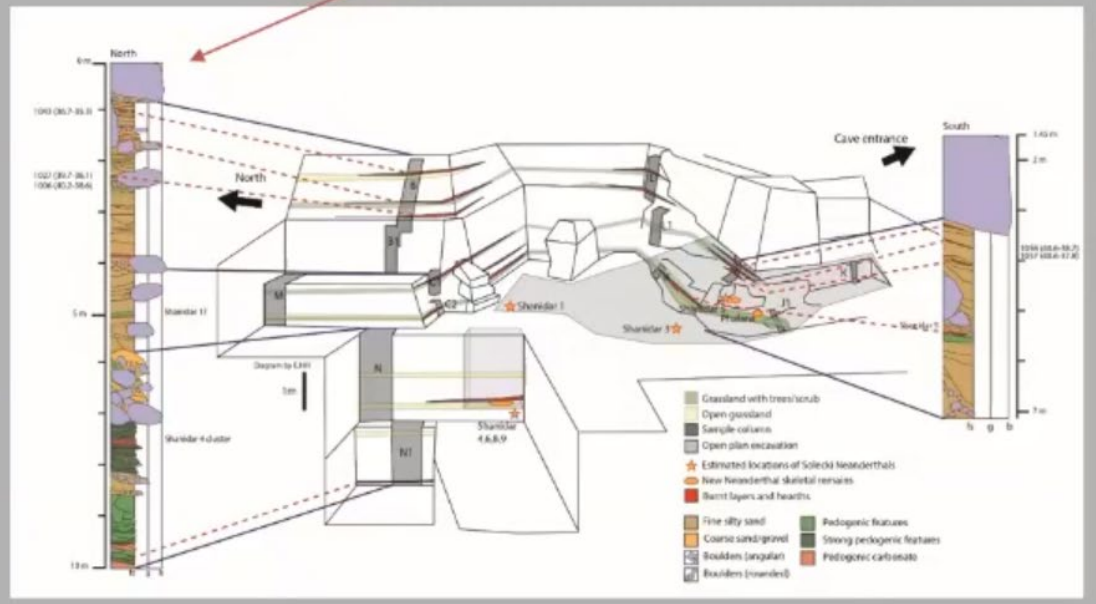


1. Last Glacial Maximum 20,000 BP:
cave too marginal to use?

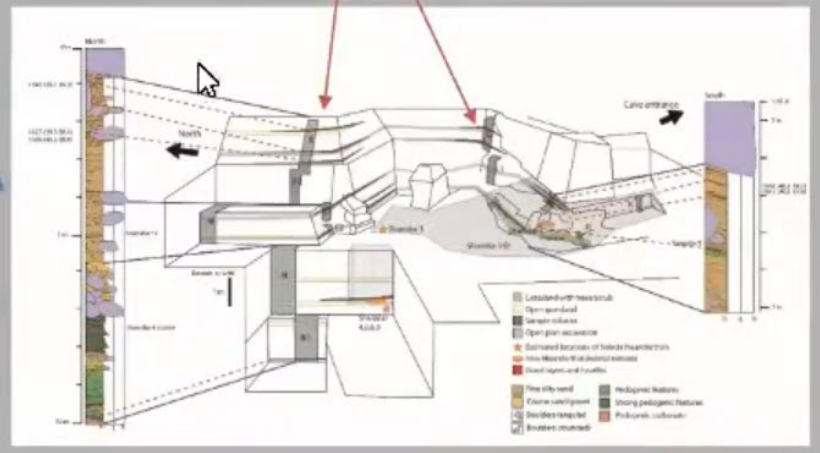


MIS 2:
rockfall at top of sequence?





2. Upper Palaeolithic 'Baradostian' (Modern Human?) occupatic



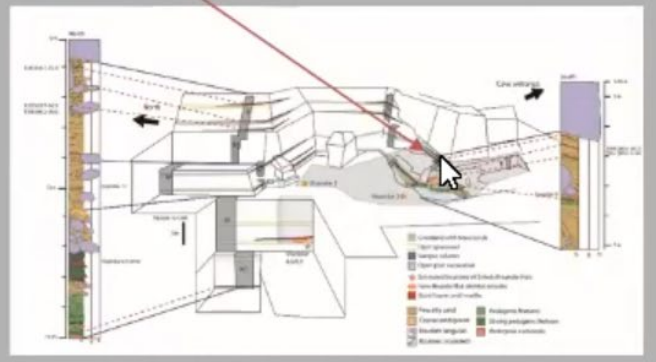
Single event hearths 45-33 ka, especially 42-38 ka

Visits at times of interstadial conditions

Baradostian hearths

No MH bones but single use hearths during warm period; UP stone tools

3. Upper Neanderthals: Shanidar 5 *c*.50 ka?



R pelvis,femur

R tibia,fibula,
Talus,navicular

40-45 year old male

Study led by Emma Pomeroy

4. ?Neanderthal occupation evidence below Shanidar 5

Excavation

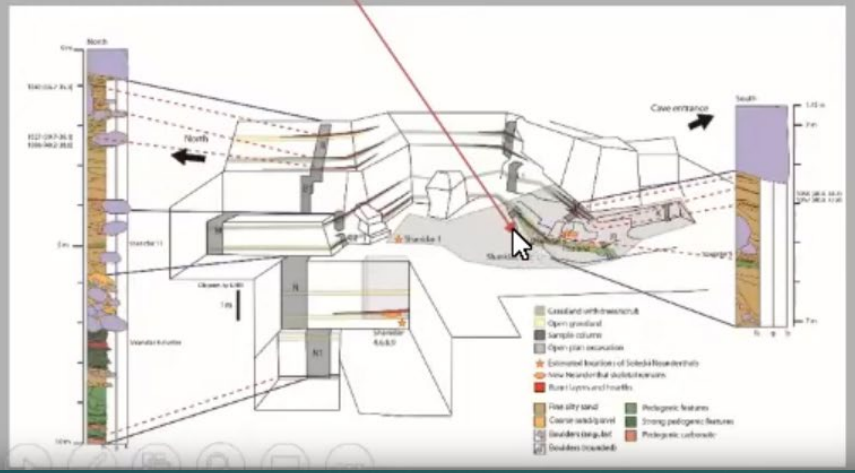
Single event hearth 1842, *c.*25 cm below Shanidar 5 location

Hearth section

Possible stakeholes

Hearth remnant near Shanidar 3 location

Visits again during interstadial conditions

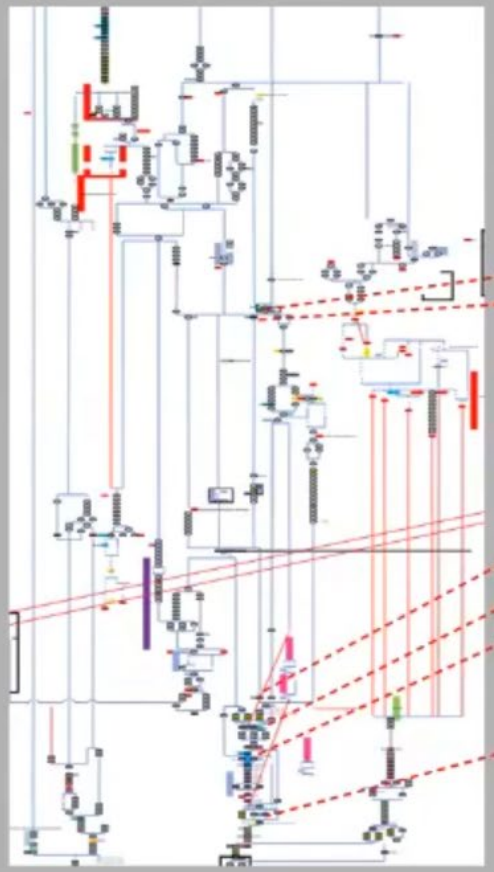


Ocupation evidence very similar to Baradostian

Ns visiting during colder period; N hearths

Stratigraphic relationships and lithics in transition zone

Stratigraphic matrix



Selected Contexts In stratigraphic order	Skeletal material	Mousterian lithics	Baradostian lithics	Other cultural objects
1856				Bead
1859				Bead
1862		Mousterian		
1832	Shanidar 5			
1816			Baradostian	Bead
1834			Baradostian	
1838		Mousterian	Baradostian	
1845		Mousterian		
1854			Baradostian	
1852			Baradostian	
1868		Mousterian		

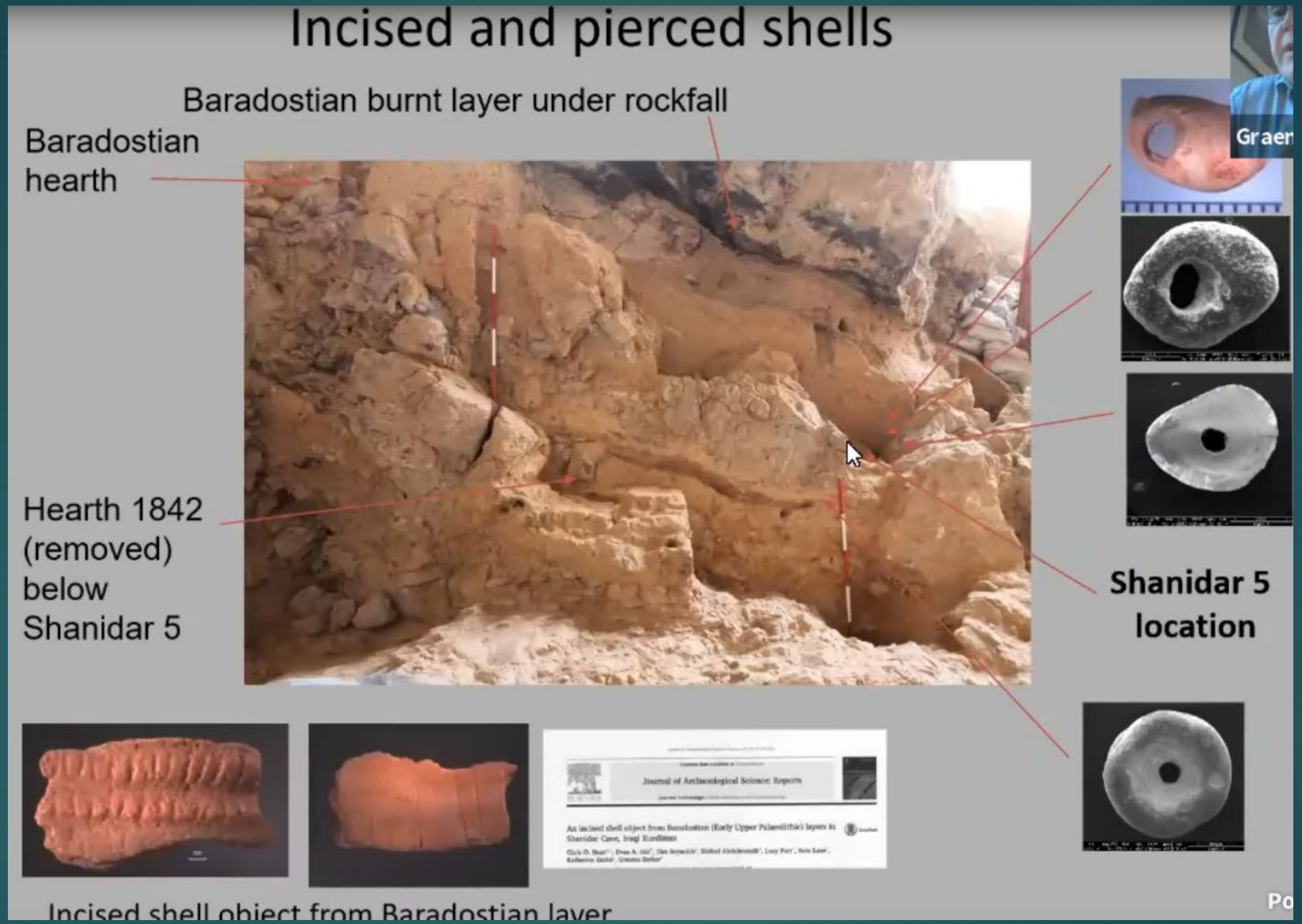
Deep blue = UP MHs

Pink = N Mousterian

Light blue = UP beads

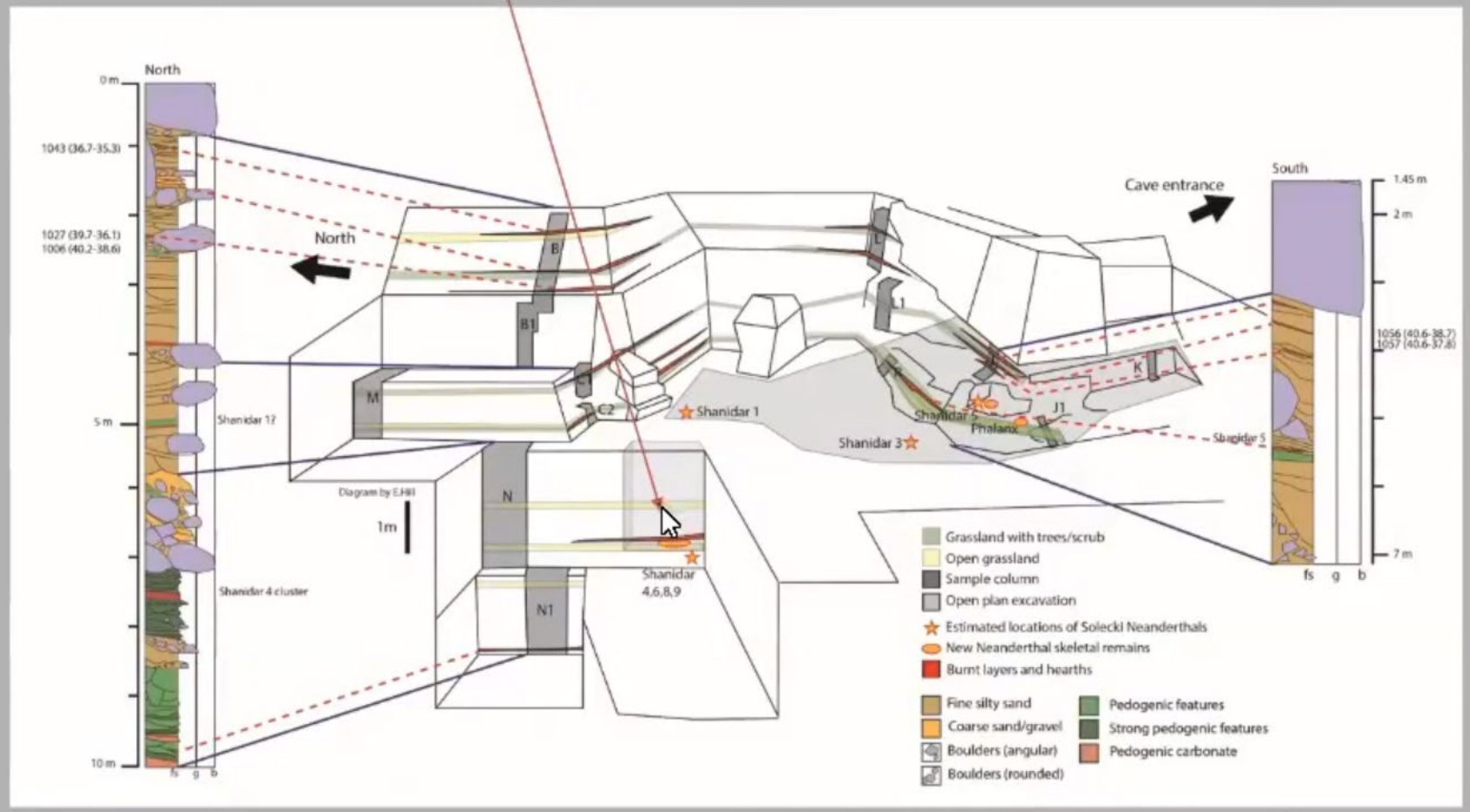
- Interdigitation of Mousterian and Baradostian forms in transition zone (though both in 1838)
- Baradostian and Mousterian forms below Shanidar 5 (sealed under big rock)

