

Scientific Updates

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by Charles J Vella PhD

Strange Evolution: boy catches piranha like fish in Oklahoma



New find: Fossilized pizza from Crustaceans period!



Did mammals take on dinosaurs at 125 Ma?



An extraordinary fossil captures the struggle for existence during the Mesozoic

- ▶ Dinosaurs and mammals have coexisted for the last ~ 230 million years. Although they undoubtedly interacted in many ways, direct fossil evidence for their interaction is rare.
- ▶ Report of a new fossil find from the Lujiatun Member of the Lower Cretaceous Yixian Formation of China, showing a gobiconodontid mammal and psittacosaurid dinosaur locked in mortal combat.
- ▶ Hypothesized explanations for this association, but the balance of the evidence suggests that it represents a predation attempt on the part of the smaller mammal, suddenly interrupted by, and preserved within, a lahar-type volcanic debris flow.

A moment of struggle

- ▶ The lack of bite marks on the dinosaur skeleton (3 × larger than the mammal), the position of the mammal atop the dinosaur, and the grasping and biting actions of the mammal collectively signal that the mammal was preying on the weakened dinosaur.
- ▶ Mesozoic mammals are usually depicted as having lived in the shadows of their larger dinosaurian contemporaries, but this **new fossil** convincingly demonstrates that mammals could pose a threat even to near fully-grown dinosaurs.

New
size

ever-
a



, 2023



A closer look at the skull of *R. robustus* with its teeth sunk into the dinosaur's ribs. (Image credit: Gang Han)

Psittacosaurus lujiatunensis-
Repenomamus robustus pair
locked in mortal combat.

Insets depict (left to right):

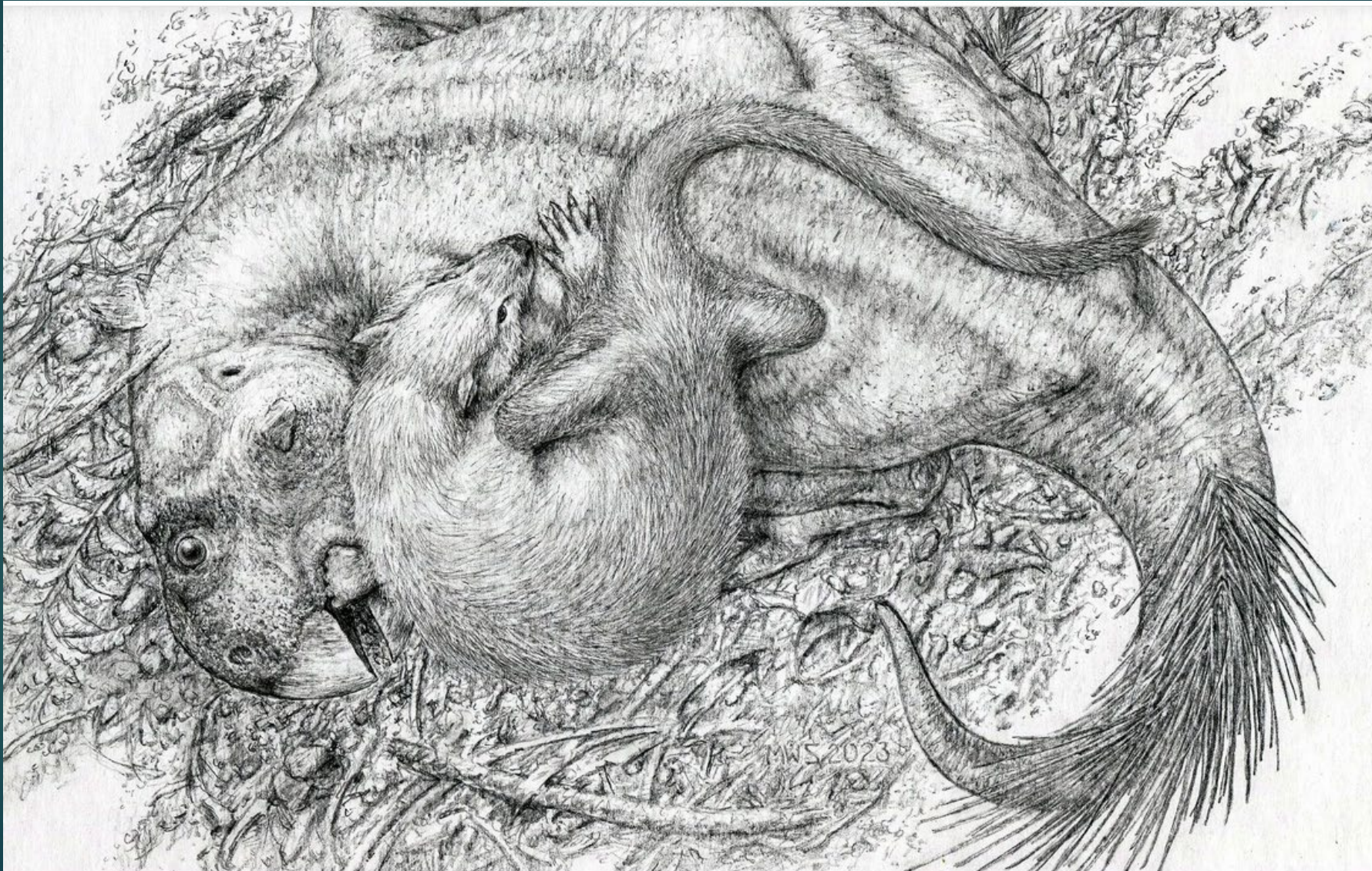
hand of *R. robustus* wrapped
around lower jaw of *P.*
lujiatunensis,

teeth of *R. robustus* embedded
in forearm of *P. lujiatunensis*,

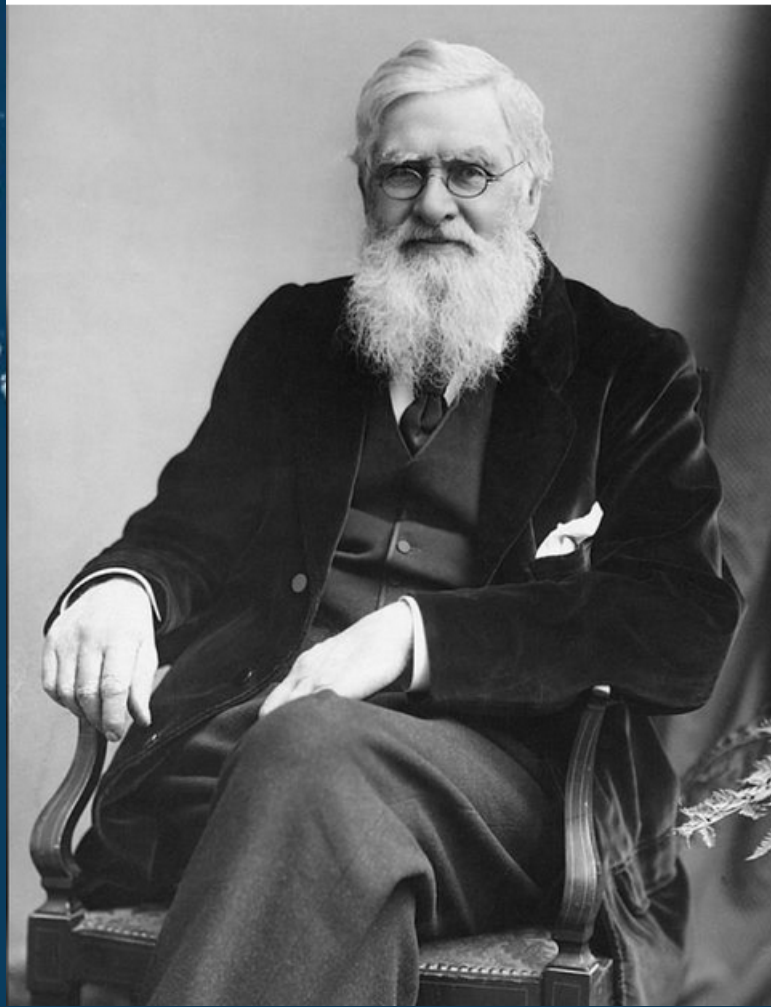
hind foot of *R. robustus*
wrapped around lower
hindlimb of *P. lujiatunensis*.

Scale bar equals 10 cm.

Not so timid mammal! The new fossil thus challenges the common assumption that Mesozoic mammals were merely fodder for the ruling dinosaurs.



The Wallace line: a gigantic evolutionary line explained



Wallace line: due to climate change

- ▶ The confusing line, which is both imaginary and real, arose millions of years ago after a continental collision triggered extreme climate change that impacted the species on each side of the divide in different ways.
- ▶ Wallace Line or Wallace's Line, is a biogeographical barrier first mapped out in 1863 by British naturalist and explorer Alfred Russel Wallace, who famously proposed the theory of evolution by natural selection at the same time as Charles Darwin.
- ▶ On his travels across the Malay Archipelago — a chain of more than 25,000 islands between Southeast Asia and Australia, Wallace noticed that the species he encountered drastically changed past a certain point.

Climate effects

- ▶ On the Asian side of the line, the creatures exclusively originate from Asia. But on the Australian side of the boundary, animals are a mix of both Asian and Australian descent. Something happened that enabled Asian species to move in one direction but prevented Australian species from moving in the reverse direction, but it wasn't clear what that was.
- ▶ Researchers now believe that the uneven distribution of species across the Wallace Line was caused by extreme climate change resulting from tectonic activity around 35 million years ago, when Australia broke away from Antarctica and crashed into Asia, birthing the Malay Archipelago.
- ▶ A computer model was used to simulate how animals were impacted by the climatic effects triggered by the continental mash-up. Looked at 20,000 species found on either side of the Wallace Line. Results showed Asian species were much better suited for living in the Malay Archipelago at the time.

Effect of climate change: Archipelago warmer, Australia colder

- ▶ The main climatic changes at the time were not caused by the movements of the continents themselves but rather by how they impacted Earth's oceans.
- ▶ When Australia drifted away from Antarctica, it opened up this area of deep ocean surrounding Antarctica. This dramatically changed Earth's climate as a whole; it made the climate much cooler.
- ▶ The changing climate did not affect all species equally. The climate in Southeast Asia and the newly formed Malay Archipelago remained much warmer and wetter than in Australia, which had become cold and dry. As a result, creatures in Asia were well-adapted to living on the Malay islands and used them as "stepping stones" to move toward Australia.
- ▶ This was not the case for the Australian species. They had evolved in a cooler and increasingly drier climate over time and were, therefore, less successful in gaining a foothold on the tropical islands compared to the creatures migrating from Asia.

Early humans were weapon woodwork experts.



Master woodworkers

- ▶ State-of-the-art analysis of a **double-pointed wooden throwing stick**, found in **Schöningenen in Germany** three decades ago, shows it was **scraped, seasoned and sanded before being used to kill animals**. The research indicates early humans' woodworking techniques were more developed and sophisticated than previously understood.
- ▶ The creation of lightweight weapons may have enabled **group hunts of medium and small animals**. The use of **throwing sticks as hunting aids** could have involved the entire community, including children.
- ▶ These early humans **demonstrated an ability to plan well in advance, a strong knowledge of the properties of wood, and many sophisticated woodworking skills** that we still use today.

Woodworking

- ▶ The Schöningen humans used a spruce branch to make this aerodynamic and ergonomic tool. The woodworking involved multiple steps including cutting and stripping off the bark, carving it into an aerodynamic shape, scraping away more of the surface, seasoning the wood to avoid cracking and warping, and sanding it for easier handling
- ▶ Found in 1994, the 77cm-long stick is one of several different tools discovered in Schöningen, which includes throwing spears, thrusting spears and a second similarly sized throwing stick.
- ▶ The double-pointed throwing stick was most likely used by early humans to hunt medium-sized game like red and roe deer, and possibly fast-small prey including hare and birds that were otherwise difficult to catch.

Throwing sticks: like a boomerang

- ▶ The throwing sticks would have been thrown rotationally—similar to a boomerang—rather than overhead like a modern-day javelin and may have enabled early humans to throw as far as 30 meters. Although lightweight, the high velocities at which such weapons can be launched could have resulted in deadly high-energy impacts.
- ▶ The fine surface, carefully shaped points and polish from handling suggest this was a piece of personal kit with repeated use, rather than a quickly made tool that was carelessly discarded.
- ▶ Hominins were technologically capable of capturing smaller fast prey and avian fauna

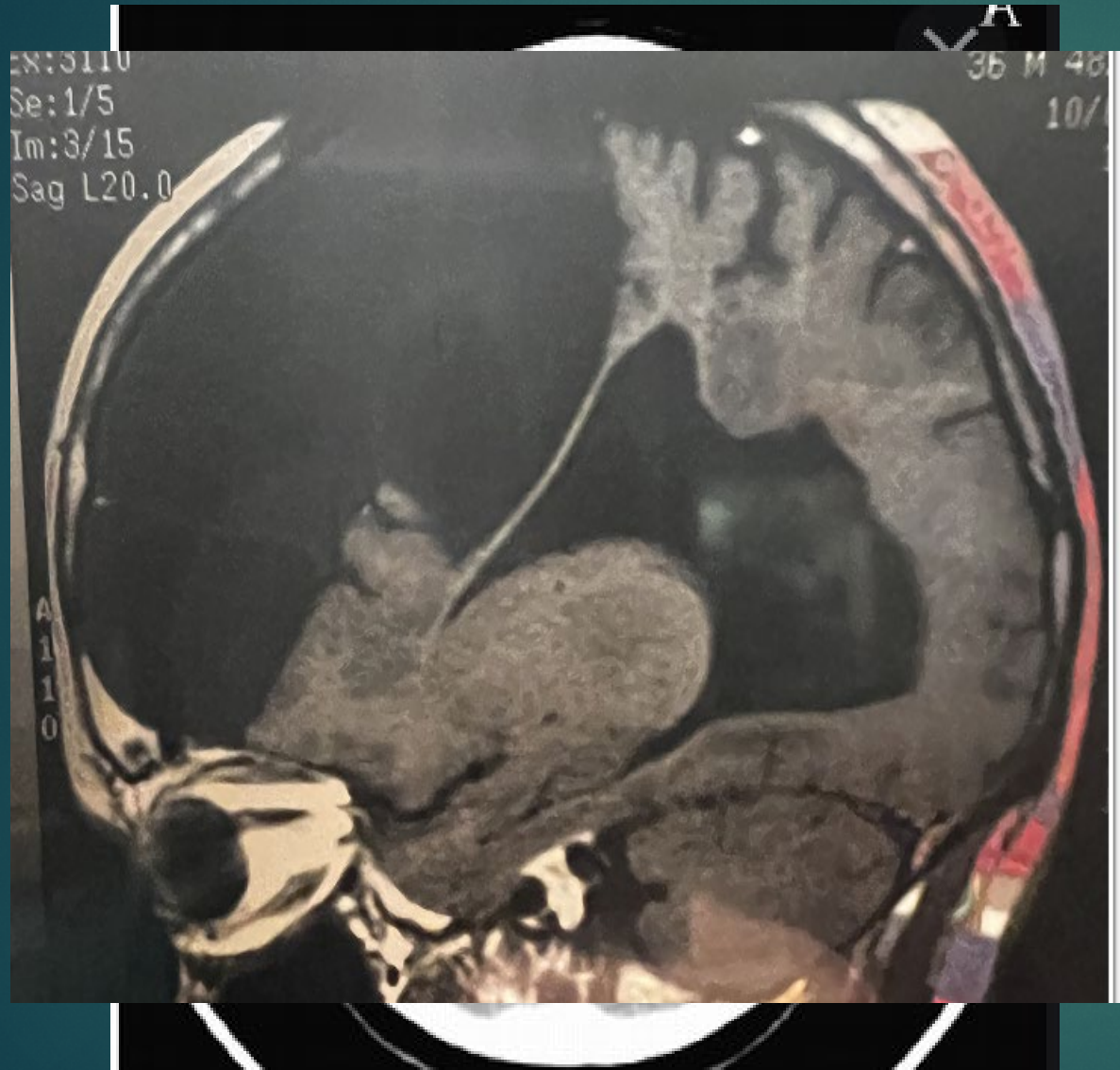


Artistic reconstruction showing the stick would have been thrown. Credit: Benoit Clarys

Kennard Principle

- ▶ **Neural plasticity** refers to the ability of the brain to change and adapt to meet different functional needs throughout an organism's lifespan, i.e. aging, brain damage, etc.
- ▶ In 1936, Margaret Kennard introduced the concept of brain plasticity in an animal model by studying the recovery of motor functions after performing brain lesions in infant and adult monkeys.
- ▶ The Kennard Principle states that the younger an organism is, the greater and swifter recovery from brain injury will be. According to the 'Kennard Principle', there is a negative linear relation between age at brain injury and functional outcome. Other things being equal, the younger the lesioned organism, the better the outcome. This principle itself is subject to controversy and debate; lesion site, in association with age, plays a key role in recovery.