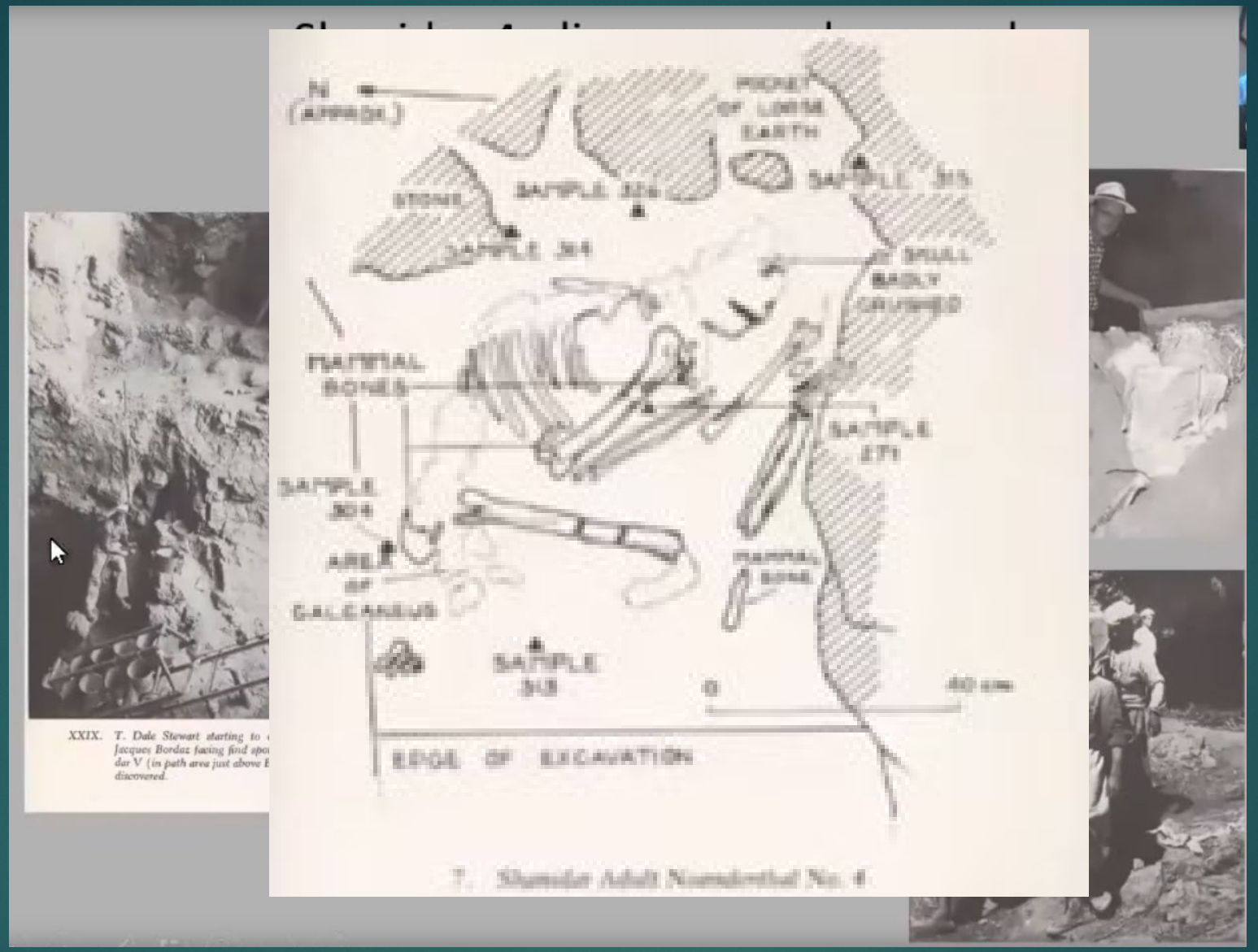
Incised and pierced shells



Unclear why some UP shells are in N level

5. Lower Neanderthal skeletal remains: Shanidar 4,6,8,9 – unique cluster of skeletal remains



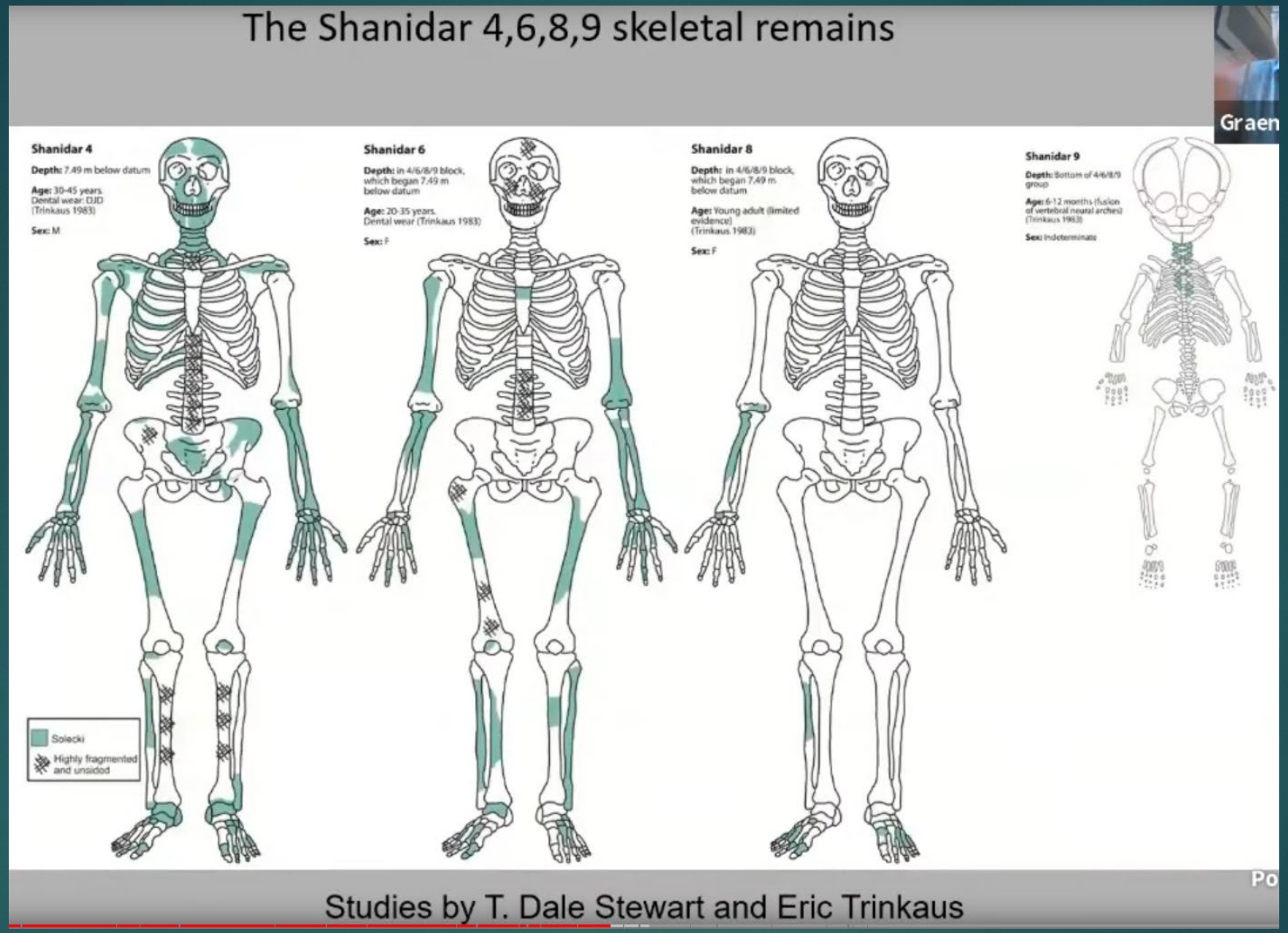


Failed attempt to encapsulate fossils in a plaster box and remove Shanidar 4 to Bagdad on top of a taxi!

Failed transport

- When the remains of Shanidar 4 were discovered in 1960, the decision was taken to remove them in a sediment block measuring approximately 1m^2 and 0.5 m deep, encased in wood and plaster.
- This block was then transported to the Baghdad Museum for excavation during which it became evident that at least three adults were represented (Shanidar 4, 6 and 8), along with the vertebrae of an infant—Shanidar 9.
- Due to disturbance of the block during transport from Shanidar to Baghdad (on a taxi roof!), the precise stratigraphic relationships between the individuals are unknown.
- It is clear, however, that Shanidar 4 was the uppermost in a cluster of individuals, suggesting either that multiple individuals died and/or were buried in the same place, or that Neanderthals returned to almost exactly the same spot to deposit multiple individuals.
- Either scenario would offer important, indeed unique, evidence for the complexity of Neanderthal mortuary activity. The detailed relationships between the individuals, and evidence for whether or not they were intentionally buried, however, have been unclear.
- New research to try to resolve these questions.

). Emma Pomeroy et al. , 2020

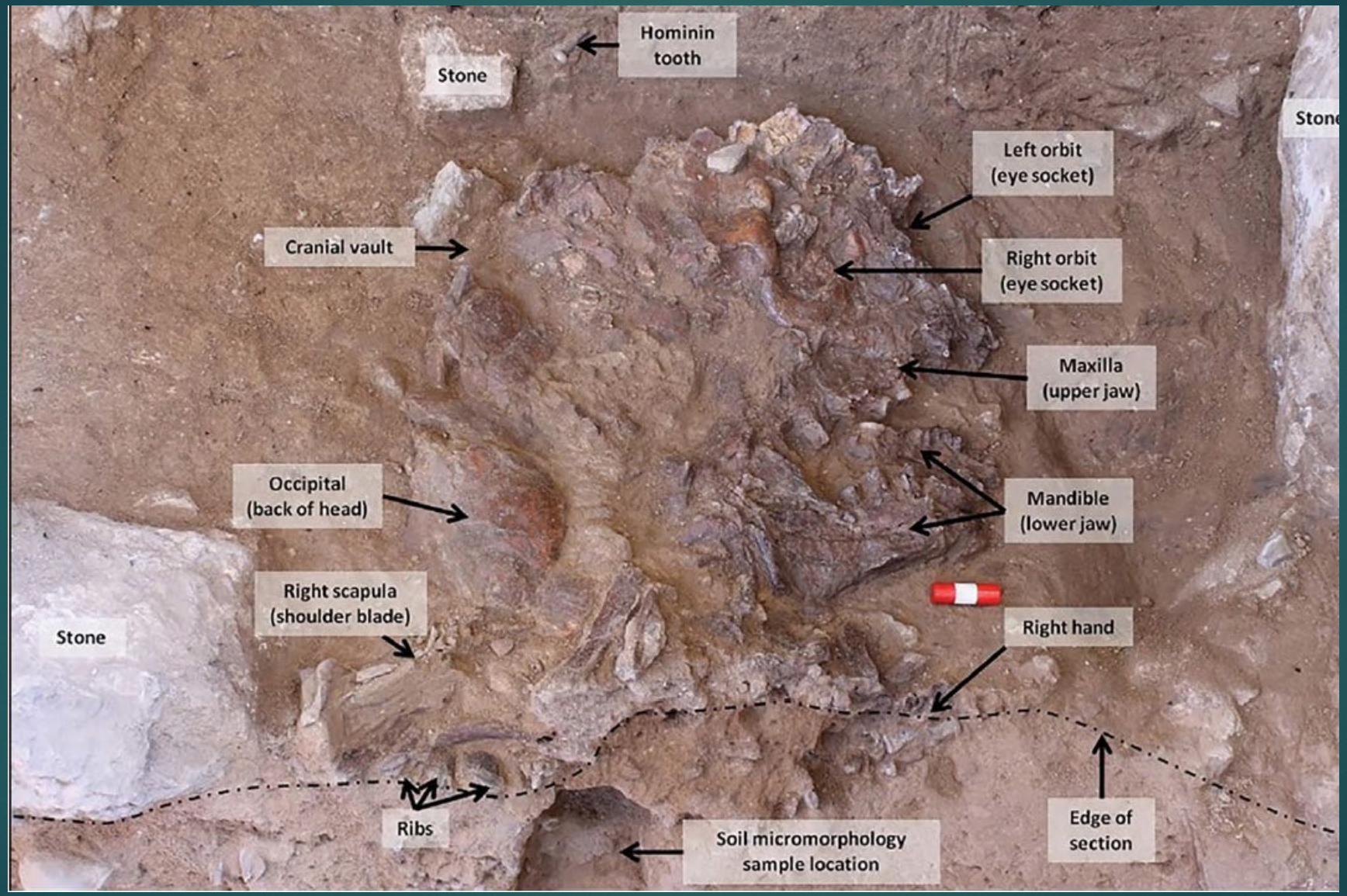


Remains in plaster box sorted by Trinkaus: bones that did not fit 4 became 6, 8, and infant; but new find renders this assessment problematic

New Neandertal Shanidar Z skeleton discovered

New Shanidar Z was found directly adjacent to Shanidar 4

What a newly discovered N fossil looks like! A flat pizza.



Cranium flattened like a pizza

Emma Pomeroy, et al. 2020

New Neanderthal remains associated with the ‘flower burial’ at Shanidar Cave

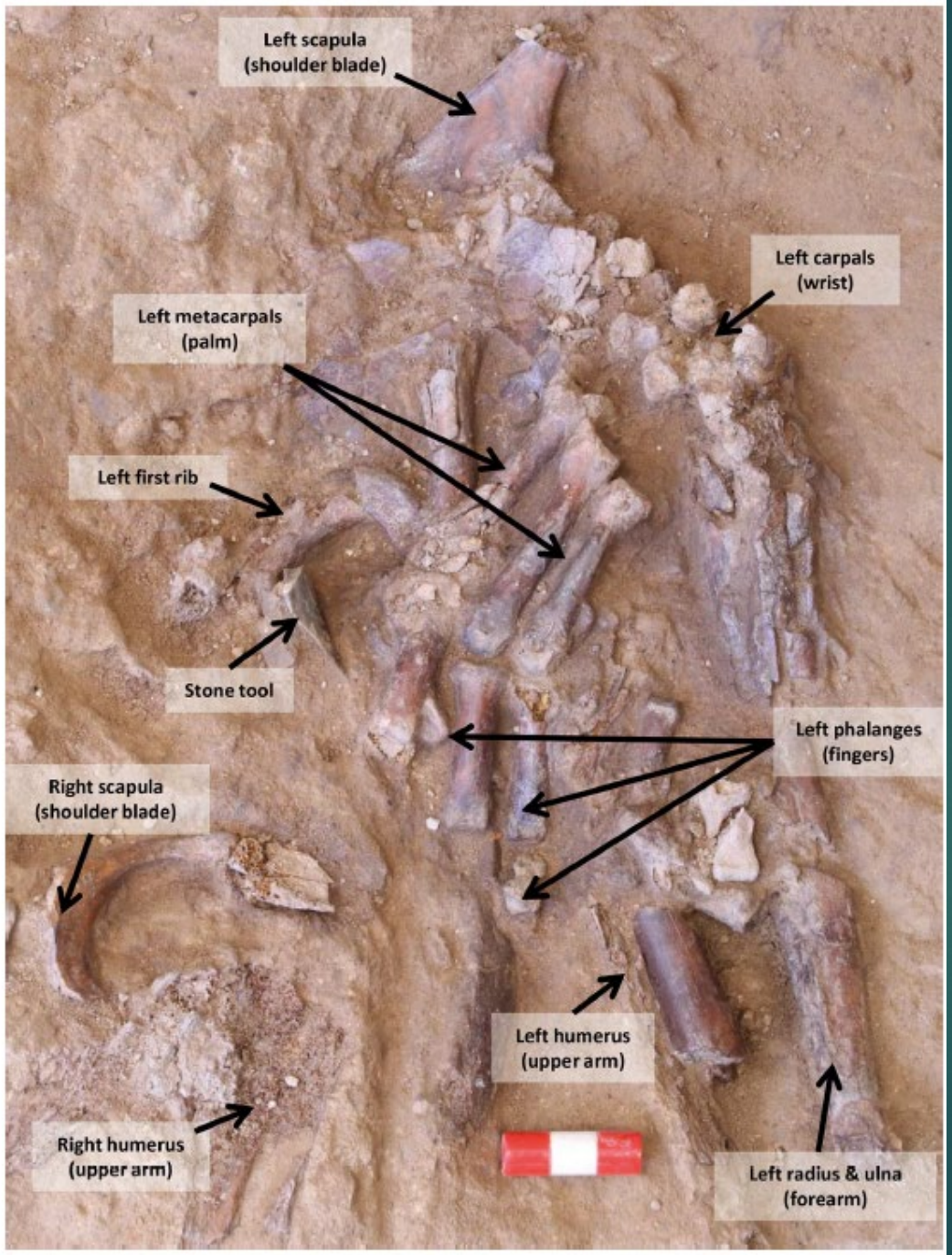
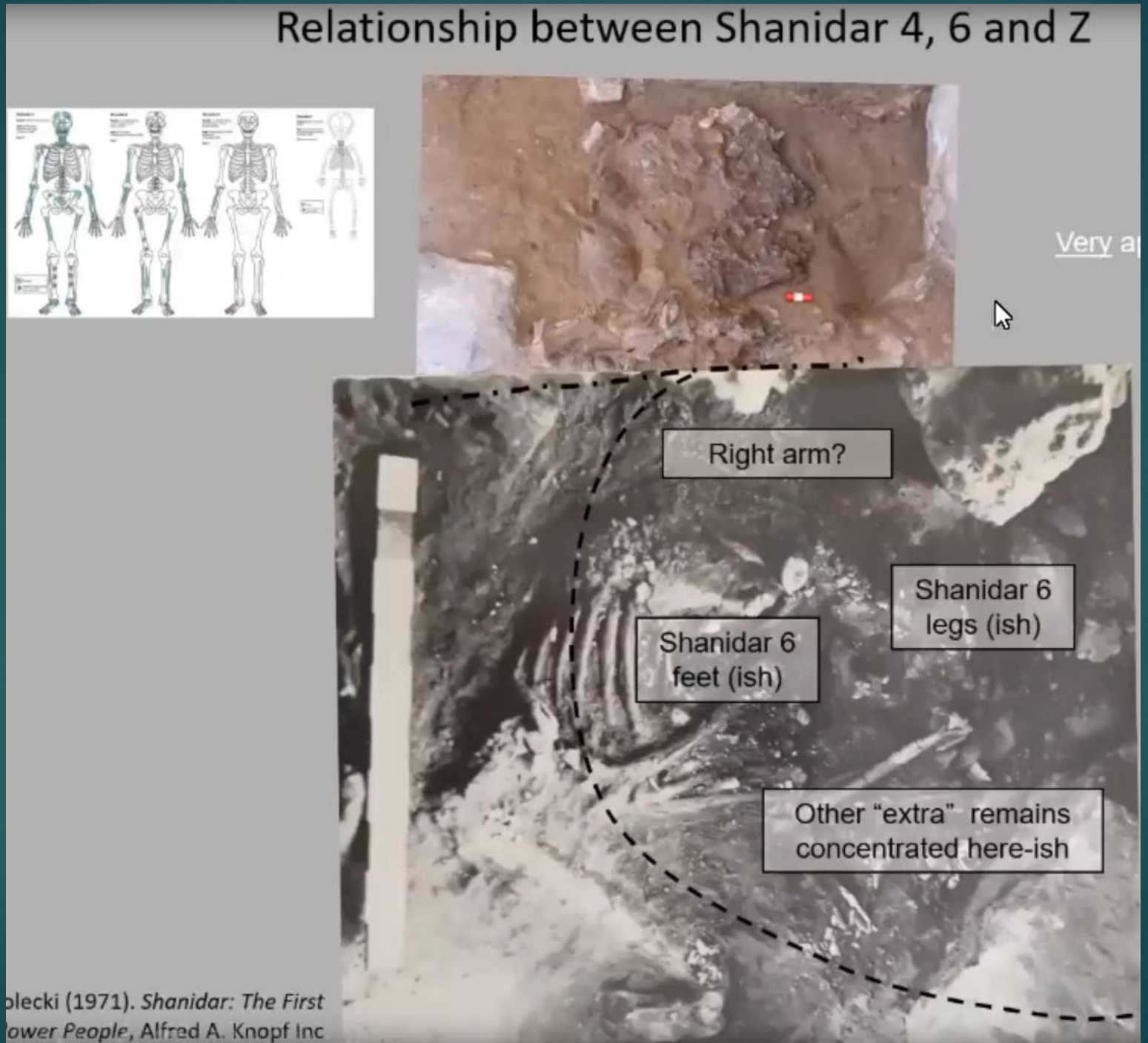


Figure 6. The upper body and left arm remains that lay beneath the skull; north is to the left of the image; scale is 30mm (photograph by G. Barker).