“Dr. Vella, I have always felt I had something missing.”

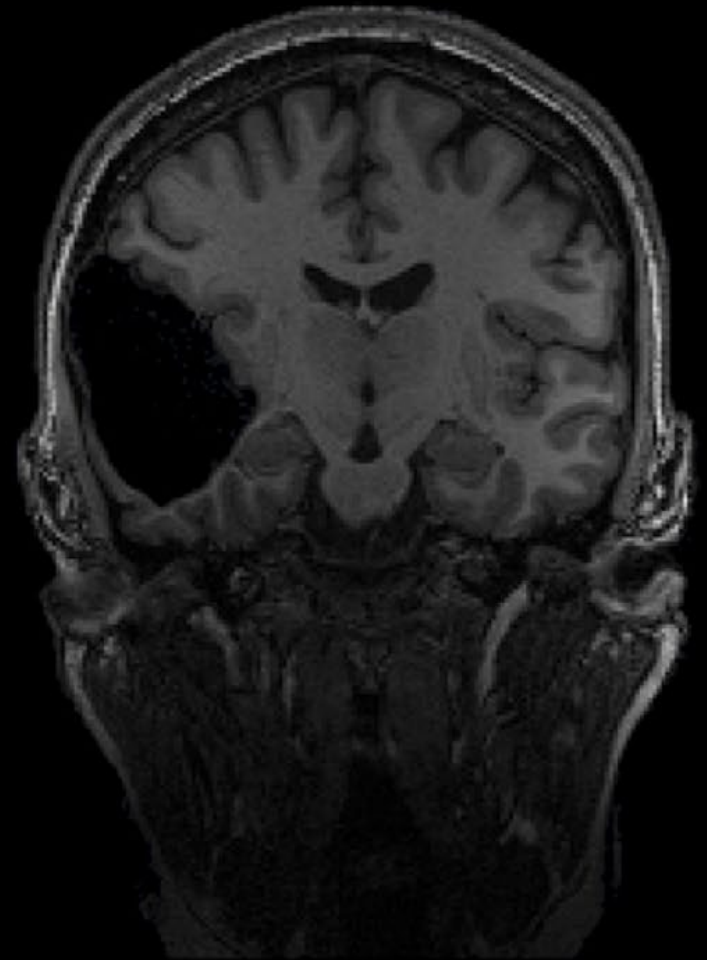
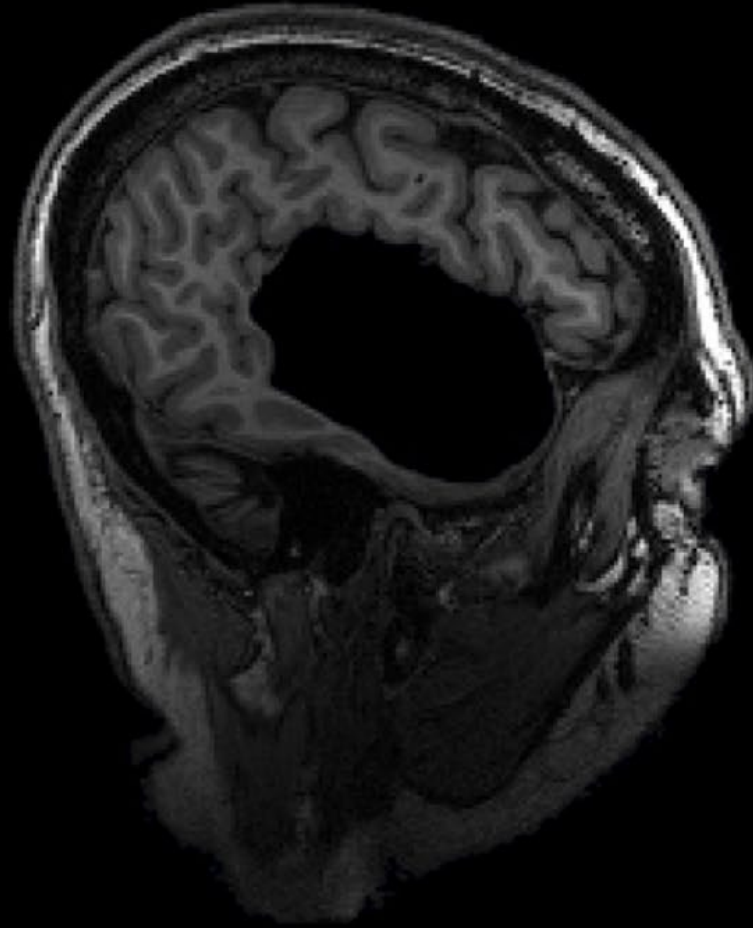
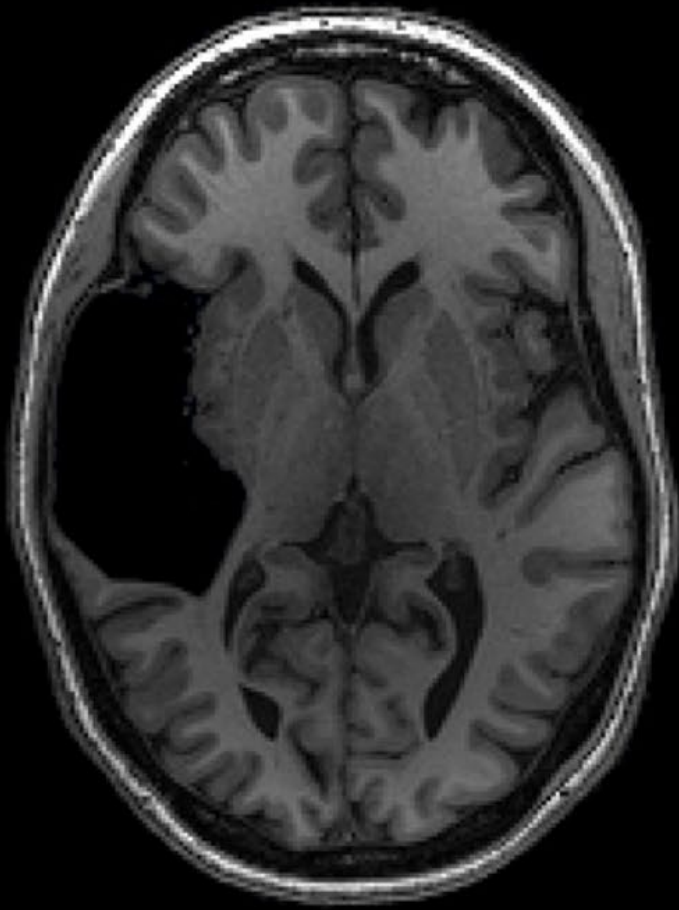


- 1993, 35 yo LH male, HS grad
- Hydrocephalus as infant
- hx of being fired (law firm file clerk), overwhelmed by tasks, forgetful, angry, disorganized, school difficulty (repeated 5th grade); avid reader
- Left Frontal Parietal cyst
- No corpus callosum
- Neuro exam WNL
- VIQ 93, PIQ 85, FIQ 89)
- Left hand tapping = 2%
- Verbal Memory 22%; Visual Memory 48%