Shanidar 4 & 6 Skeletal assessment may have some of Shanidar Z's lower skeleton

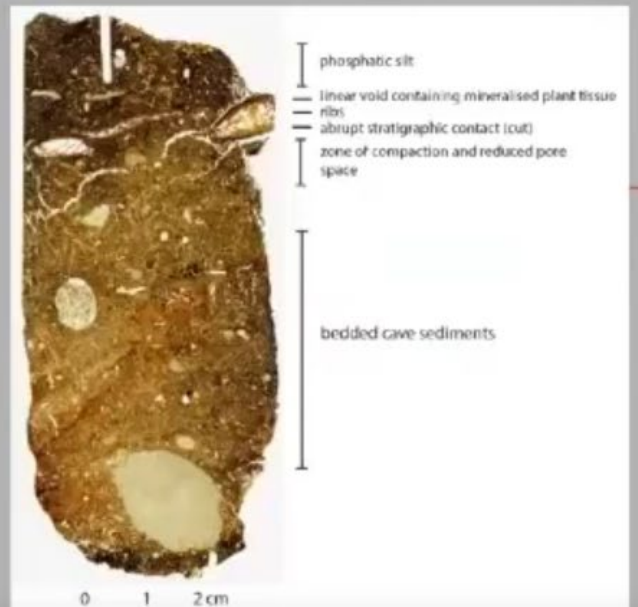


Burial site appears to have been “shoveled” to create it.

Shanidar Z a burial?

Occupation evidence runs up to it

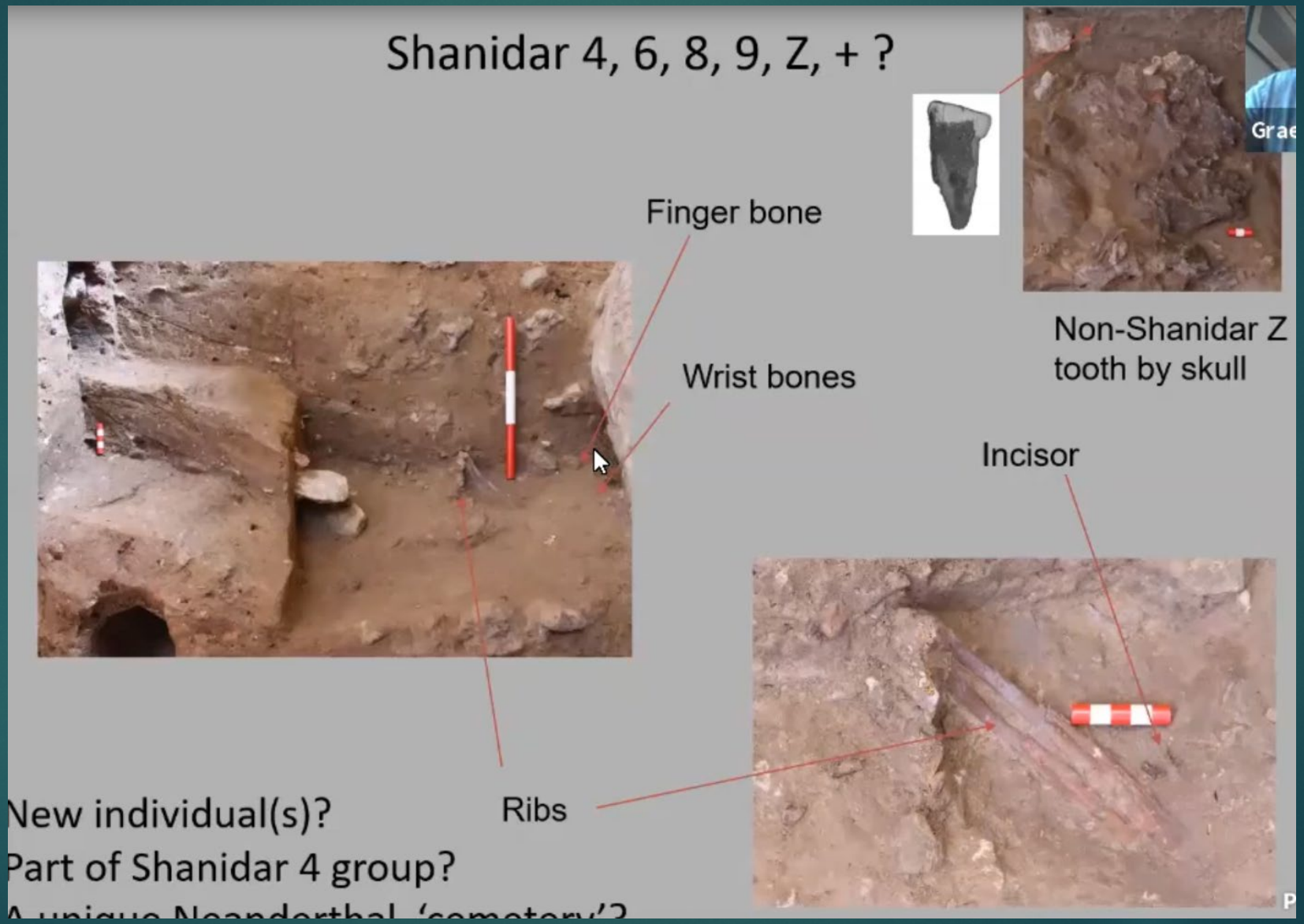
In waterlain channel, but non-fluvial sediments within and under body



Clear non-natural ‘cut’ on one side of scoop

Stones placed on top of Shanidar Z

Ns buried together at Shanidar

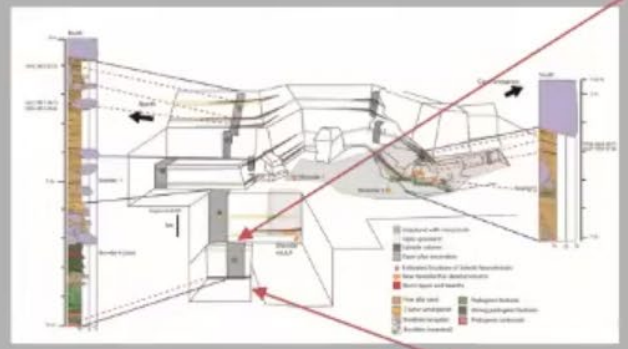


A 'persistent place' in the Neanderthal landscape?

"L'Hortus, La Quina, La Ferrassie, Krapina, Shanidar “imply the transmission of mortuary tradition...centred around a fixed point in the landscape that could be used, if not exclusively, to hide, process and bury the dead... To the groups at La Ferrassie and Shanidar...the dead had not quite depart

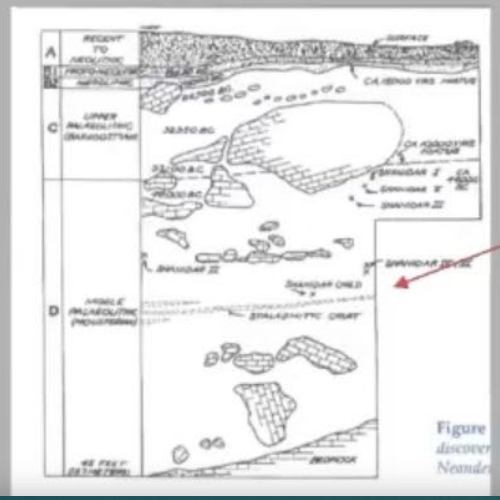
Paul Pettitt: *The Palaeolithic Origins of Human Burial*

6. And below these bodies?



Lower burials,
*c.*75 ka

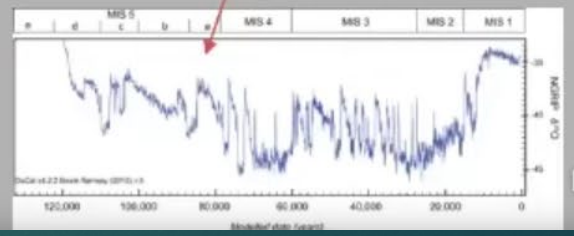
Indications of warm moist climate:
MIS 5?



At Solecki's 'stalagmite layer'?

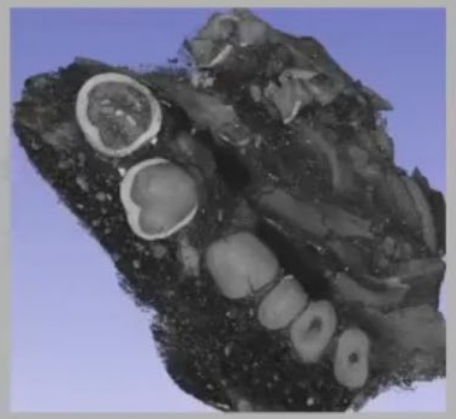
Present depth of excavation
c. 10 m

Basal OSL date c.85 ka

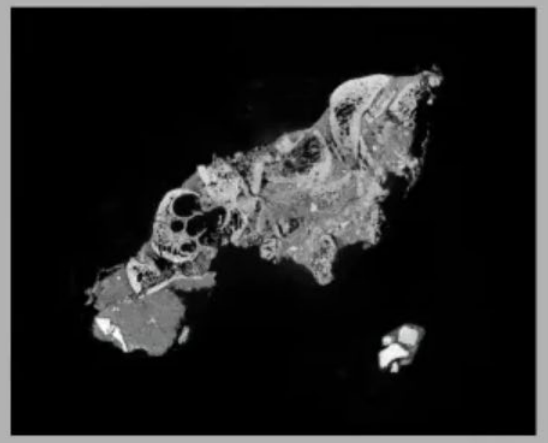


Shanidar Z: diet? health? genetics?

3D rendering of micro-CT scan



Dental wear



Cross-section showing petrous bone

eDNA was discovered higher up that is being evaluated by Eske Willerslev

Shanidar cave is a national monument for the people of Kurdistan, who use it and visit it

“Flower burial”?

- April is time of massive yellow wild flowers outside the cave.
- Flower pollen found with S4 as well as all bellow.
- There are animal burrows in with the N layers
- Theories include flowers laid on body, plants covered bodies, flowers brought in on feet of tourists today as well as Solecki’s team, and original Ns, as well as gerbles introducing the pollen.
- Original 1960s analysis of Arlette Leroi-Gourhan considered all of these and concluded it was a “flower burial“
- Graeme Barker believes flowers were part of the burials.

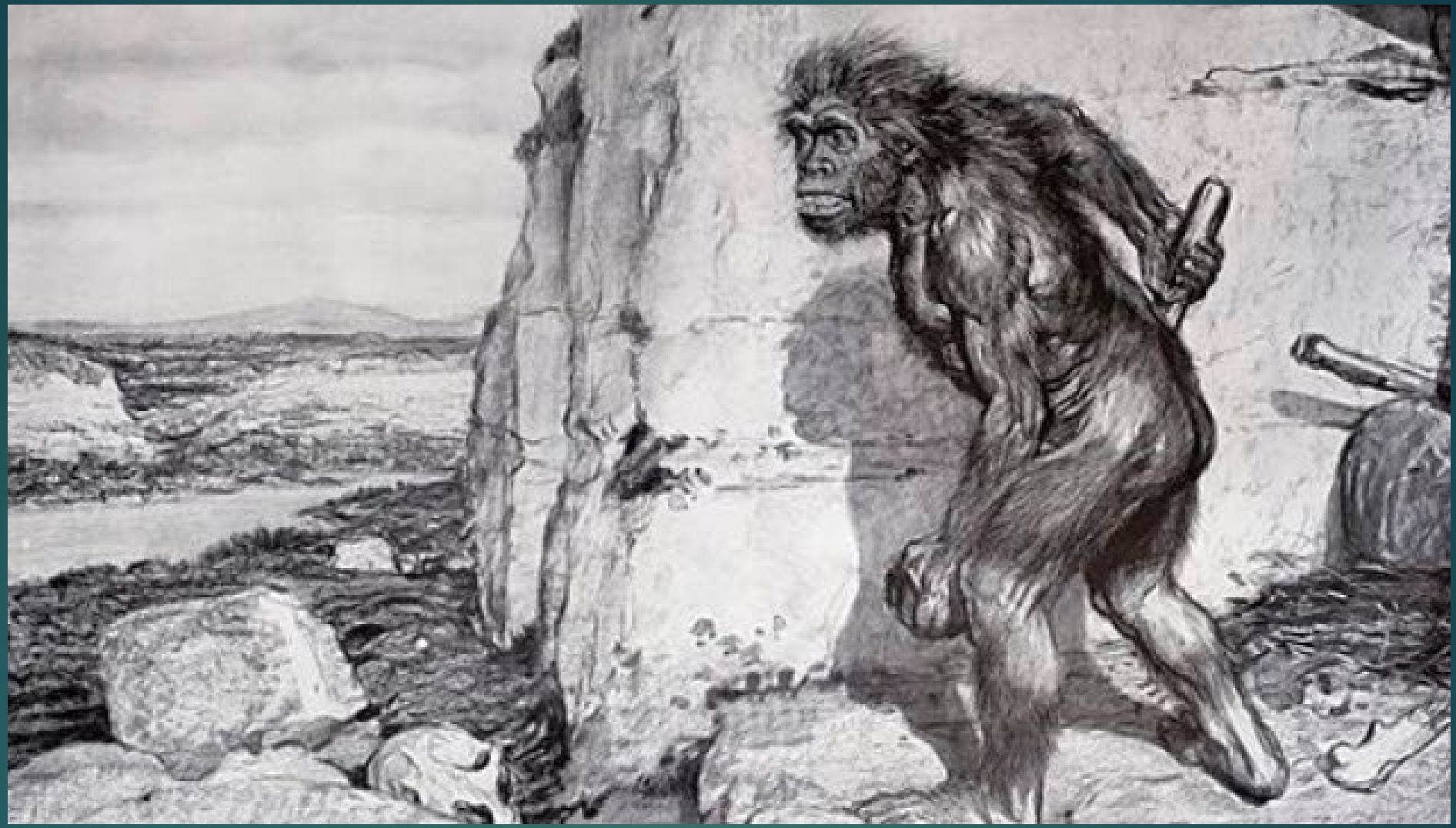
Deliberate burials

- The older rockfall theory appears discredited.
- The new in situ articulated Neanderthal remains from Shanidar Cave reported here, in combination with their stratigraphic contexts, provide strong evidence for the deliberate burial of this individual.
- They also offer an unparalleled opportunity to reassess the relationships between the individuals represented by the Shanidar 4, 6, 8 and 9 remains, and to consider whether this unique assemblage represents evidence of simultaneous (or near simultaneous) burial activity or of Neanderthals returning to the same place over time to deposit their dead.

ChatGPT: What did Ns look like?

- They were robustly built and had a distinctive appearance that set them apart from modern humans.
- They had a low, sloping forehead and a prominent brow ridge above their eyes.
- Their faces were large and wide, with a protruding mid-face.
- They had a large, broad nose with wide nostrils, for breathing in cold, dry air.
- Their jaws were powerful and projected forward, which gave them a distinctive chinless appearance.
- Neanderthals were generally shorter than modern humans, with males averaging about 5 feet 5 inches (165 cm) tall and females about 5 feet 1 inch (155 cm) tall.
- They were heavily built, with stocky limbs and a barrel-shaped chest that helped them retain body heat in cold environments.

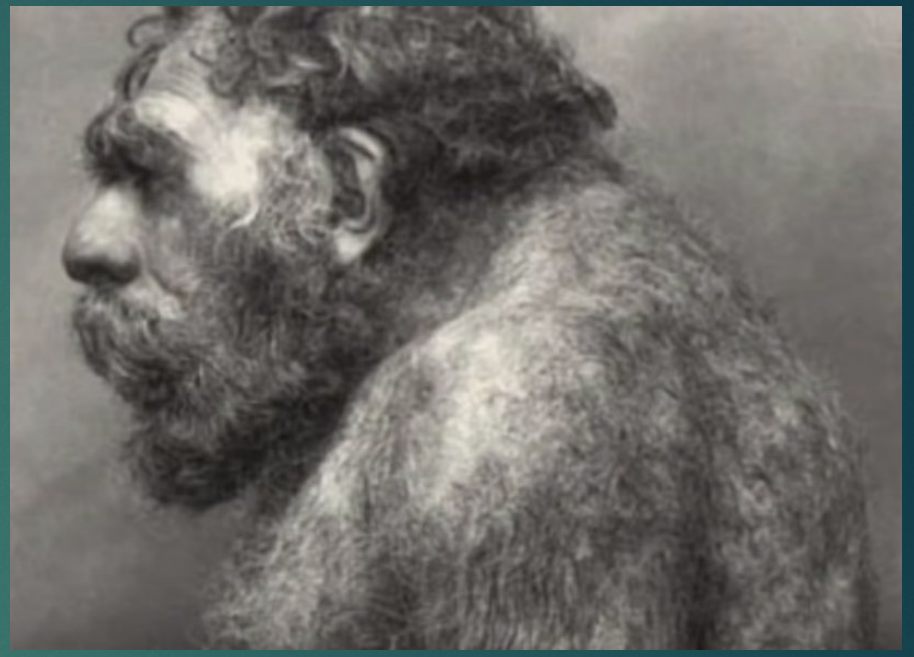
We need to update
our image of Neandertals



19th Century Neanderthal Portrayal = stupid brute,

1909 by Frantisek Kupka

Chicago Field Museum, 1915: Why would you image mating with them?