Possibility of brain reorganization in the young brain

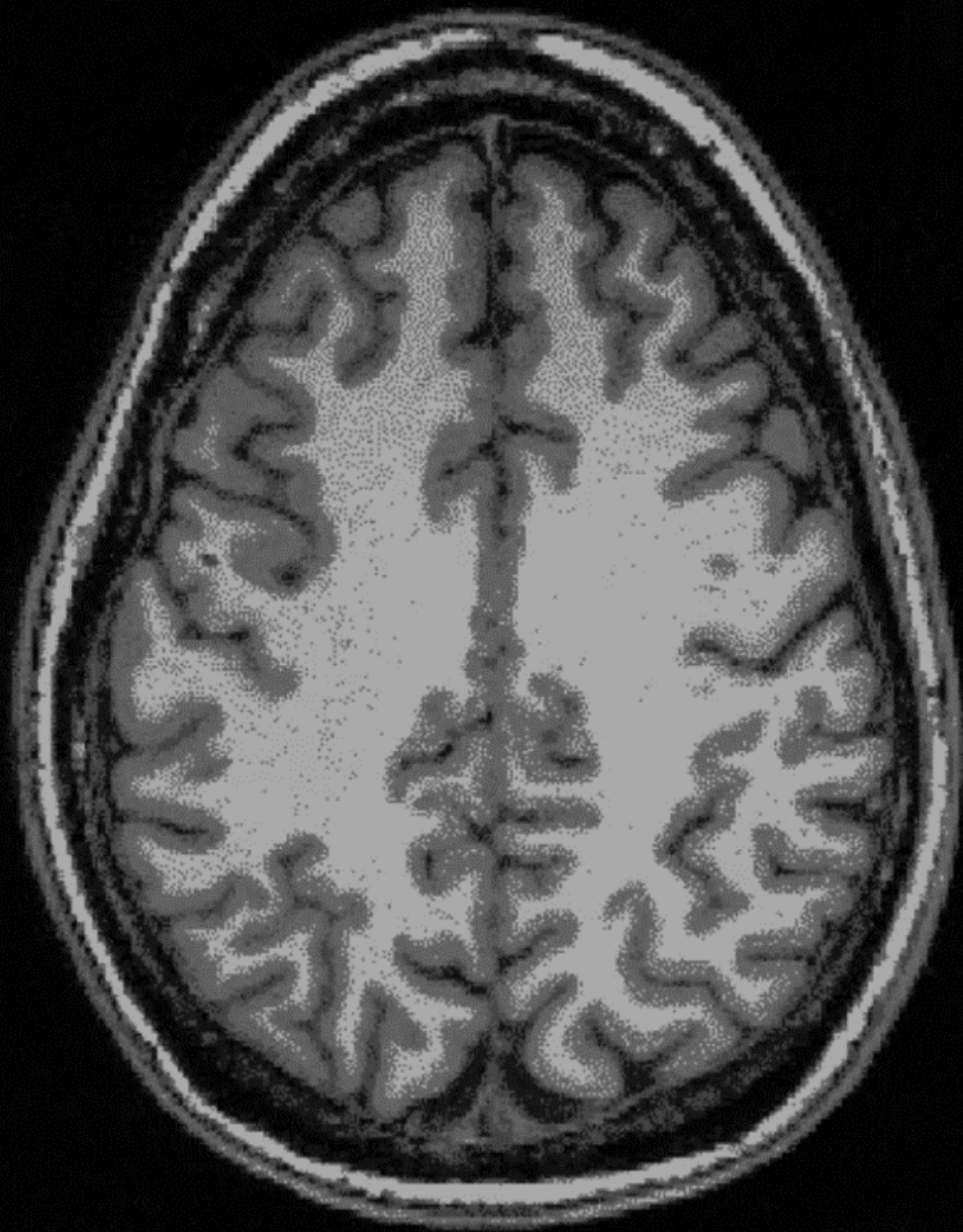
- ▶ The **mature human brain is lateralized for language**, with the left hemisphere primarily responsible for sentence processing and the right hemisphere primarily responsible for processing vocal emotion. Left frontal lobe also normally is involved in verbal expression. However, it has long been hypothesized that in early life there is plasticity for language, allowing young children to acquire language in other cortical regions when LH areas are damaged
- ▶ It has long been **claimed that the young brain, post injury, is capable of recovery and reorganization that does not occur in adults**.

The fabulous brain of Elyse G.



It's also missing a big chunk.

- ▶ Elyse G. found out she lacked most of her left temporal lobe when she was 25 years old. The brain region is typically crucial for speech and language — but until her brain was scanned, no one knew Elyse was missing hers. In adults, strokes in the left temporal region can produce severe aphasia and alexia.
- ▶ A new project explores interesting brains to better understand neural flexibility
- ▶ Scientists can't say exactly how it happened. It's possible that sometime long ago, perhaps due to a stroke before or shortly after birth, a portion of Elyse's brain died and then ultimately disappeared, leaving behind only liquid — brain tissue swapped for a fluid-filled void. Her sister has one too.



Elyse G. & sister Martha M.

- ▶ Elyse and her sister, Martha M. look and act perfectly ordinary. But each lacks most of a temporal lobe, but in the opposite hemisphere. Elyse is also missing part of her brain stem.
- ▶ The women are two of **who knows how many people living their lives without brain structures** generally thought to be crucial.

Tribute to brain flexibility

- ▶ Elyse emailed MIT's Evelina Fedorenko her brain images in 2016, decades after the void was discovered. She had read an article about neuroscience research at MIT and was curious if scientists would be interested. “She said, ‘I’m missing my left temporal lobe. Do you want to study me?’ ” Fedorenko remembers.
- ▶ What started as a single case study has now snowballed into the **Interesting Brains Project; now 40 people with atypical brains.**
- ▶ Elyse first learned about her atypical brain after an MRI scan in 1987. She was 25 years old and in her first year of grad school in Washington, D.C., an avid reader and a whiz with a needle and thread.

Atypical brains

- ▶ Elyse had been previously diagnosed with epilepsy despite never having a seizure. Elyse, for example, experiences smell hallucinations. She picks up whiffs of electrical fires whenever she's under a lot of stress.
- ▶ Elyse's doctors were surprised she had more than a fifth-grade vocabulary.
- ▶ She scored near the top of every language test she took.



Martha M., Elyse G.'s younger sister, is also missing most of a temporal lobe, but on the right side of the brain — a near-mirror image of Elyse's lesion.

Later, fluid buildup in the brain pressed against the nerves of her eyes, hindering her sight.

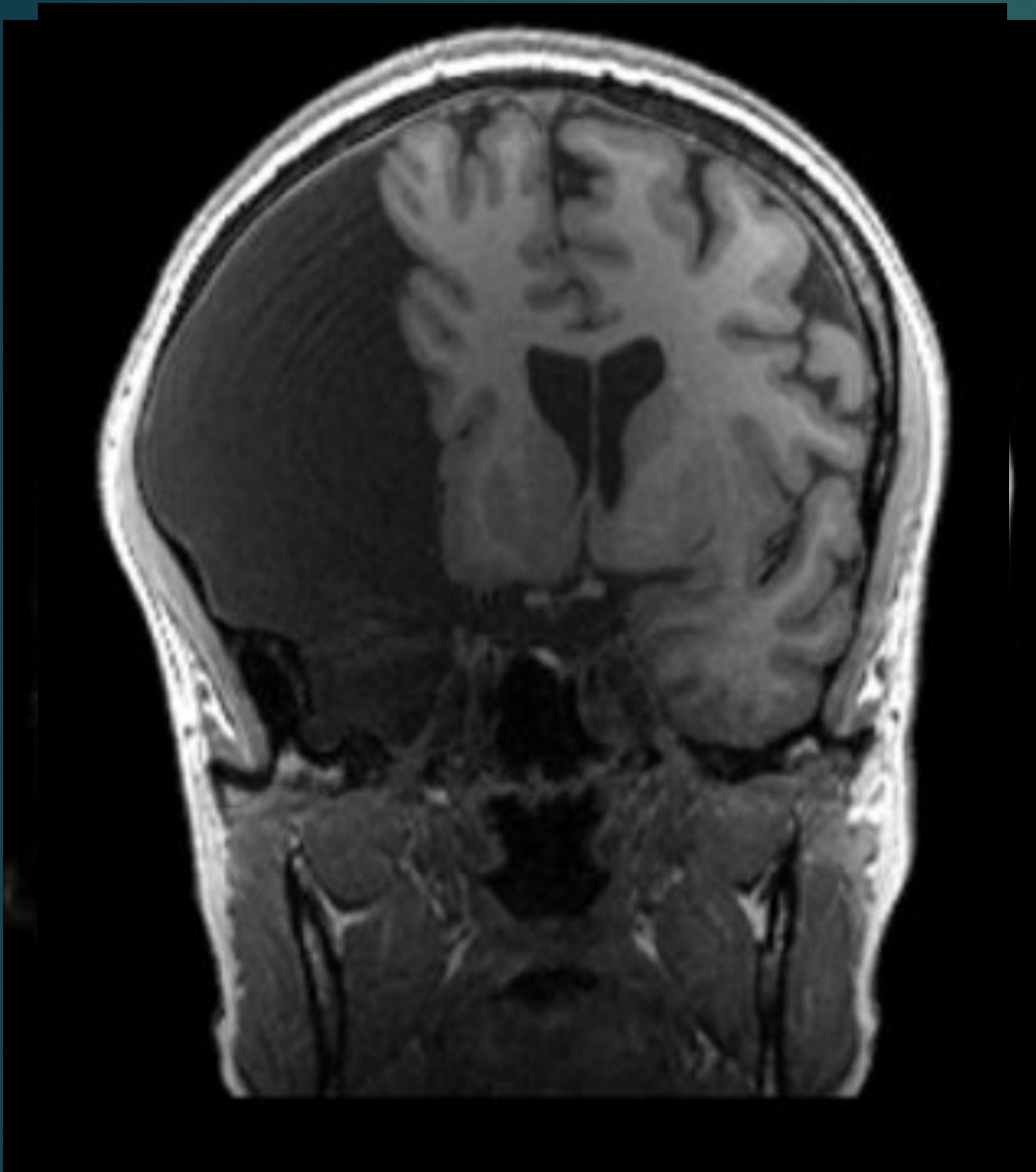
Like all of the Interesting Brains Project participants tested so far, Martha scores at or above average on language and cognitive tasks.

fMRI results: Frontal language areas do not emerge in the absence of temporal language areas

- ▶ fMRI revealed language activity in the right side of her brain. Her left frontal lobe is perfectly intact. But that lobe showed no language-responsive areas at all.
- ▶ She completely lacks a typical temporal region for reading words - 'visual word-form area'. Instead, she appears to tap into a network of neurons across the visual cortex
- ▶ Helen Santoro, a science journalist had a stroke before birth and was missing her left temporal lobe, like Elyse. But enough healthy tissue in the back of her temporal lobe is the site of her language system.
- ▶ Kids who've had early strokes in the motor cortex: some kids with large brain injuries have only minor weakness on one side of their body. Others with just very small damage on their MRI have quite profound disabilities for their entire life

Atypical brains

- ▶ These atypical arrangements can stem from cysts, surgery, strokes or hydrocephalus (excess fluid buildup in the brain). Some can result in a brain with much less neural tissue than usual — and sometimes the change can be abrupt.
- ▶ A group of 15 kids and young adults who all had perinatal strokes that resulted in left hemisphere damage in an area that processes words and sentences. In nearly every case, the participants' brains shifted language over to the same spots in the right hemisphere. Certain brain areas can serve as pinch hitters for language function.
- ▶ And a damaged left hemisphere doesn't always mean language moves to the right. Sometimes language function stays behind, surviving on the fringes of the damaged region

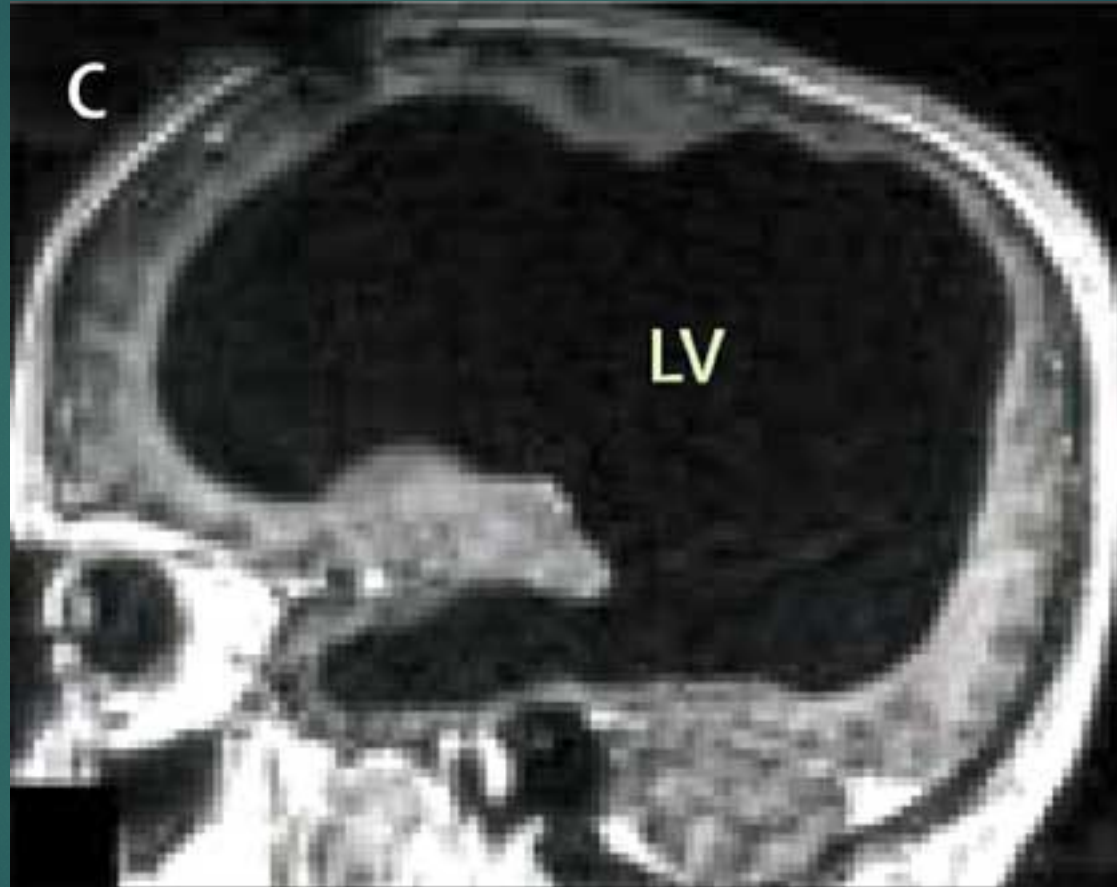


- E.S.'s atypical brain may stem from an assortment of issues, including an **arachnoid cyst**, a fluid-filled sac that forms between the brain and one of its membranes. **Hydrocephalus**, when excess fluid collects in the middle parts of the brain, may also have compressed E.S.'s brain tissues. He **also has agenesis of the corpus callosum**. In their daily life, E.S. is **a professor and researcher in the field of speech-language pathology**.
- **K. V. = Hydrocephalus** pushing neural tissue toward the sides of their skull and pressing the cortex thin. K.V.'s ventricles, cavities filled with cerebrospinal fluid (center), are larger than most people's and form a fluid-filled void in the center of the brain. K.V. makes their living as **a writer**.
- **G.C.** may have developed **a cyst** in their left hemisphere early in life. That could have compressed their left frontal, temporal and parietal lobes. Though G.C.'s language areas are squished, the cyst does not seem to have affected their daily life. G.C. is **a speech-language pathologist**.

What will you see on CT?