Based on the La Chapelle N

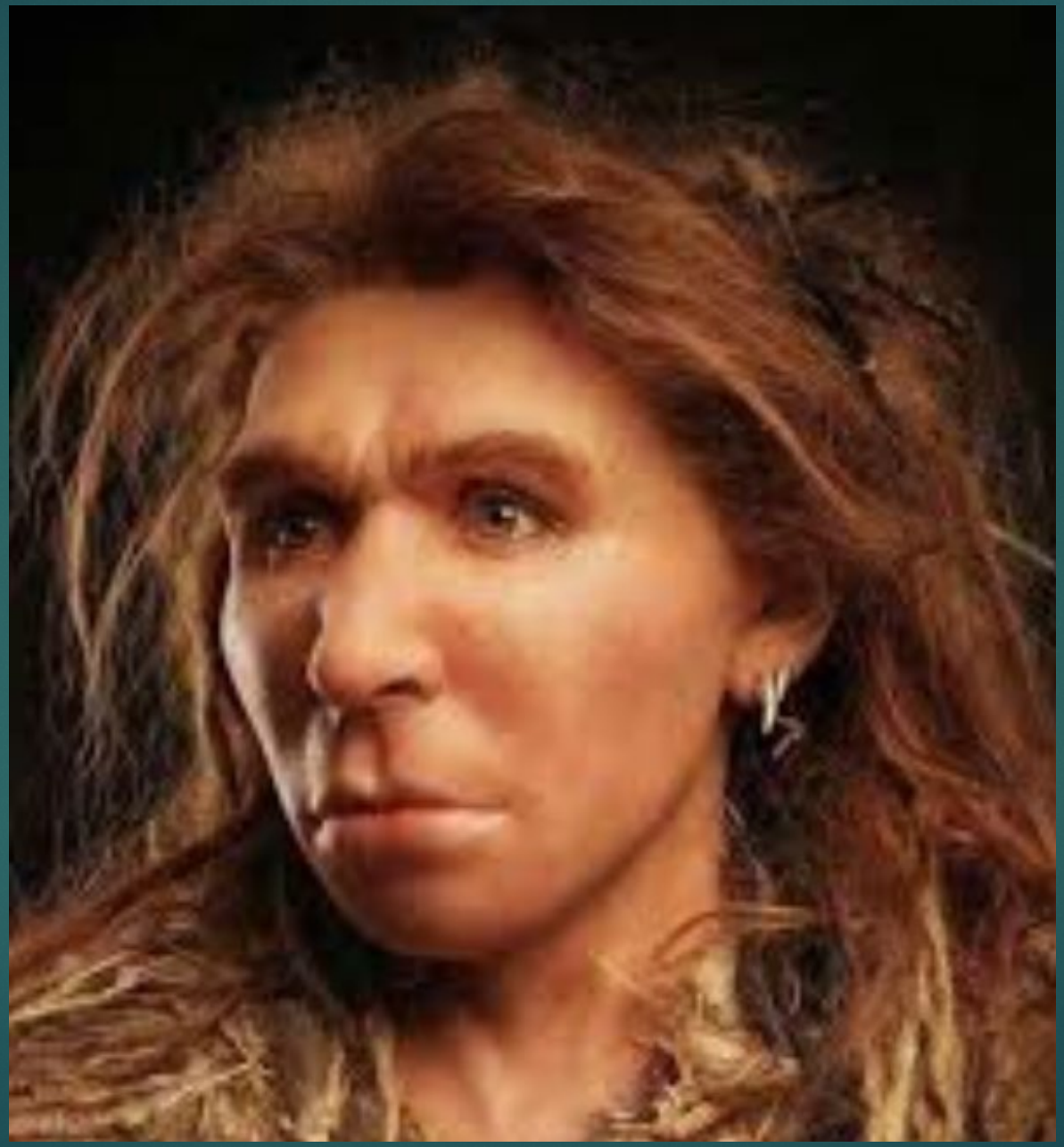
Earlier Views = Not history's Intellectuals

Neandertals Were People, Too.

Based on the 2 Gibraltar skulls: called Nana and Flint

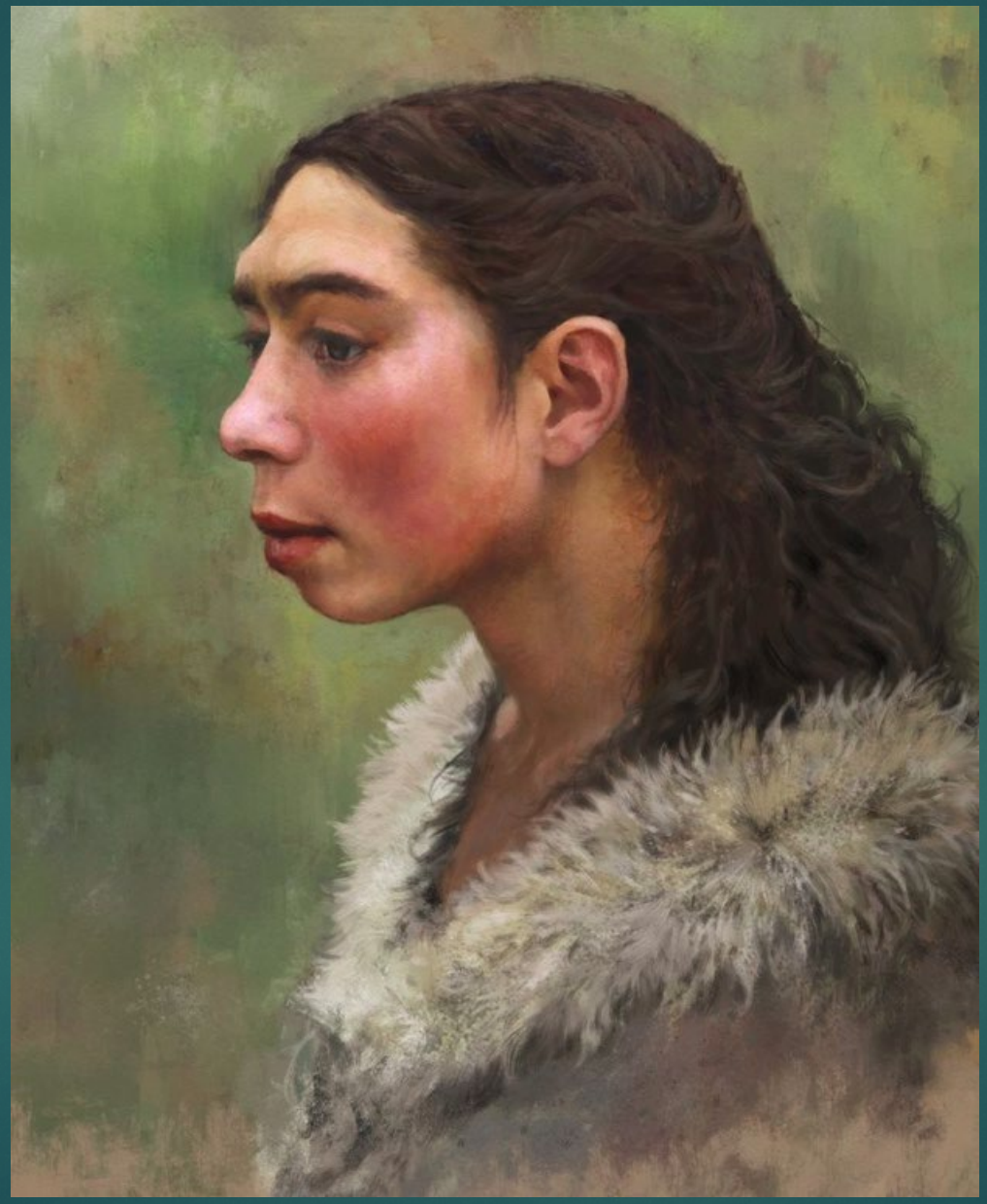
New York Times, 1/15/17:
Adrie & Alfons Kennis

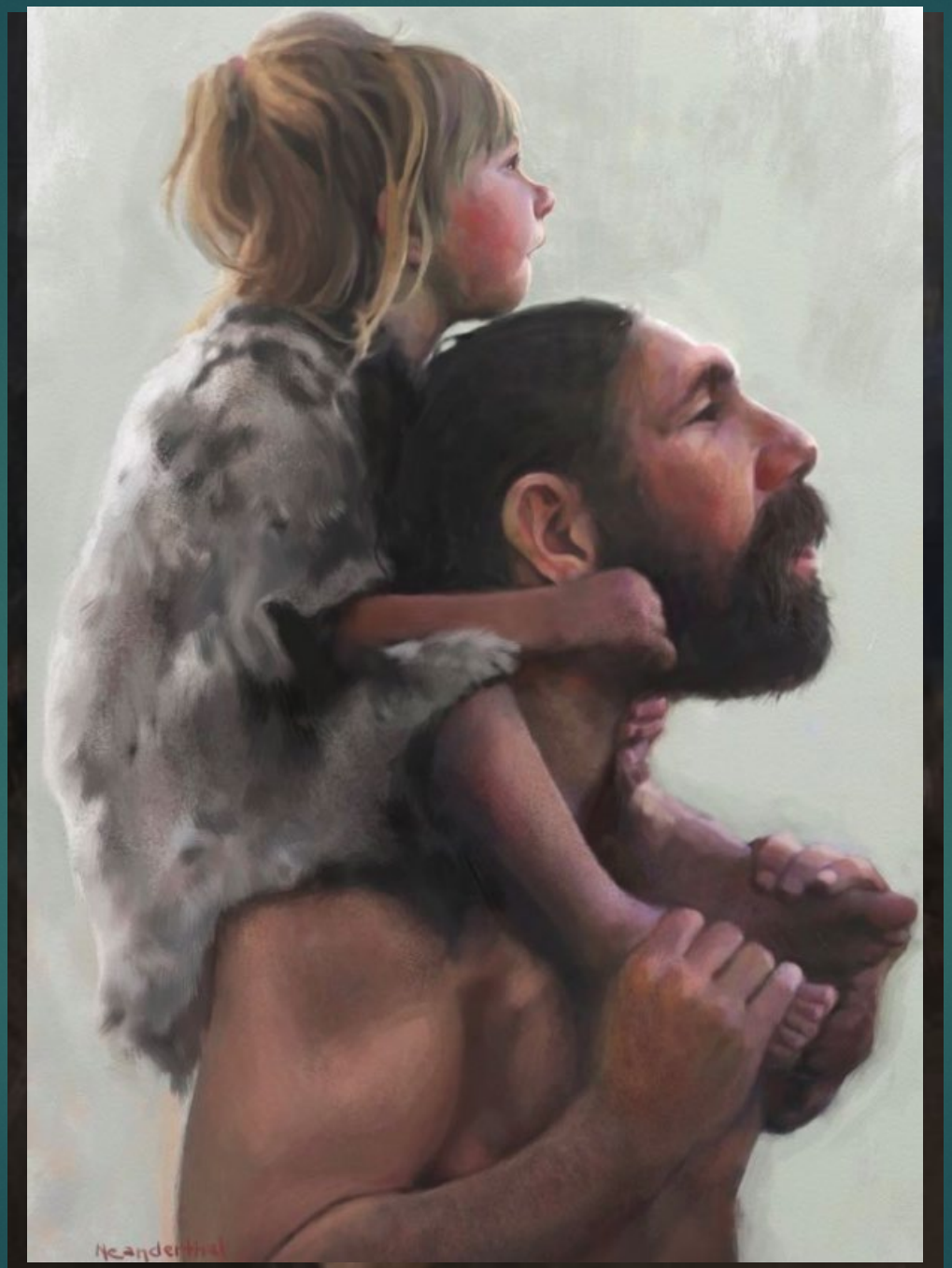
Some newer reimagings of Neandertals



Artist:
Tom Björklund has done a Neandertal Image update

Digital print of a Neanderthal woman by Tom Björklund (2018).





Much more interesting as a potential mate?

Clothing the Caveman – Phoebe Baker, 2022

Did Ns make clothing?


What Type of Clothes Did Neanderthals Wear?

Upper Paleolithic – needles?

Artistic reconstruction of the Sunghir 1 burial (artist: Libor Balák)

Magdalenian beads in the Musée National de Prehistoire

Bone needle dating to 12ka (left) and bone points dating to 12.5ka (right) found at Creswell Crags (Creswell Crags Museum, 2022).

Beaded cap at Arene Candide, Ligurian Archaeological Museum

Textile imprints on ceramics found at Pavlov I (Svoboda, 2018)

Needles only from Denisova Cave

Middle Paleolithic environments

MIS	Date (ka)	Type	Environment	Ecology	MAT (°C)	MTCM (°C)	Precip.	References
9	337-300	Interglacial	Mixed temperate forests with mosaiced habitats. More open vegetation by end of the period.	Tilia, Picea, Carpinus, Alnus, Corylus flora all represented in northern limits. Diverse faunal availability, including equids, Elephantidae, cervids, Bovidae, Homotherium and Vulpes.	West: 10.7 East: 6.9	West: 1 East: -6.1	West: 725 East: 727	Szymanek and Julien, 2018, van Kolfschoten et al. 2015
8	300-243	Glacial	Relatively little research in this period. Likely similar to other glacial periods, with significant steppe-tundra.	Uncertain, probably expansion of reindeer, mammoth, steppe bison. Reduction of tree cover.	West: 7.4 East: 2.1	West: -2.7 East: -11.6	West: 731 East: 719	Von Koeningswald, 2011
7	243-191	Interglacial, divided into 5 sub-stages (MIS 7e – a)	Relatively little research, with only 9 sites with hominin remains corresponding to this period. Likely mix of woodlands, meadows.	Likely similar to other interglacials with changes in flora and fauna over the various warm and cold periods throughout this stage.	West: 10.6 East: 6.7	West: 0 East: -6.4	West: 725 East: 727	Von Koeningswald, 2011; López-Garcia, 2014
6	191-130	Glacial	Extended steppe-tundra. Massive expansion of northern ice sheets.	Expansion of reindeer, mammoth, steppe bison. Reduction of tree cover.	West: 6.6 East: 1.1	West: -4.2 East: -14.5	West: 735 East: 715	Von Koeningswald, 2011
5	130-71	Interglacial, divided into 5 sub-stages (MIS 5e – a)	Large expansion of temperate forests, mosaiced habitats. Gradual stepped descent into glacial steppe-tundra conditions throughout MIS 5d – 5a.	Range of floral species including Abies, Betula, Carpinus, Corylus, Quercus, Picea, Taxus, Tilia and Ulmus. Very diverse micro and macrofauna.	West: 12.2 East: 9	West: 1.6 East: -3.1	West: 722 East: 732	Felde et al. 2019,
4	71-57	Glacial	Steppe-tundra. Comparatively less severe than MIS 6.	Expansion of reindeer, mammoth, steppe bison. Reduction of tree cover.	West: 7.9 East: 2.9	West: -2.9 East: -11.9	West: 732 East: 719	Van Andel and Tzedakis (1996)
3	57-29	Interglacial	Period of high climatic instability. Oscillations between steppe and boreal forests.	Mixed and changeable flora and fauna.	West: 7.7 East: 2.6	West: -3.1 East: -12.3	West: 732 East: 718	Badino et al. (2020) Van Meerbeeck et al. (2011)

Glacial: expansion of ice sheets, steppe-tundra, reindeer, mammoth, bison; less tree cover; 42^{O}F
Interglacial: reduction of ice sheets, change to warmer fauna & flora: 50^{o}F

Biological adaptations of Ns

- Large, barrel-chests combined with short limbs (Allen-Bergman rule)
- Enlarged nasal cavities (debated)
- Increased body hair
- Increased subcutaneous fat?
- Enhanced muscle tissue?
- Greater development of brown adipose tissues
- Increase in basal metabolic rate
- Hibernation (possibly)

Major papers on clothing: simple (capes) vs complex

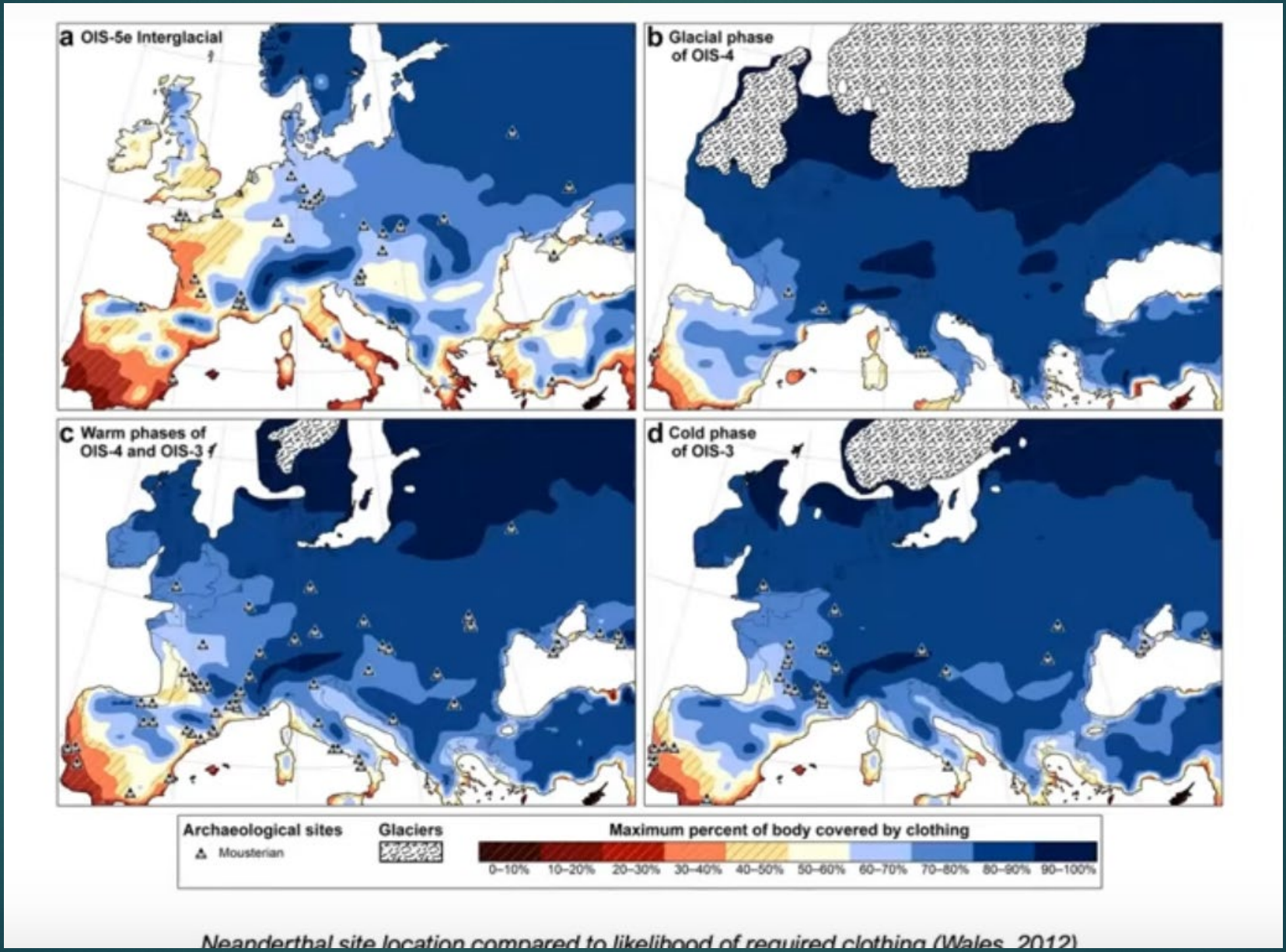
Reference	Type of Source	Type of Clothing	Evidence used
Aeillo and Wheeler, 2003	Primary	Inconclusive	Energetic modelling, physiological modelling, palaeoenvironmental modelling
Churchill, 2014	Review	Complex	Energetic modelling, physiological modelling, palaeoenvironmental modelling, ethnographic analogy
Collard et al. 2016	Primary	Simple	Faunal, ethnographic analogy
Gilligan, 2007	Review	Simple	Palaeoenvironmental modelling, physiological modelling
Gilligan, 2010	Review	Simple	Palaeoenvironmental modelling, physiological modelling, archaeological technology
Gilligan, 2017	Comment	Simple	NA. Article is a comment on Hosfield (2016)
Hosfield, 2016	Review	Simple	Palaeoenvironmental modelling, faunal remains
Hosfield, 2020	Review	Inconclusive	Archaeological technology
MacDonald, 2018	Primary	Simple	Energetic modelling, physiological modelling, ethnographic analogy
Ocobock et al. 2021	Review	Simple	Energetic modelling, physiological modelling, archaeological technology, faunal remains
Sørensen, 2009	Primary	Complex	Energetic modelling
Wales, 2012	Primary	Simple	Palaeoenvironmental modelling, site modelling, ethnographic analogy
White, 2006	Review	Complex	Palaeoenvironmental modelling, physiological modelling, archaeological technology, ethnographic analogy

Not cold adapted

3 survival methods for living in the cold

Only method of portable warmth

Areas requiring N clothing: 90% body coverage needed = x



Neanderthal site location compared to likelihood of required clothing (Wales, 2012)

Simple vs complex clothing

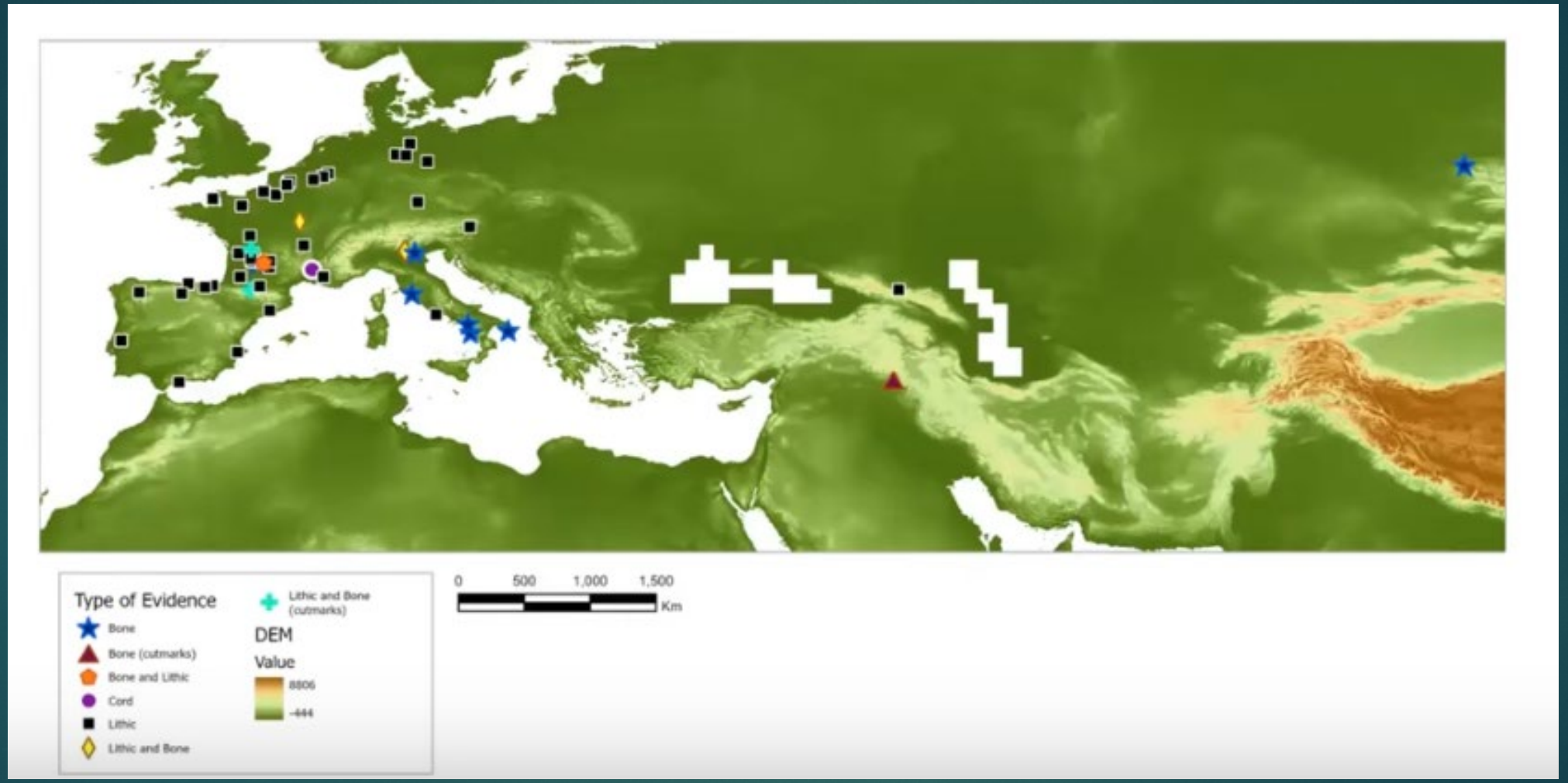
- Simple: does not require tailoring - capes
- Complex: requires tailoring - trousers
- Related to cognitive ability
- Fur and skin from the deer family seems to have been the most widely used material used for clothing in both Neanderthal and early modern human assemblages

13 studies: Archeological evidence for N clothing

Reference	Type of Source	Type of Clothing	Evidence used
Aeillo and Wheeler, 2003	Primary	Inconclusive	Energetic modelling, physiological modelling, palaeoenvironmental modelling
Churchill, 2014	Review	Complex	Energetic modelling, physiological modelling, palaeoenvironmental modelling, ethnographic analogy
Collard et al. 2016	Primary	Simple	Faunal, ethnographic analogy
Gilligan, 2007	Review	Simple	Palaeoenvironmental modelling, physiological modelling
Gilligan, 2010	Review	Simple	Palaeoenvironmental modelling, physiological modelling, archaeological technology
Gilligan, 2017	Comment	Simple	NA. Article is a comment on Hosfield (2016)
Hosfield, 2016	Review	Simple	Palaeoenvironmental modelling, faunal remains
Hosfield, 2020	Review	Inconclusive	Archaeological technology
MacDonald, 2018	Primary	Simple	Energetic modelling, physiological modelling, ethnographic analogy
Ocobock et al. 2021	Review	Simple	Energetic modelling, physiological modelling, archaeological technology, faunal remains
Sørensen, 2009	Primary	Complex	Energetic modelling
Wales, 2012	Primary	Simple	Palaeoenvironmental modelling, site modelling, ethnographic analogy
White, 2006	Review	Complex	Palaeoenvironmental modelling, physiological modelling, archaeological technology, ethnographic analogy

Collard, 2015: comparison of N, MH, modern ethnographic groups on faunal evidence – N used reindeer a lot; But not fur trim animals, like wolverines, with thick hair; therefore simple clothing

Sites with clothing evidence – hide processing tools



No direct organic evidence of clothing; but hide processing tools

HIDE PROCESSING: SKINNING

Images taken from Wikihow 'How to Skin a Dead Animal'

Site	Country	Date (ka)	MIS	Site Type	Process Type	Material Type
Schöningen 12 II-1 and 12B	Germany	320	9	Open Air	HP	Bone (*Ursus;* cut marks)
Grotte du Noisetier	France	ND	3	Cave	HP	Bone (cut marks)
Marillac (Les Pradelles)	France	57	4,3	Cave	HP, Tendon Removal	Bone (cut marks)
Shanidar Cave	Iraq	49.6-50.5	3	Cave	HP, Tendon Removal	Bone (cut marks)

Very delicate cutmarks on bear bones and skins

Hide processing: based on microwear on Stone Tools

- At least 55 sites have stone tools with some evidence of hide processing, including cutting, scraping and piercing (many collated by E. Claud et al. 2019).
- Our oldest example of cutting and scraping fresh and dry hides dates to 300ka, at Schöningen, Germany.
- Some sites, such as La Combette, show complete hide processing sequences (from flesh to dry, useable hides).
- Most examples cluster within the last glacial cycle and are associated with Châtelperronian or Uluzzian industries. (45-35 Ka)

N leather working bone tools: awls and lissoirs

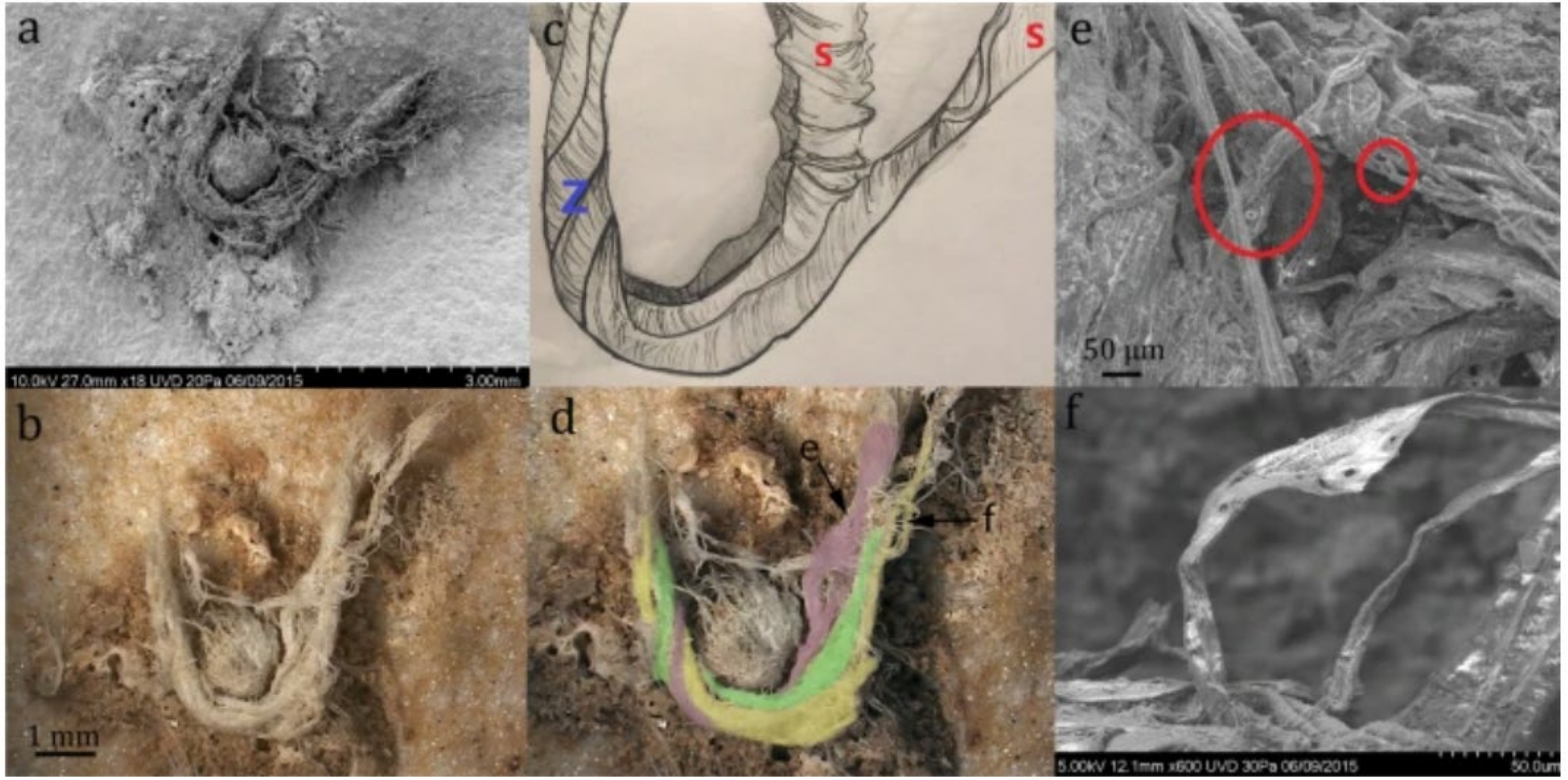
Photographs of the (**a**) Pech-de-l'Azé I (PA I) and (**b**-**e**) Abri Peyrony (AP) *lissoirs*. (**a**) PA I G8-1417. (**b**) AP-4209. (**c**) AP-4493. (**d**) AP-10818, newly published here. (**e**) AP-7839. Adapted/modified from[4].

For leather piercing; could also have used sharp twigs, flint/obsidian points; first holes in shells = 150 Ka

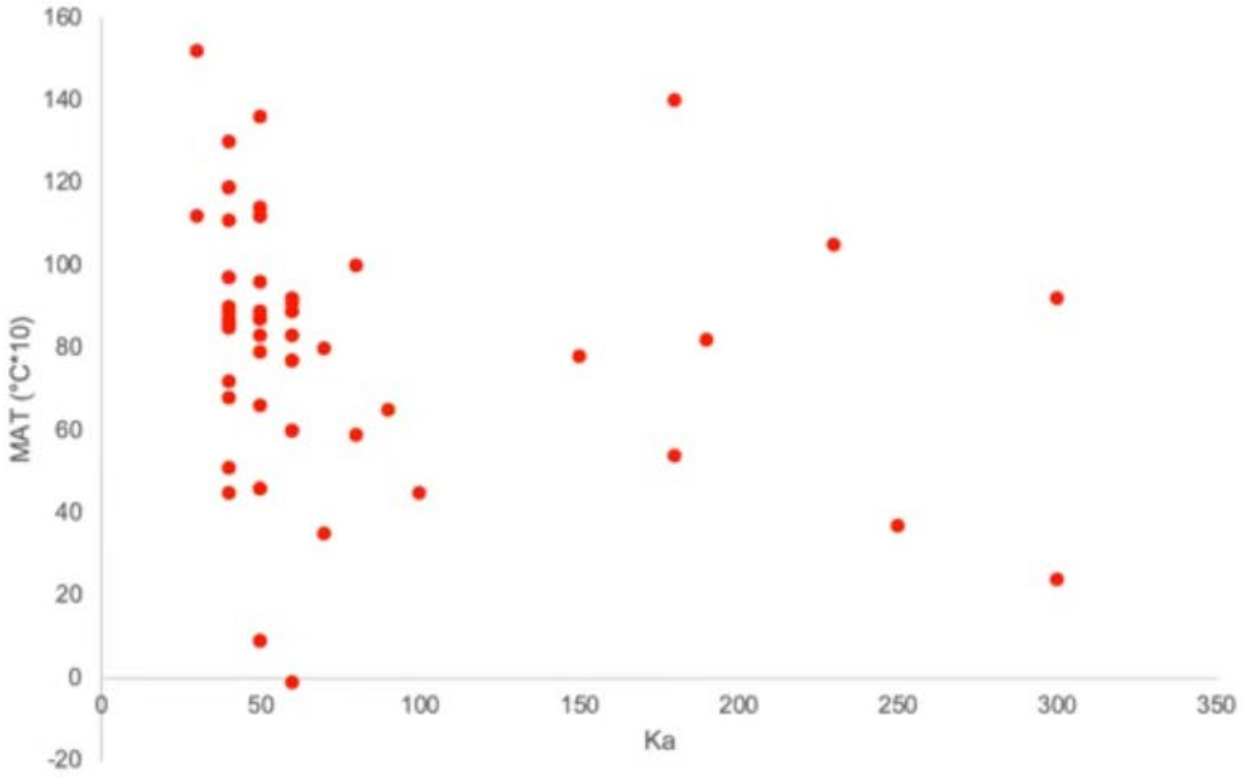
HIDE PROCESSING: TANNING?