- ▶ A 44-year-old man presented with a 2-week history of mild left leg weakness.
- ▶ At the age of 6 months, he had undergone a ventriculoatrial shunt, because of postnatal hydrocephalus of unknown cause. When he was 14 years old, he developed ataxia and paresis of the left leg, which resolved entirely after shunt revision.
- ▶ His neurological development and medical history were otherwise normal. He was a married father of two children, and worked as a civil servant, a tax collector.
- ▶ On neuropsychological testing, he proved to **have an IQ of 75: his verbal IQ was 84, and his performance IQ 70.**

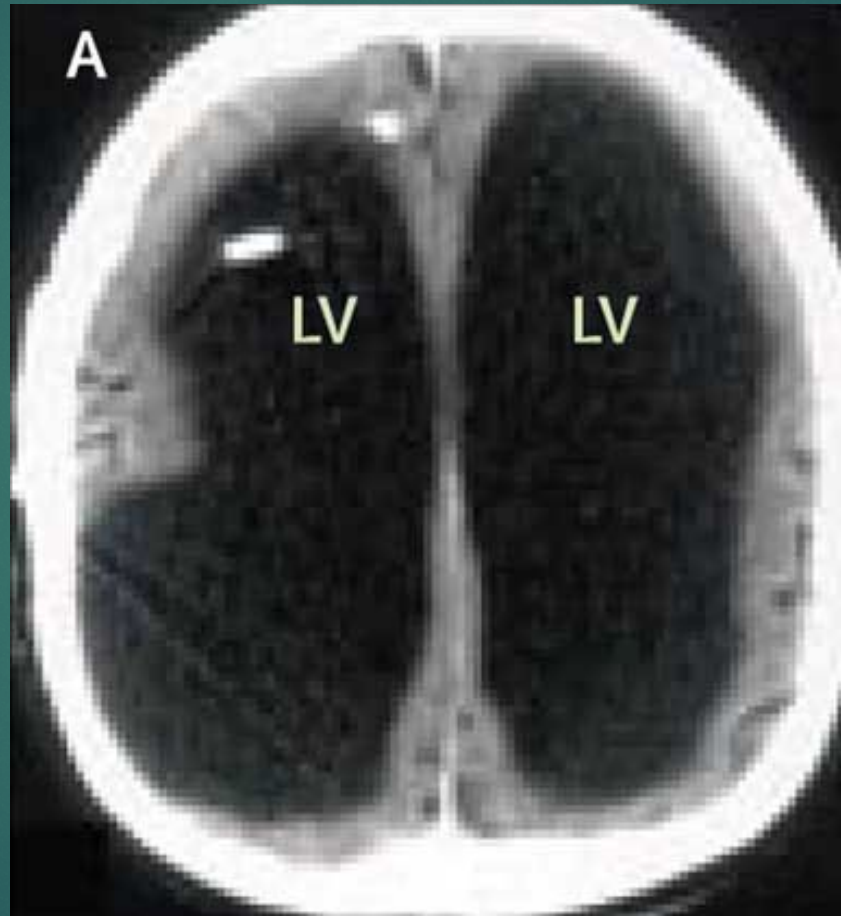
French Tax Man, 2007: Hydrocephalus



LV = Lateral Ventricle

Hydrocephalus at 6 m; shunted until 14; leg weakness led to MRI

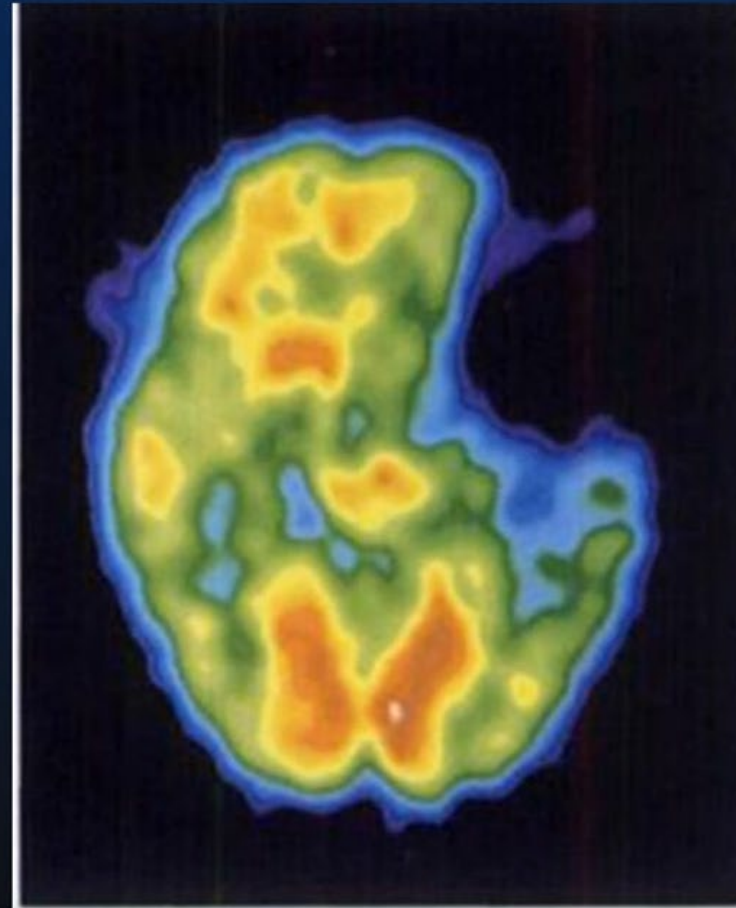
French Tax Man 2



Taxman 3

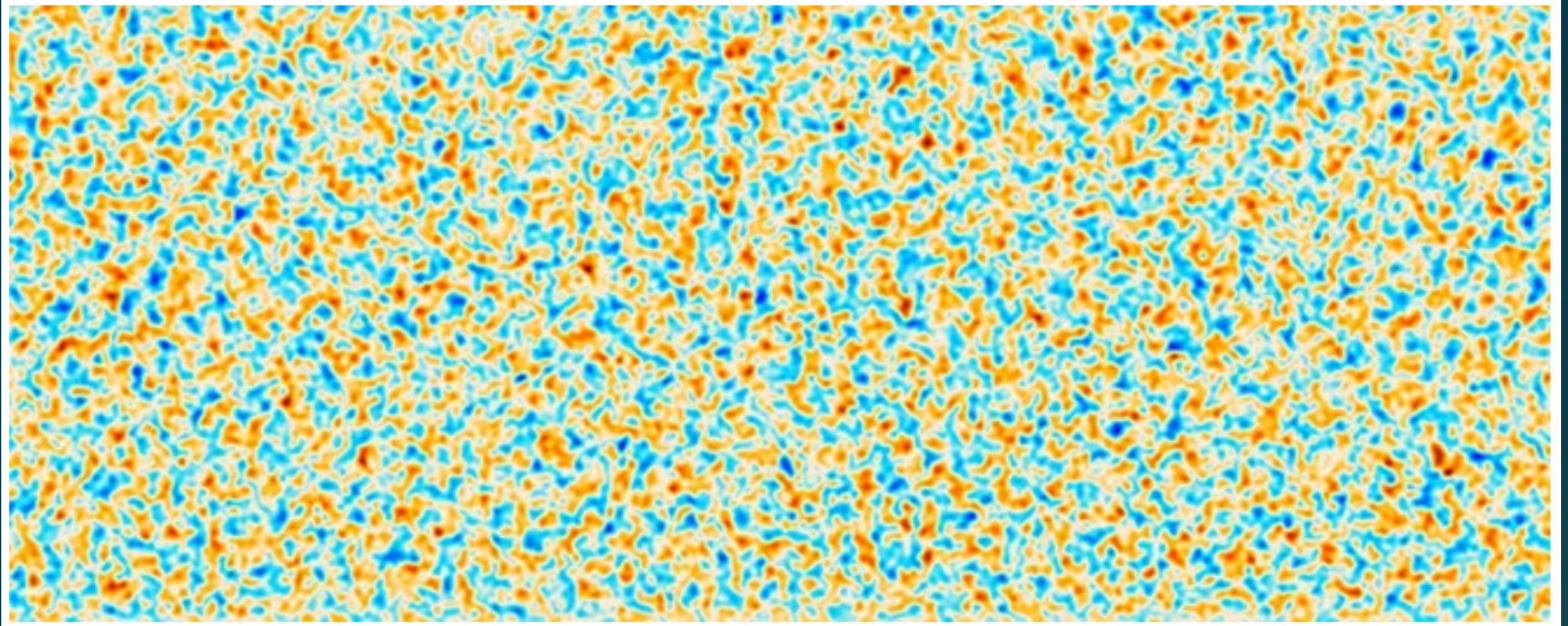
- ▶ CT showed severe dilatation of the lateral ventricles; MRI revealed massive enlargement of the lateral, third, and fourth ventricles, a very thin cortical mantle and a posterior fossa cyst.
- ▶ Diagnosed as a non-communicating hydrocephalus (flow of CSF is blocked along one or more of the narrow passages connecting the ventricles), with probable stenosis of Magendie's foramen
- ▶ The leg weakness improved partly after neuroendoscopic ventriculocisternostomy, but soon recurred;
- ▶ After a ventriculoperitoneal shunt was inserted, the findings on neurological examination became normal within a few weeks. The findings on neuropsychological testing and CT did not change.