- Residues of plant matter, ochre and manganese dioxide have been found on stone tools also used in hide processing.
- Awls found at the Grotta del Cavallo and the Grotta La Fabbrica, Italy, also contain traces of ochre.
- **Ocher for coloring clothing**

Stone scraper with potential residue from oak bark tanning © State Office for Heritage Management and Archaeology Saxony-Anhalt, Juraj Lipták.


a
10.0kV 27.0mm x18 UVD 20Pa 06/09/2015
3.00mm
c
S
S
Z
e
50 µm
b
1 mm
d
e
f
f
5.00kV 12.1mm x600 UVD 30Pa 06/09/2015
50.0um

No correlation between hide processing and temperature



- Sites with evidence associated with clothing are visible across Neanderthal time and space.
- There seems to be relatively little correlation between sites being colder and exhibiting evidence for clothing manufacture/ hide processing.
- When comparing the minimum coldest temperatures, we have a low of -16.7°C (recorded at Lichtenberg).
- There is a difference of 15.1°C between highest and lowest values for the mean average temperature.

Hide processing

- The number of tools and variety of processes related to hide processing imply that these activities were a relatively common aspect of Neanderthal culture and technology.

.

- Clothing likely existed on a spectrum ranging from simple to complex.

- The burst of activity related to hide processing during the Châtelperronian and Uluzzian industries is interesting but hide processing does have a history that extends well before this.

Was there foot wear?

La Ferrassie 2 foot by Pablos (2015)

ALTERNATIVE METHODS

Birch Bark Glue and its Potential Use in Neanderthal Clothing: A Pilot Study

| **Persistent Identifier:** https://exarc.net/ark:/88735/10608

| Print PDF | **Author(s):** P.H. Baker, C.B. Scott, P. Gethin, A. Sinclair, | **Publication Date:** 2021-11-25

| **EXARC Journal Issue 2021/4**

Iran May Have Served As A Meeting Ground For Neanderthals, Denisovans, And Modern Humans

- The authors of a recent study have retraced the likely dispersal paths used by Neanderthals as they migrated out of Europe in an effort to solve the enigma of the interbreeding of Ns and MHs, and they have identified regions in modern day Iran as a potential meeting point between these three related species. The report's main conclusion, which was published in *PLoS One*, revealed that the area had numerous "humid" periods when lakes and rivers were abundant.
- Stone tools used by Neanderthals typically belong to one of the two technical cultures known as Micoquian or Mousterian. The geographical distance between these lithic traditions raises the possibility that Neanderthals divided into groups and moved eastward via various routes.

Elham Ghasidian, et al., 2023 Kambiz Kamrani, 2023

Two potential dispersal routes for the Neanderthals out of Europe.

- The researchers then utilized computer modeling to determine the two most plausible dispersal pathways taken by Neanderthals as they traveled from Europe to Asia based on the distribution of Mousterian and Micoquian archaeological sites as well as information on topography and temperature
- One of these routes would have required our prehistoric ancestors to go across Siberia, where the harsh climate would have made survival challenging.
- However, the other traveled across the more comfortable Southern Caspian Corridor (SCC) in the direction of the south. The SCC, a thin strip of land in present-day Iran between the Alborz Mountains and the Caspian Sea, served as a warm haven for several plant and animal species through glacial periods between 57,000 and 71,000 years ago.

2022 study: Modern human incursion into Neanderthal territories 54,000 years ago at Mandrin, France

- Hominin fossils from Grotte Mandrin in France reveal the earliest known presence of modern humans in Europe was between 56,800 and 51,700 years ago.
- This early modern human incursion in the Rhône Valley is associated with technologies unknown in any industry of that age outside Africa or the Levant.
- Mandrin documents the first alternating occupation of Neanderthals and modern humans, with a modern human fossil and associated Neronian lithic industry found stratigraphically between layers containing Neanderthal remains associated with Mousterian industries.
- We document at least four alternating phases of replacement, with Neanderthals occupying the area

Ludovic Slimak, et al., 2022

Mandrin, France: 4 phases

- Around Mandrin from MIS 5 up to ~54 ka (Mandrin layers J to F):
  - a modern human incursion at around 54 ka (56.8 to 51.7 ka; Mandrin E)
  - followed by Neanderthal reoccupations (Mandrin D-C2-C1-B3-B2),
  - a second modern human phase from ~44.1 ka to 41.5 ka (Mandrin B1) onward.
  - This succession also represents the first known archeological evidence in Europe for the interstratification of a modern human occupation between those of Neanderthals (Mandrin E versus Mandrin F and Mandrin D).

Mandrin: rapid replacement

- No tech exchange over time: no obvious processes of cultural exchange in terms of technical traditions either between the different Neanderthal groups or between modern human and Neanderthal populations, a situation congruent with a scenario of rapid replacement processes with no major interactions.

- Both populations replaced each other rapidly or even abruptly, at least twice, in the same territory.

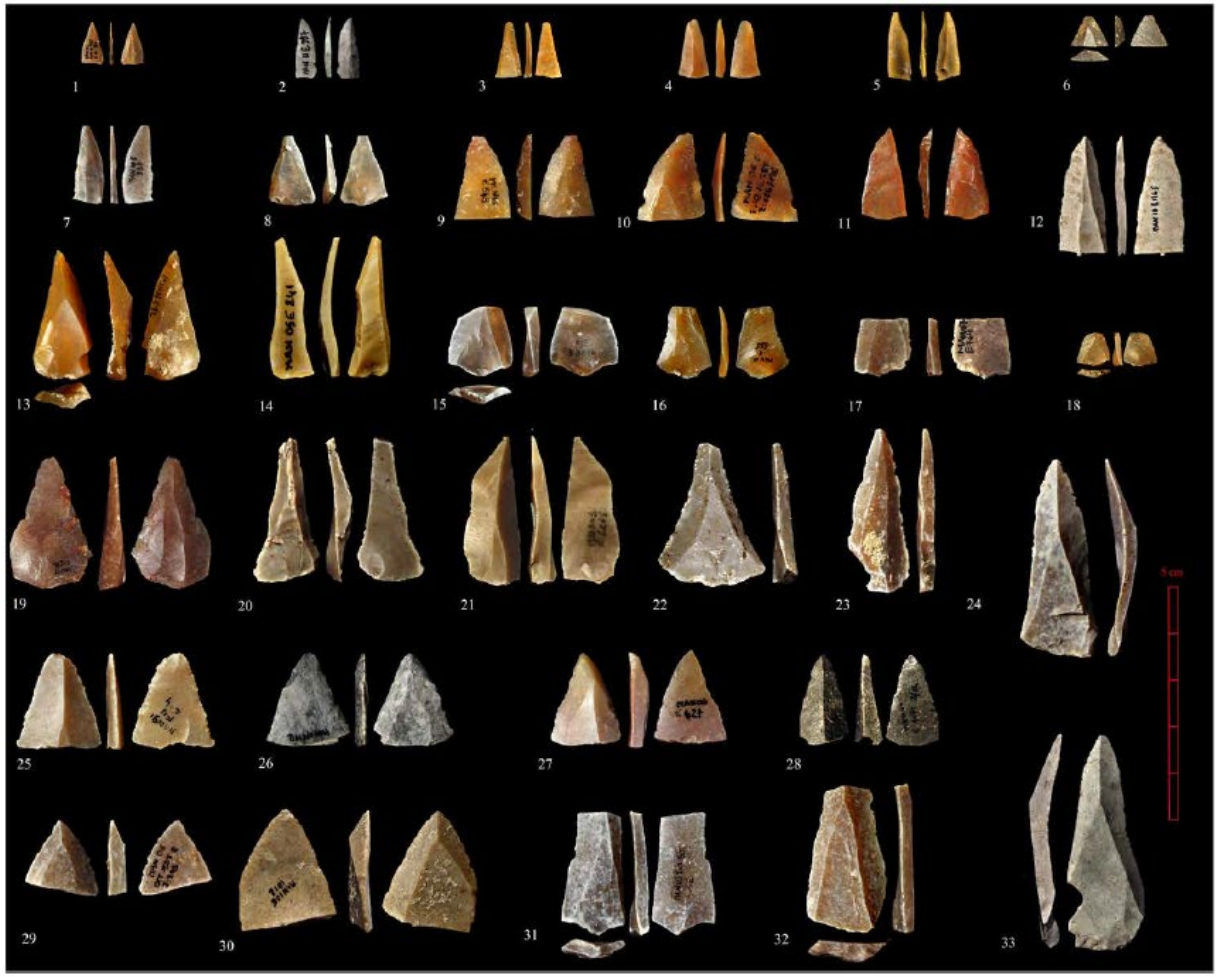


Fig. 2. Neronian points from Mandrin layer E. Micro- and nanopoints (numbers 1 to 23), pointed micropoint (number 10), and points (numbers 24 to 33).

These points represent a substantial technological difference from all of the Mousterian industries in the Mandrin sequence.

Named the “Neronian” [after the Grotte de Néron site].

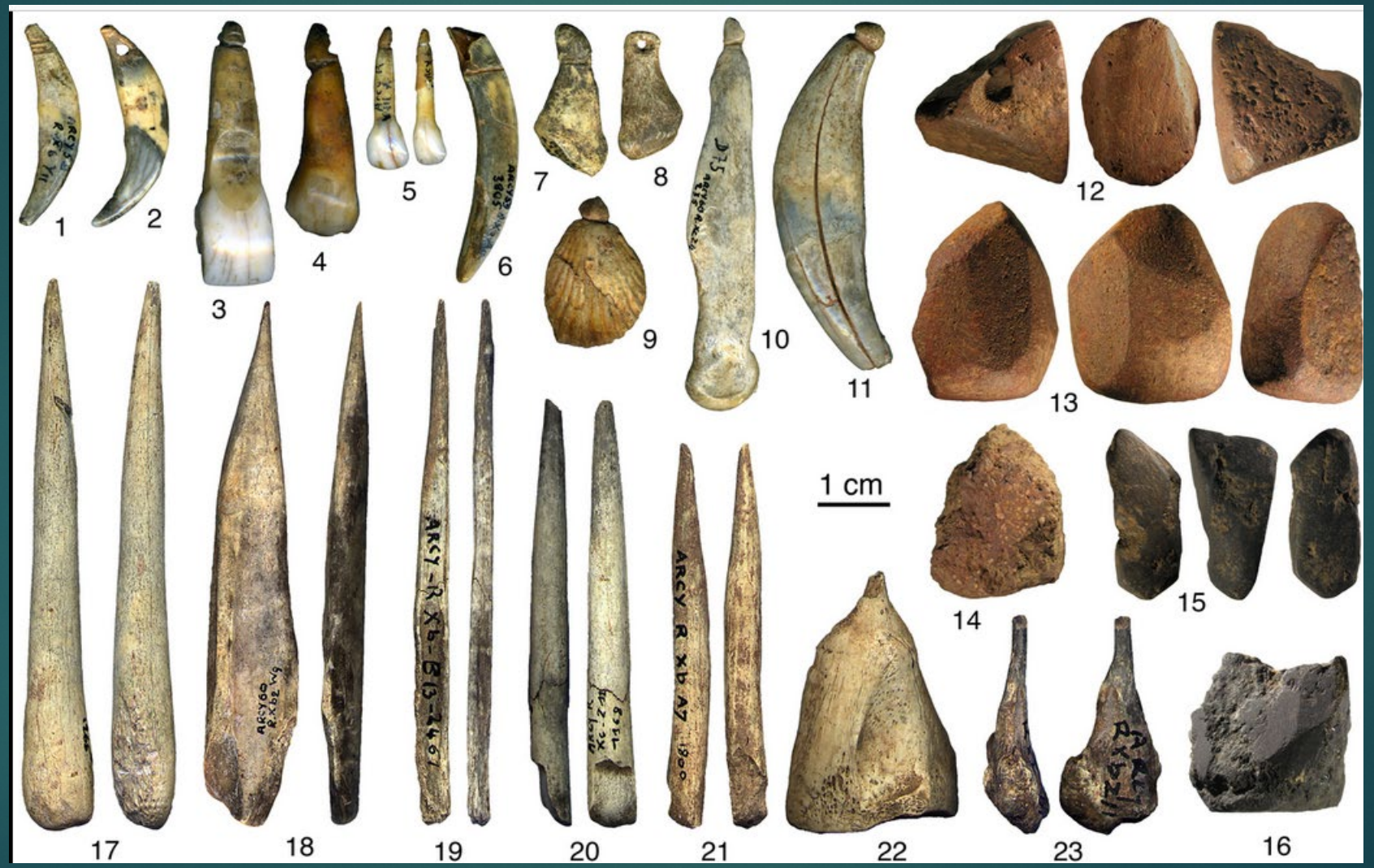
Until now, the Neronian industry had not been documented anywhere as early as at Mandrin, and its makers had not been identified.

Single evidence for MH origin of arrow points: 1 molar = MH

MH layer Mandrin E: arrow points and 1 MH tooth

- Layer E tooth: a deciduous maxillary second molar crown
- Teeth from layers F, D, and C are classified as Neanderthals
- The single tooth Man12 E 1300 specimen from layer E is unequivocally classified as an Upper Pleistocene modern human
- Note: Ancient DNA analyses were initially carried out on fossil horse teeth excavated from throughout the stratigraphic sequence to assess the level of DNA preservation, and whether destructive attempts to recover DNA from the hominin remains to identify the population affiliation of these individuals would be warranted.. However, the overall poor preservation signal from the horse material cautioned against sampling hominin remains at this time.

Châtelperronian tools and jewelry: ultimately proved to be N



MH layer Mandrin E: arrow points and 1 tooth

- CJV: a note of caution – this study's conclusions based on 3 assumptions:
  - A single molar is concluded to be MH based on PCI analysis
  - Arrowheads are assumed to be MH because they are different from N Mousterian tools above and below layer E
  - No known history of Ns making arrowheads
- A similar scenario to the Châtelperronian controversy which assumed that Ns were incapable of making UP jewelry and stone tools
- They opted not to do aDNA testing of the "MH" molar in layer E because tested equid teeth from other layers were too fragile
- No sediment DNA done
- CJV: what if molar is not MH; or that there was a gifted N who created these tools just as Ns created Châtelperronian material

2023: Europe's first humans hunted with bows and arrows

- New 2023 study: A cave site in France holds hundreds of tiny stone points, alongside remains thought to belong to *Homo sapiens*.
- A 54,000-year-old cave site in southern France holds hundreds of tiny stone points, which researchers say closely resemble other known arrowheads — replicas that they tested on dead goats.
- The discovery suggests that the first *Homo sapiens* to reach Europe hunted with bows and arrows.
- But it also raises the question of why Neanderthals — which occupied the Grotte Mandrin rock shelter in the Rhône Valley before and after *Homo sapiens* — never adopted these superior weapons.

L. Metz, et al., 2023

Mandrin

- In 2022, researchers excavating Grotte Mandrin claimed that the site held the earliest known evidence of *Homo sapiens* in Europe
- Among the tools were hundreds of tiny points, many of which were as small as 1 centimeter wide, weighed only a few grams and were nearly identical in shape and size. Some contained similar fractures and other damage at their tips, which could have been created by high-velocity impact.
- The researchers made dozens of replica points from flint found near the rock shelter, and fashioned them into bows and arrows using wood and other materials. They also made thrusting spears and spear-thrower darts. They used the weapons to stab or shoot at dead goats.