1992: Herbert Weinstein: First PET scan used in criminal trial.



- Calm, cool, business man
- Came home
- Strangled his wife
- Threw her out of 12th story apt.
- No remorse
Do you cut him some slack in sentencing?

We do not have base rate of how many have this & how often they murder.



A portion of a new picture of the oldest light in the universe. The light, emitted 380,000 years after the Big Bang, varies in polarization (represented by redder or bluer colors). Astrophysicists used the spacing between these variations to calculate a new estimate for the universe's age.

How old is the universe? 13 Billion? No.

- ▶ New study was released challenging the long-held notion that our universe is nearly 13.8 billion years old. If the findings of this latest research prove accurate, the Big Bang may have taken place 26.7 billion years ago, making the actual age of the universe nearly twice as old as we thought.
- ▶ How the 'impossible early galaxy problem' undermined our understanding of the universe's age
- ▶ For years, astronomers and physicists have primarily calculated the age of the cosmos by measuring the time elapsed since the Big Bang and studying the oldest stars.
- ▶ What's referred to in the new study as the "impossible early galaxy problem" has long baffled scientists who struggle to reconcile why some galaxies thought to have come into existence long after the Big Bang appear to in fact be much older than the universe's estimated age.

Using the redshift of light

- ▶ Observed through NASA's James Webb Telescope, **galaxies and stars like the Methuselah appear to have a level of maturity and mass typically associated with billions of years of cosmic evolution.** It's a notable observation considering the **widely-held belief that they came to existence hundreds of millions of years after the Big Bang.**
- ▶ Calculating the time that has passed since the Big Bang is not the only method scientists have used to estimate the age of the universe.
- ▶ The **redshift of light — literally, light from distant galaxies stretched and shifted toward the red part of the spectrum** — is what has long helped to inform physicists' estimates of the universe's age. In simple terms, the thought has been that the **redshift indicated the distance of stars and galaxies, and hence, the faster they are moving away from Earth.**

Tired light theory

- ▶ By estimating the rate at which the stars are moving away, scientists can calculate how fast space is expanding into an infinitely-growing universe.
- ▶ But the so-called "tired light theory" that originated in 1929 with Swiss astronomer Fritz Zwicky offered an alternative explanation: Perhaps the redshift we see isn't due to galaxies moving away from us. Instead, Zwicky's hypothesis was that it might be because light loses its energy and shine after traveling a long distance.
- ▶ Proposes that if we allow Zwicky's theory to coexist with the idea of an expanding universe, we can reinterpret the redshift as a hybrid of both of these phenomena and thus arrive at an even more accurate age estimate of the universe. It would offer an explanation for the advanced level of development and mass observed in the previously puzzling early galaxies.

AI or not

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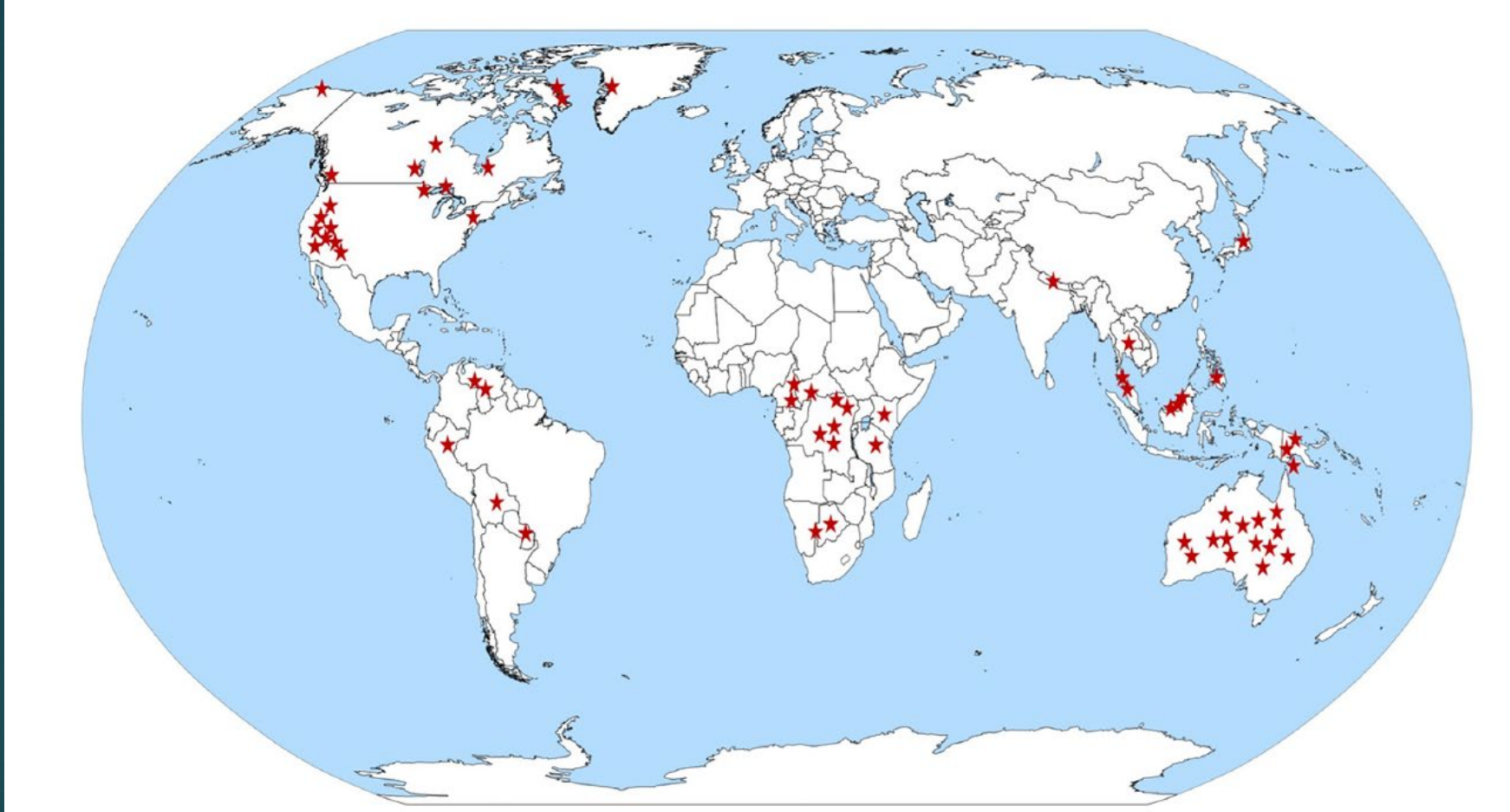
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The Myth of Man the Hunter: Women's contribution to the hunt across ethnographic contexts

- ▶ For decades anthropologists have witnessed **forager women**—those who live in societies that both hunt and gather—**around the world skillfully slay prey**:
 - ▶ In the 1980s, Agta women of the Philippines drew bows and arrows as tall as themselves and aimed at wild pigs and deer, **and**
 - ▶ Matsigenzas Amazonians struck pacarana rodents with machetes.
 - ▶ Observations from the 1990s described **Aka** great-grandmothers and girls as young as age 5 trapping duiker and porcupine in central Africa.
- ▶ A study has united these reports for a **first-of-its-kind global view of women hunters**. Reviewing **accounts by ethnographers**, as well as those by **observers** between the late 1800s and today, the researchers found that women hunted in nearly 80% of surveyed forager societies.

World map of the locations of 63 different foraging societies analyzed. Women hunted in all of them



Worldwide survey kills the myth of 'Man the Hunter'

- ▶ Analysis of data from dozens of foraging societies around the world shows that women hunt in at least 79% of these societies.
- ▶ A common belief holds that, among foraging populations, men have typically hunted animals while women gathered plant products for food.
- ▶ However, mounting archaeological evidence from across human history and prehistory is challenging this paradigm; for instance, women in many societies have been found buried alongside big-game hunting tools.
- ▶ Analyzed 391 foraging societies from the past 100 years and identified 63 foraging societies around the world, including societies in North and South America, Africa, Australia, Asia, and the Oceanic region. Women hunted in 50 of those 63 societies,

Women hunting

- ▶ Found that women hunt in 79% of the analyzed societies, regardless of their status as mothers.
- ▶ More than 70% of female hunting appears to be intentional—as opposed to opportunistic killing of animals encountered while performing other activities, and intentional hunting by women appears to target game of all sizes, most often large game.
- ▶ The analysis also revealed that women are actively involved in teaching hunting practices and that they often employ a greater variety of weapon choice and hunting strategies than men.