Mandrin

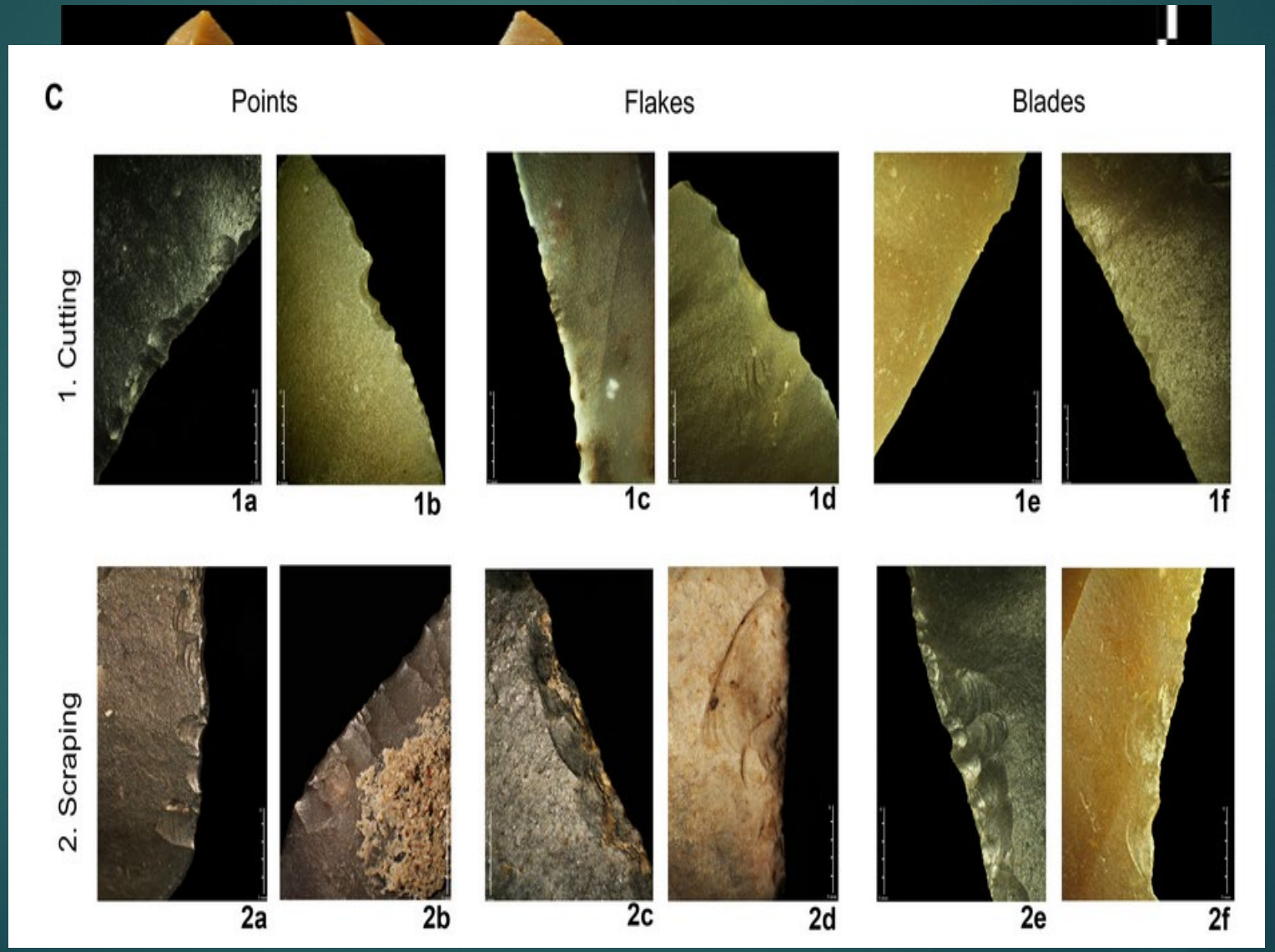
- Found a horse femur with damage consistent with a stone point
- Above and below Grotte Mandrin's layer E, researchers have found Neanderthal teeth and DNA, and Mousterian tools.
- Slimak's team contends that layer E represents an early but short-lived incursion of *Homo sapiens* into Neanderthal territory, more than 10,000 years before the species permanently settled in Europe.
- Not all archaeologists agree.
- If *Homo sapiens* did make the stone points in layer E, it's not clear why Neanderthals in the region and elsewhere did not pick up bow-and-arrow technology.

Bow-and-arrow, technology of the first modern humans in Europe 54,000 years ago at Mandrin, France

- Consensus in archaeology has posited that mechanically propelled weapons, such as bow-and-arrow or spear-thrower-and-dart combinations, appeared abruptly in the Eurasian record with the arrival of anatomically and behaviorally modern humans and the Upper Paleolithic (UP) after 45,000 to 42,000 years (ka) ago, while evidence for weapon use during the preceding Middle Paleolithic (MP) in Eurasia remains sparse.
- The ballistic features of MP points suggest that they were used on hand-cast spears, whereas UP lithic weapons are focused on microlithic technologies commonly interpreted as mechanically propelled projectiles.
- Present the earliest evidence for mechanically propelled projectile technology in Eurasia from Layer E of Grotte Mandrin 54 ka ago in Mediterranean France, demonstrated via use-wear and impact damage analyses.

L. Metz, et al., 2023

Arrow tips? At Mandrin, France, 54 Ka



Grotte Mandrin

- Grotte Mandrin is a vaulted rock shelter directly overlooking the middle valley of the Rhône River.
- Mandrin records a reference archaeological succession, for it contains all of the phases currently known for the last Neanderthal societies, right up to the emergence of the UP.
- Each archaeological layer has yielded a rich lithic industry and paleontological remains.
- Layer E yielded 2267 lithic elements attributed to the Neronian, a "culture" entirely oriented toward the production of standardized Levallois points. Quantitatively, blades, bladelets, and a variety of points represent 75% of all lithics found

Tiny points

- For almost 40% of them, = less than 10 mm in maximum diameter. This diameter of 10 mm represents an important boundary. Ethnographic stone weapons whose shafts' maximum diameter is below 10 mm are exclusively from bow technologies.

- These tiny points of less than 10-mm breadth and that are distally armed are for the use of bow-and-arrow technology at the exclusion of any other delivery system

Arrows

- These results give solid evidence of the use of the bow and arrow within the smallest Neronian points, while the largest Mandrin E points = used with a spear-thrower, but these large points could ballistically be also delivered by bow.

- More generally in sub-Saharan Africa, there is strong evidence for the combination of bow and javelin hunting by 70 to 58 ka ago, but it seems more complex for the use of spear-thrower-and-dart.

Mandrin

- At Mandrin, functional analyses of all the MP layers before and after Layer E demonstrate a lack of the advanced technologies documented in Layer E.

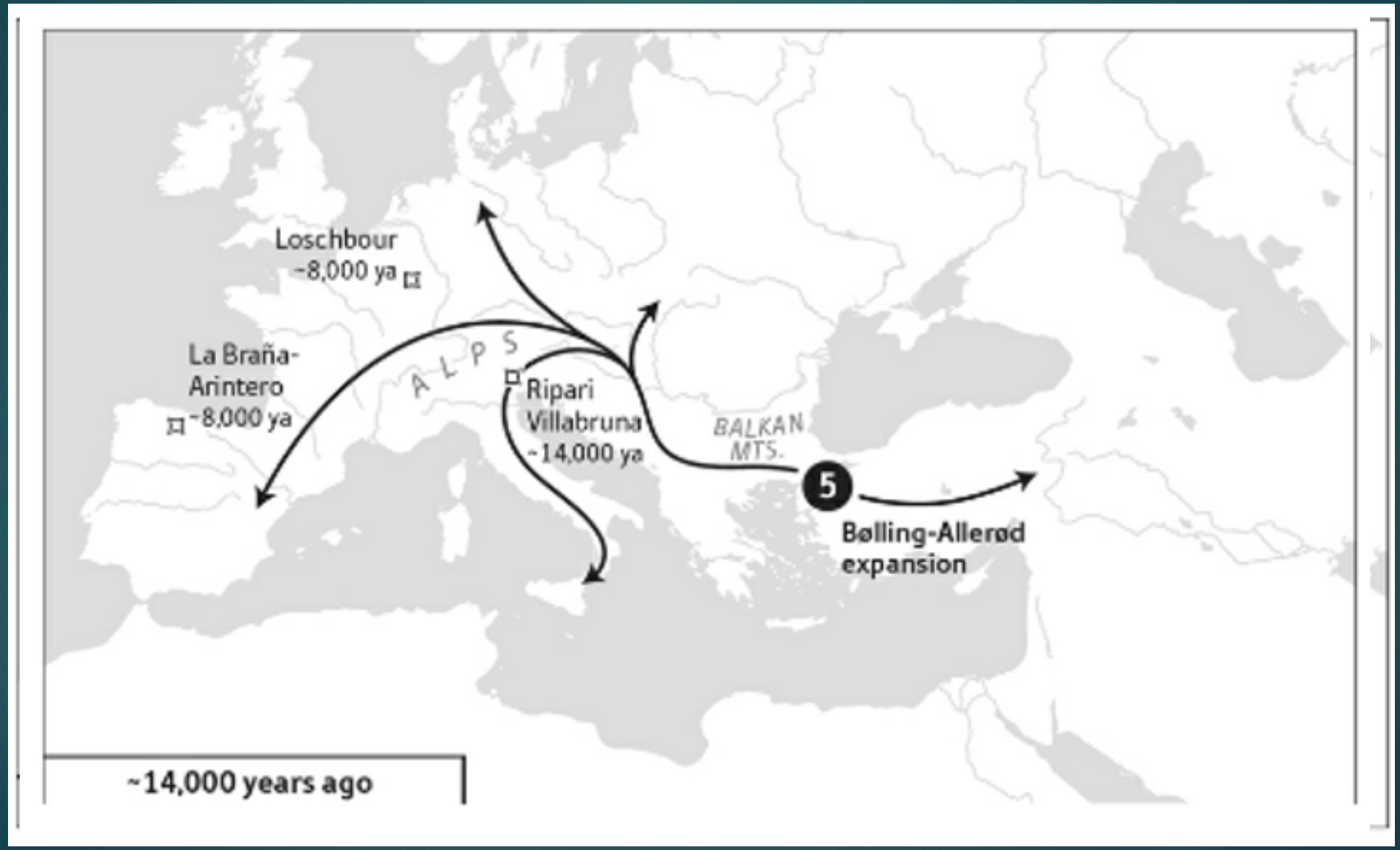
- Document here that this earliest migration of humans into Neanderthal territories is associated with the mastery of bow.

- We also show that these highly controlled technologies were unknown locally among Neanderthals groups like elsewhere in Eurasia.

The new genetic makeup of the European Hunter Gatherers:

The Hunter Gatherers of Europe prior to the Neolithic migration at 8 Ka were a genetically diverse group

5 Great Events in History of Hunter-Gatherers



A genetic mystery: A missing period of 20 thousand years

- Earliest MHs who left Africa reached Europe at least 45,000 years ago. These pioneers left no genetic ancestry.
- Instead, a landmark 2016 study identified a genetic signature in 35,000-year-old remains from the Goyet cave system in Belgium, which persisted in hunter-gatherer populations that lived tens of thousands of years later. The Goyet remains were associated with Aurignacian artefacts, a Europe-wide material culture known for its elaborate cave-wall art and 'Venus' figurines.
- But the 2016 study raised a mystery. The Goyet ancestry was missing in remains from a roughly 20,000-year period, before reappearing later in hunter-gatherers in western Europe. "Where were these people hiding for 20,000 years?

Different genetic groups within the Gravettian culture

- Ancient European DNA that reveals striking genetic diversity of 8 groups within apparently unified prehistoric Gravettian culture.

- This sweeping 2023 study analyzed 116 newly sequenced genomes and hundreds of previously published ones, ranging from about 45 Ka to 8 Ka, and from the Iberian Peninsula to the western steppes of modern-day Russia

- Suggests conclusions drawn from archaeological evidence such as tools, hunting styles, and burial rituals need to be re-evaluated. These coherent cultural populations don’t stand up to the genetic test.

Different genetic groups within the Gravettian culture

- Historical differences in Gravettian culture: only people in Eastern and central Europe constructed mammoth bone shelters; even the female figurines are made in different ways from different materials, deposited in different settings and found in different contexts. Now, it seems they were the handiwork of distinct populations.

Ancient DNA upends European prehistory: Genes reveal striking diversity within similar ice age cultures

- Two studies offer the most detailed look yet at groups of hunter-gatherers living before, during and after the last ice age.

- Thirty thousand years ago, Europe was a land of open steppes with herds of grazing mammoth and other megafauna—and a strikingly uniform human culture = Gravettian's.

- They carved palm-size sculptures of stylized female figurines with exaggerated breasts and buttocks, and left their distinctive art and artifacts from Spain to western Russia.

Ewen Callaway, 2023 Andrew Curry, 2023

Gravettian culture

- You could make a case for saying the Gravettian is the first pan-European culture.
- But despite appearances, the Gravettians were not a single people.
- New DNA evidence, published today in *Nature*, shows Gravettians in France and Spain were genetically distinct from groups living in what is now the Czech Republic and Italy. There were 2 distinct genetic groups.

The Gravettians, as shown in this reconstruction, had a common culture with sophisticated art and artifacts. But they were two distinct populations. TOM BJOERKLUND

Last Glacial Maximum: Head south

- The DNA sheds light on what happened to these ancient Europeans when the climate worsened between 25,000 and 19,000 years ago, during LGM when much of Northern and central Europe was blanketed in ice more than 1 kilometer thick.

- Archaeologists had assumed people including the Gravettians retreated into ice-free areas in southern Europe beginning about 26,000 years ago, then filtered back north several thousand years later as the glaciers melted.

LGM: Iberian Peninsula

- The head south scenario appears to hold true in the Iberian Peninsula and the south of France: People living there before the ice reached its peak persist through the worst of the cold spell, then surge back north and east as the continent warms.

- The two studies suggest that the Iberian Peninsula was a refuge for hunter-gatherers as the climate cooled and glaciers ensconced northern Europe. The genetic signature — the same one found in the Belgium Goyet 35,000 years ago — later pops up across western Europe and even into Poland after Europe's climate warmed.

But not in Italy

- But the Italian Peninsula, long thought to have been a relatively secure refuge, showed something different. The DNA reveals the Italian refuge was actually a dead end.

- Expected Italy to be a climate refugium, but there's a sharp and complete genetic population turnover. The Gravettian population completely disappears.

- Instead, after the glacial maximum, people in Italy show genetic links to the Near East, suggesting a new population arrived from the Balkans.

- Ice-age Italy was less hospitable to humans than was Iberia. Italy was once connected to Croatia by a now-submerged plain, so it makes sense that eastern hunter-gatherers moved in.

Magdalenians vanish

- Post-LGM Magdalenian technocomplex has been interpreted as being derived from groups associated with the pre-LGM Aurignacian.

- Despite broadly similar hunting and gathering lifestyles, people in Western Europe remain genetically distinct from those east of the Baltic Sea.

- They even looked different: Genetic data suggest that before the arrival of farmers in northern Europe around 6000 BC,
  - hunter-gatherers in Western Europe had dark skin and light eyes.
  - People in Eastern Europe and Russia, meanwhile, had light skin and dark eyes.

- The two groups spent millennia not mingling. From 14,000 years ago to 8000 years ago, they do not mix at all.

Classic nomenclature for UP Cultures = Modern Humans

- Bohunician Culture - c. 48,000 - 35,000 BC (incl. Uluzzian Cultures)
- Châtelperronian Culture - c.43,000 - 39,000 BC
- Aurignacian Culture - c.38,000 - 29,000 BC
- Gravettian Culture - c.29,000 - 22,000 BC; (incl. Pavlovian Culture)
- Solutrean Culture - c.22,000 - 17,000 BC
  - (Epigravettian (20,000–10,000 BC))
- Magdalenian Culture - c.17,000 - 12,000 BC (incl. the Badegoulian Interlude & the Villabruna Cluster)
- Then post UP: Mesolithic to Neolithic

Some new Gravettian subcultures: at least eight populations

- Pre-40 ka HG group: Bacho Kiro, Oase; no descendants
- Kostenki cluster: Russia; became Vèstonice
- Fournol cluster: France & Spain
- Vèstonice cluster: Russia; replaced by Villabruna
- GoyetQ2 cluster: descend from Fournol; in the north
- Villabruna cluster: from Balkans; replaced Goyet Q2
- Oberkassel cluster: WHG from Villabruna; replaced the GoyetQ2
- Sidelkino cluster: EHG from Russia
- By 14 Ka, only the Oberkassel and Sidelkino

Two 14,000-year-old skulls, one male and one female, found in western Germany. DNA suggests they belonged to a population of hunter-gatherers called the Oberkassel that expanded from Italy across northern Europe as the continent warmed

Before LGM

- The Gravettian culture was one of the most widely distributed Upper Palaeolithic cultures across western Eurasia before the LGM. A pan-European cultural mosaic with regional variations in material to symbolic productions
- Historically thought of as a biologically homogeneous population on the basis of craniometric and genomic data.
- New study reveals the presence of three distinct groupings:
  - (1) a pre-40 ka group with individuals from the Ust'Ishim, Bacho Kiro, Zlaty kůň and Peştera cu Oase sites,
  - (2) a Věstonice cluster including Gravettian-associated individuals from central–eastern and southern European sites
  - (3) a Fournol cluster comprising Gravettian-associated individuals from western and southwestern European sites. = closely related to Aurignacian-associated individuals from Belgium dated to 35 ka

The genomic history of ice-age Europeans

- DNA from the remains of 357 ancient Europeans, spanning between 35,000 and 5,000 years ago, researchers discovered that several waves of hunter-gatherers migrated into Europe.

- The studies identified at least eight populations, some more genetically distinct from each other than modern-day Europeans and Asians.

- They coexisted in Europe for thousands of years, apparently trading tools and sharing cultures. Some groups survived the Ice Age, while others vanished, perhaps wiped out by other groups.

K. Zimmer, 2023 C. Posth, et al., 2023

Hunter-gatherers of Europe

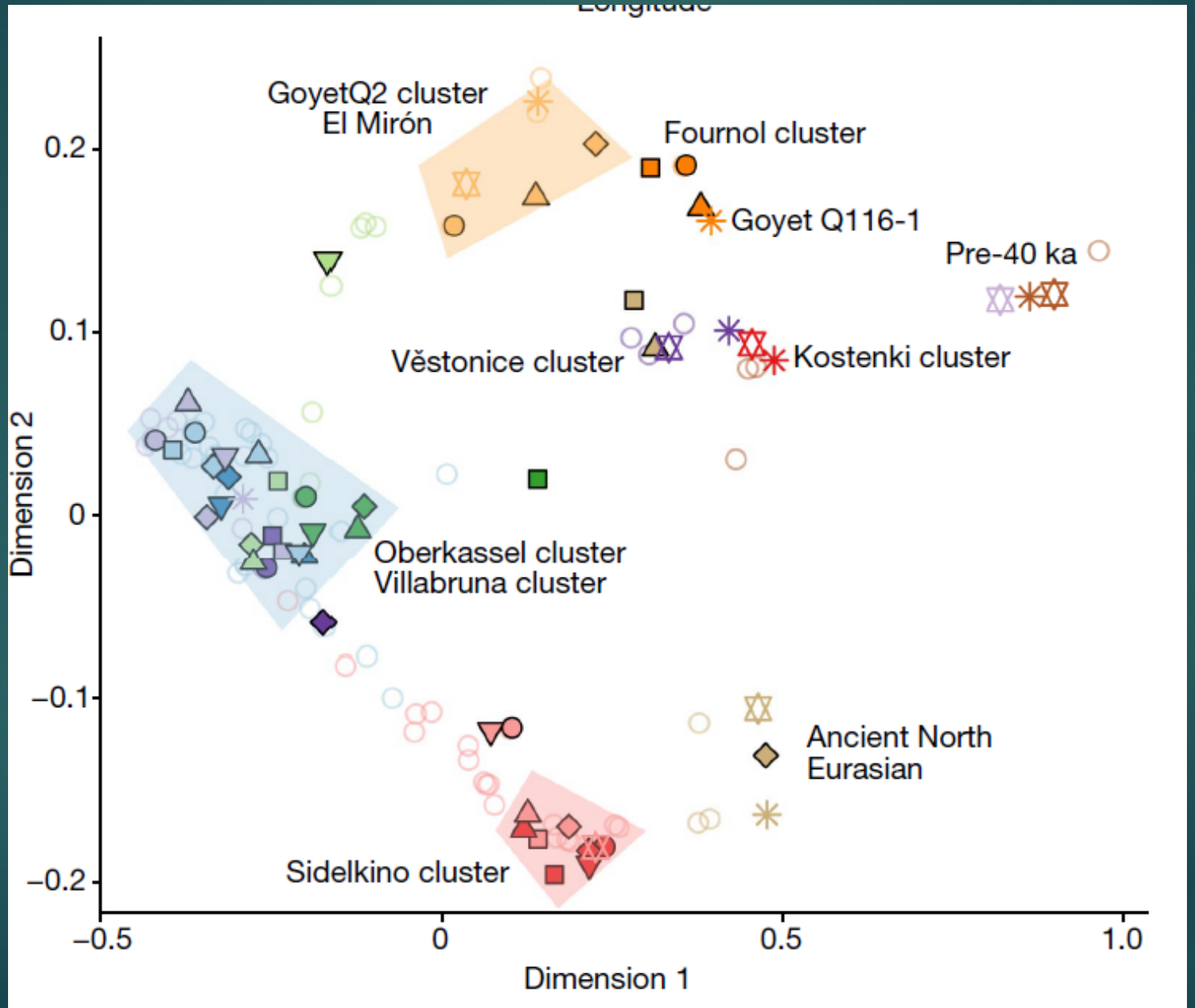
- The new genetic analysis suggests that when farmers arrived in Europe about 8,000 years ago, they encountered the descendants of this long history, with light-skinned, dark-eyed people to the east, and possibly dark-skinned and blue-eyed people to the west

- These early Europeans have almost no genetic link to younger remains of hunter-gatherers.

Hunter-gatherers of Europe

- It appears that the first modern humans in Europe (pre-40 Ka) may have disappeared along with the Neanderthals.
- Have found DNA in Gravettian remains scattered across Europe.
- Researchers had expected all of the individuals to have come from the same genetic population, but instead found two distinct groups: one in France and Spain, and another in Italy, the Czech Republic and Germany.

Multidimensional scaling: 6 new UP genetic groups



UP Gravettian

- Identified a genetic ancestry profile in individuals associated with Upper Palaeolithic Gravettian assemblages from western Europe that is distinct from contemporaneous groups related to this culture in central and southern Europe, but resembles that of preceding individuals associated with the Aurignacian culture.

- This genetic profile survived during the Last Glacial Maximum (25,000 to 19,000 years ago) in human populations from southwestern Europe associated with the Solutrean culture, and with the following Magdalenian culture that re-expanded northeastward after the Last Glacial Maximum.

Genetic turnover: Fournol and Vestonice groups

- There was a genetic turnover in southern Europe suggesting a local replacement of human groups around the time of the Last Glacial Maximum, accompanied by a north-to-south dispersal of populations associated with the Epigravettian culture.
- From at least 14,000 years ago, an ancestry related to this culture spread from the south across the rest of Europe, largely replacing the Magdalenian-associated gene pool.
- Newly named the western population = Fournol people in France & Spain, with a genetic link between this group and 35,000-year-old Aurignacian remains in Belgium.
- The eastern group = Vestonice; they share an ancestry with 34,000-year-old hunter-gatherers (Sunghir) who lived in Russia.

Fournol and Vestonice people

- Argue that the Fourn … two waves that migrated into Europe separately.
- After they arrived, the … years sharing the Gravettian culture but remaining …
- About 26,000 years a … ew threat to their survival: an advancing wall of gla …
- During the Ice Age, fr … nter-gatherers were shut out of much of the contin … refuges. This movement was accompanied by … flint tools, produced by people deriving from local Fournol groups.

Different graves

- Individuals in western and southwestern Europe related to the Fournol cluster are consistently deposited in cave sites

- Individuals related to the Věstonice cluster are buried with grave goods and/or personal ornaments and ochre in open air or cave sites in central-eastern and southern Europe, respectively

Near Eastern: Villabruna

- ‘Near-Eastern’ genetic affinities that define a cluster called Villabruna, and spread farther south in small groups that reached present-day Sicily around 14 ka.
- The implication is that the post-LGM ‘Epigravettian’ industry did not, as was previously thought, develop in situ from earlier local Gravettian groups in Italy — suggesting that the peninsula might not have offered a glacial refuge to humans.
- The Villabruna influence also extended outside Italy — found evidence of this ancestry in an individual dated to 19 ka found at El Miron in Spain. This reveals a southern edge of Europe that acted as a corridor from the Balkans to Iberia.

Fournol become GoyetQ2 & Vestonice replaced by Villabruna

- Once the glaciers retreated, some descendants of the Fournol continued living in Iberia.
- But others expanded north as a new population = GoyetQ2. which is associated with the Magdalenian lithic industry
- The Vestonice, by contrast, did not survive the Ice Age. When the glaciers were at their most expansive, the Vestonice may have endured for a time in Italy.
- Found no Vestonice ancestry in Europeans after the Ice Age. Instead, they discovered a population of hunter-gatherers that appeared to have expanded from the Balkans, known as the Villabruna. They moved into Italy and replaced the Vestonice.

Villabruna become the Oberkassel

- The Villabruna, 14,000 years ago, crossed the Alps and encountered the GoyetQ2 people to the north.
- A new population emerged, its ancestry three parts Villabruna to one part GoyetQ2.
- This new people, which study calls Oberkassel, expanded across much of Europe, replacing the old GoyetQ2 population.

The Oberkassel & the Sidelkino

- About 14,000 years ago, a pulse of strong warming produced forests across much of Europe. The Oberkassel people may have been better at hunting in forests, whereas the GoyetQ2 retreated with the shrinking steppes.

- Individuals of mainly Oberkassel ancestry persisted in Germany until roughly 5 ka. This could reflect local communities limiting admixture with incoming farmers but adopting a farming lifestyle.

- To the east, a new group of hunter-gatherers, who probably arrived from Russia = Sidelkino, who lived in Ukraine and surrounding regions.

European HGs at 8 Ka: Iberians, the Oberkassel and the Sidelkino.

- The Iberians after the Ice Age still carried a great deal of ancestry from the Fournol people who had arrived thousands of years before the glaciers advanced.

- The Villabruna people moved into northern Spain, but added their DNA to the mix rather than replacing those who were there before.

- When the first farmers arrived in Europe from Turkey about 8,000 years ago, three large groups of hunter-gatherers thrived across Europe: the Iberians, the Oberkassel and the Sidelkino.

LGM in southwestern and western Europe

- The Solutrean culture is temporally intermediate between the Gravettian and the Magdalenian cultures, and is found in southwestern and western Europe, which are considered to have been climatic refugia for human populations during the LGM

- After the LGM, the Epigravettian culture was widespread in southern and southeastern Europe

- Found that all of the newly and previously reported Epigravettian-associated individuals fall within the Villabruna cluster

Epigravettian culture

- To summarize, our results highlight a genetic turnover in the Italian peninsula of the Gravettian-associated Věstonice cluster by the Epigravettian-associated Villabruna cluster that might correlate with discontinuities observed in the archaeological record.

- We show that all analyzed Epigravettian-associated individuals carry a homogeneous Villabruna ancestry,

- The turnover took place much earlier than 17 ka.

Post-14 ka to Neolithic

- Two main hunter-gatherer ancestries were predominant across most parts of Europe after around 14 ka— that is,
  - the western hunter-gatherer (WHG) ancestry, related to the Villabruna cluster, and
  - the eastern hunter-gatherer (EHG) ancestry, showing affinity to both the Villabruna and the ancient north Eurasian (ANE) ancestry found in Upper Palaeolithic Siberian individuals.
- The two 14 ka Oberkassel individuals mark the earliest presence of WHG ancestry north of the Alps, which we therefore rename the Oberkassel cluster

Oberkassel/Sidelkino

- The contact zone and the admixture patterns between the Oberkassel and Sidelkino ancestries changed over time.
- Between 14 and 8 ka, all hunter gatherers in western and central Europe carried only Oberkassel ancestry.
- Further north and east, individuals from the Baltics (Baltic HG), Scandinavia (SHG), the Balkans (Iron Gates HG) and Ukraine (Ukraine HG) already carried an Oberkassel/Sidelkino admixed ancestry before 8 ka
- This raises the possibility that the replacement by the Oberkassel cluster and the formation of the Sidelkino cluster might have been the result of population expansions influenced by the abrupt warming during the Bolling–Allerod interstadial

Summary: Oberkassel and Sidelkino clusters after 14 Ka

- The two main hunter-gatherer ancestries present in Europe from 14 ka onwards = the Oberkassel and Sidelkino clusters
- Oberkassel cluster = Epigravettian-associated ancestry spread from the south to central Europe passing through the western side of the Alpine region. The Sidelkino ancestry also emerged around 14 ka.
- The increasing level of admixture between distinct hunter-gatherer populations from around 8 ka onwards indicates an intensified mobility of those forager groups.
- This might have been in part triggered by the concomitant expansion of Neolithic farmers across Europe and/or by environmental factors, such as the climatic event around 8.2 ka, the largest abrupt cooling in the northern hemisphere during the Holocene epoch.

Phenotypic differences

- The Sidelkino people in the east had genes associated with dark eyes and light skin.
- The Oberkassel in the west, in contrast, probably had blue eyes and may have had dark skin.
- These groups of hunter-gatherers remained isolated from each other for about 6,000 years, until the farmers from Turkey arrived.
- After this advent of agriculture, these groups began mixing. It's possible that the spread of farmland forced them to move to the margins of Europe to survive. But over time, they were absorbed into the agricultural communities that surrounded them.

Conclusions: archeology does not tell all; but genes do

- Posth and colleagues have revealed population turnovers that shaped the European genetic landscape in the face of climate change.
- Their findings caution against simple narratives equating lithic industries and ethnicity.
- Provided five novel insights into the genomic history of hunter-gatherer populations over a time span of 30,000 years from the Upper Palaeolithic to the Neolithic.

Gravettian Culture

- First, we show that individuals associated with the Gravettian culture across Europe were not a biologically homogeneous population.

- The ancestry found in individuals associated with the preceding Aurignacian culture from central Europe (GoyetQ116-1 ancestry) gave rise to Gravettian-associated individuals from western and southwestern Europe.

Fournol

- This derived ancestry—the Fournol cluster—survived during the LGM in Solutrean-associated individuals, possibly within the Spanish climatic refugium, leading to later populations associated with the Magdalenian culture (GoyetQ2 cluster).

- Conversely, the ancestry found in pre-30 ka eastern European individuals contributed to Gravettian-associated individuals from central and southern Europe (Věstonice cluster)

Epigravettian culture: Villabruna cluster

- Second, the ancestry of individuals associated with the Epigravettian culture (Villabruna cluster), which was found to genetically connect European and Near Eastern hunter-gatherers, reached southern Europe

- Its entry point into northeastern Italy from the Balkans followed by a north-to-south expansion into the Italian peninsula

Magdalenian's

- Third, Magdalenian-associated individuals not only from Iberia but also from the rest of Europe carry Epigravettian-associated ancestry (Villabruna cluster).

- The spread of the Magdalenian across Europe is linked to southwestern to northern and northeastern post-LGM population expansions and not to movements from southeastern Italian refugia.

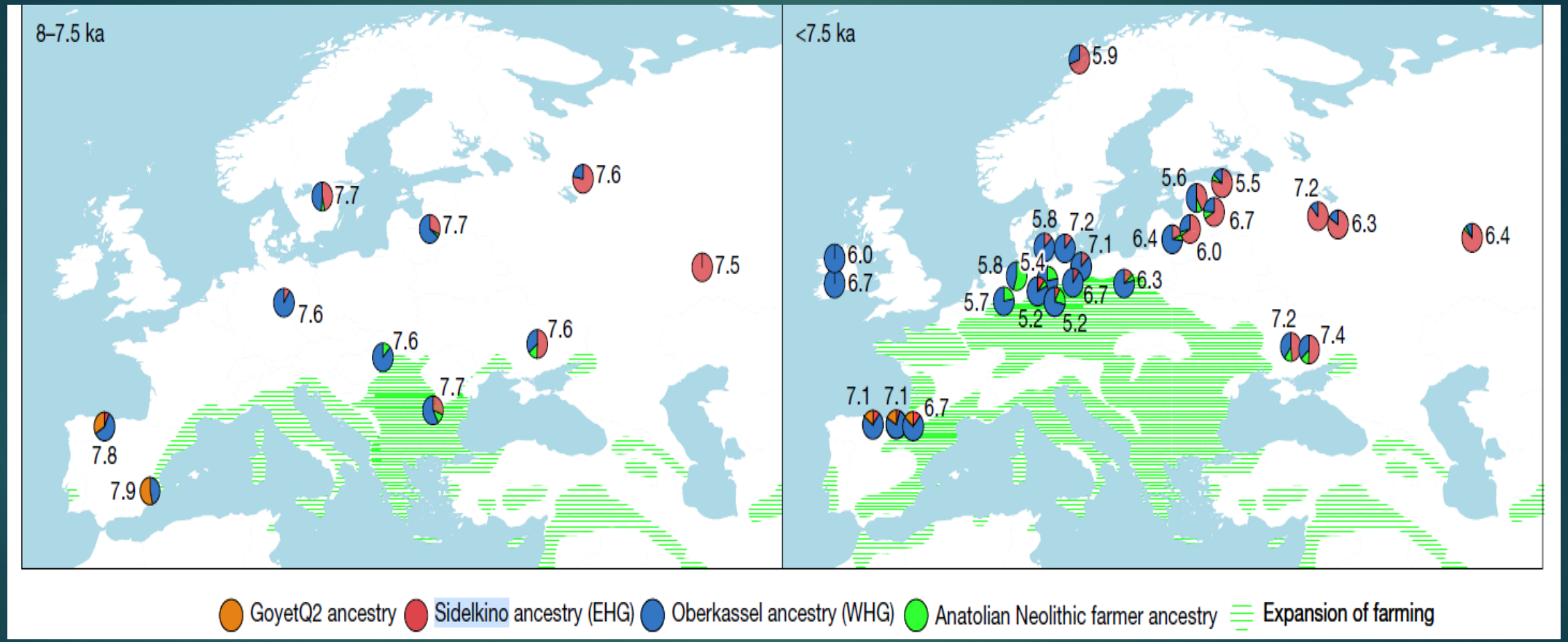
Oberkassel cluster (WHG)): Western Europe

- Fourth: finding of a large-scale genetic turnover as early as 14 ka in central and western European hunter-gatherers associated with multiple techno-complexes despite considerable technological continuity with the preceding late Magdalenian.

- Oberkassel cluster (= WHG)) -- its expansion into continental Europe might have started from the west side of the Alps. Between 14 and 8 ka, all HGs in western & central Europe carried only Oberkassel ancestry, with no detectable contribution from the Sidelkino cluster.

- Fifth, the Oberkassel ancestry in western and central Europe and the Sidelkino ancestry in eastern Europe remained largely isolated for almost 6,000 years until genetic interactions were first observed— around 8 ka in northeastern Germany.

European HGs: After 8 Ka, Oberkassel in West, Sidelkino in East



Spain and West were the refugia

- In conclusion, our study reveals that
  - western and southwestern Europe (Spain) served as climatic refugia for the persistence of human groups during the coldest phase of the last Ice Age
  - whereas populations in the Italian peninsula and the eastern European plain were genetically overturned, challenging the role of these regions as glacial refugia for humans.

- The incoming Villabruna ancestry from the Balkans later became the most widespread hunter-gatherer ancestry across Europe.

- This presentation contains some copyrighted material from journals the use of which has not always been authorized by the copyright owner. Such material is made available in an effort to advance understanding of the topics discussed in this presentation. This constitutes 'fair use' of any such copyrighted material as provided for in section 107 of the US Copyright Law. In accordance with Title 17 U.S.C. Section 107, the material on this site is distributed without profit, and is used for nonprofit educational purposes. If you wish to use copyrighted material from this site for purposes of your own that go beyond 'fair use', you must obtain permission from the copyright owner. If you are the copyright owner and would like this content removed from this site, please contact me.

Contact Info

- Charles J. Vella, PhD
- www.charlesjvellaphd.com
- charlesvella@comcast.net
- 415-939-6175