Women hunters

- ▶ These findings suggest that, in many foraging societies, women are skilled hunters and play an instrumental role in the practice, adding to the evidence opposing long-held perceptions about gender roles in foraging societies.
- ▶ The authors note that these stereotypes have influenced previous archaeological studies, with, for instance, some researchers reluctant to interpret objects buried with women as hunting tools.
- ▶ They call for reevaluation of such evidence and caution against misapplying the idea of men as hunters and women as gatherers in future research.

Woman the hunter

- ▶ The authors add, "Evidence from around the world shows that women participate in subsistence hunting in the majority of cultures."
- ▶ Individuals wielded various weapons including spears, machetes, knives, and crossbows. Some relied on hunting dogs, nets, or traps.
- ▶ Women followed tracks to big game and beat the ground with sticks to flush out critters.
- ▶ Childcare posed little problem: Mothers carried infants or left them at camp with other community members; older children often tagged along, hunting as well.

A more accurate paradigm of subsistence flexibility

- ▶ The team did discover **differences between male and female strategies**. For example, among the Agta, men almost always wielded bows and arrows, whereas some women preferred knives. Men were more likely to head out solo or in pairs, whereas women generally hunted in groups and with dogs.
- ▶ Despite gender differences, the team found little evidence for rigid rules. **If somebody liked to hunt, they could just hunt.**
- ▶ Evidence from the past one hundred years supports archaeological finds from the Holocene that women from a broad range of cultures intentionally hunt for subsistence. These results aim to shift the male-hunter female-gatherer paradigm to account for the significant role females have in hunting, thus dramatically shifting stereotypes of labor, as well as mobility.

Women hunting

- ▶ **Women's hunting style:**
 - ▶ 21 (46%) hunt small game,
 - ▶ 7 (15%) hunt medium game,
 - ▶ 15 (33%) hunt large game and
 - ▶ 2 (4%) of these societies hunt game of all sizes.
- ▶ In societies where women only hunted opportunistically, small game was hunted 100% of the time.
- ▶ In societies where women were hunting intentionally, all sizes of game were hunted, with large game pursued the most.
- ▶ Of the 36 foraging societies that had documentation of women purposefully hunting, **5 (13%) reported women hunting with dogs** and **18 (50%) of the societies included data on women (purposefully) hunting with children**

Women hunting

- ▶ Conclusion that women in foraging societies across the world participate in hunting during more recent time periods; women contribute disproportionately to the total caloric intake of many foraging groups
- ▶ Women in foraging societies across the world historically participated and continue to participate in hunting regardless of child-bearing status.
- ▶ The collected data on women hunting directly opposes the traditional paradigm that women exclusively gather and men exclusively hunt and further elucidates the diversity and flexibility of human subsistence cultures

5 Grindstones from 39 to 43 Ka: cereals into flour

- ▶ **Italian-led study of five ancient grindstones from around 39,000 to 43,000 years ago shows that milling for food dates back to the transitional period between Neanderthals and Homo sapiens.**
- ▶ Pushes back by several thousand years the earliest evidence of plant processing and flour production
- ▶ **One pestle from Riparo Bombrini, a N site in northern Italy**
- ▶ The **Neanderthal-to-Homo sapiens period** was characterized by the coexistence of the Late Mousterian (Neanderthal), Uluzzian and Protoaurignacian (*H. sapiens*) techno-complexes in the northwest and southwest of present-day Italy.
- ▶ **The grindstones come from two Paleolithic sites some 1,000 km apart on the Tyrrhenian Sea side of the peninsula: Riparo Bombrini, in the Balzi Rossi archaeological area of Liguria, and Grotta di Castelcivita, at the foot of the Alburni Massif, in Campania.**

Neandertals ground starches

- ▶ Starch granules with different morphologies were found on the surface of grindstones at both sites, testifying to the use of different plants, including wild cereals, by humans who inhabited the areas at that time.
- ▶ Evidence of similar grinding practices in both contexts underlines how certain technological knowledge and eating habits were widespread in both populations, perhaps as a legacy already present within the two different cultural traditions or perhaps as a result of actual contact between the two groups.

Neandertal Grindstones

- ▶ The grindstone from the Mousterian levels of the Riparo Bombrini constitutes the oldest European examples of the processing and transformation of plant products in Europe and shows Neanderthals engaged in this practice.
- ▶ The two pestles from the Protoaurignacian levels at the site show modern humans who occupied the site less than a millennium later also engaged in the same behavior.
- ▶ Transforming cereals into flour is an important innovation because it **allowed** Paleolithic foragers to store and transport food more easily.
- ▶ The recovery of starch grains associated with use-wear on Palaeolithic grinding tools offers proof of a specific technology for making flour among Pleistocene hunter-gatherers.

Grindstones

- ▶ Analyzed five grindstones from two Italian sites, Riparo Bombrini and Grotta di Castelcivita, both inhabited during a crucial phase spanning the decline of the Neanderthals and the establishment of Sapiens.
- ▶ The recovery of starch grains on a Mousterian grindstone at Bombrini suggests that the last Neanderthals not only consumed and processed plants but also made flour 43–41,000 years ago.
- ▶ Starch grains attributable to Triticeae on Protoaurignacian grindstones at both sites testify that Sapiens were processing wild cereals at least 41,500–36,500 years ago when they expanded into Eurasia, long before the dawn of agriculture. These new data suggest a profound knowledge of available plant resources in both human groups.

Flour production via grinding stones

- ▶ **Grinding** was of particular importance, offering new possibilities for the consumption of underground storage organs, fruits, and seeds. **Flour** is a high calorie food that can be used for varied carbohydrate-rich recipes such as gruel, biscuits etc.
- ▶ **Flour production calls for a multistep procedure**, from harvesting to cooking, to obtain a suitable, digestible, and high-energy food
- ▶ The earliest prior evidence comes from the Protoaurignacian site of Kostenki 14-Markina Gora layer III, Russia (38–36 ka). Evidence of the first Australian plant foods was recovered at Madjedbebe, 65-53 ka; with grinding stones.
- ▶ First direct evidence – starch grains in association with use-wear traces – of the use of this technology by Neanderthals

Technology or taphonomy? A study of the 2.04–1.95 Ma bone tools from Drimolen Main Quarry, South Africa

- ▶ Analysis of 124 rounded fossils, potential bone tools, from the 2.04–1.95 Ma early hominin-bearing Drimolen Main Quarry paleocave deposits in South Africa were subject to comparative analysis of fossil and bone collections with known taphonomic accumulator/s, actualistic experiments, and comparative analysis relative to published data in the taphonomic literature.
- ▶ From this sample, **51 specimens were identified as bone tools**. The inclusion of these specimens **raises the number of bone tools identified at Drimolen Main Quarry to 65**. The bone tools have a rounded tip and an associated use-wear pattern that is restricted to, and radiates from, this rounded tip. Diaphyseal (long bone shaft) fragments were the most common raw material selected for tool use.

- ▶ Suggests that the tools may have had a multi-use application.
- ▶ **Drimolen Main Quarry species: *Paranthropus robustus***, isolated teeth of early *Homo* and a partial skull of the earliest specimen of *Homo erectus*
- ▶ **Six stone tools that are consistent with southern African Mode 1 technology and 14 previously published bone tools**
- ▶ In total, 108 bone tools have been published from the palaeocave sites of Swartkrans, DMQ, Kromdraai, Coopers D and Sterkfontein. These include 84 bone tools from Swartkrans

After the emergence of the Acheulean at Melka Kunture (Upper Awash, Ethiopia): From Gombore IB (1.6 Ma) to Gombore Iγ (1.4 Ma), Gombore Iδ (1.3 Ma) & Gombore II (1.2 Ma)

- ▶ While the **emergence of the Acheulean is well documented in East Africa at ~1.7 Ma**, subsequent developments are less well understood and to some extent controversial.
- ▶ Here, we **provide robust evidence regarding the time period between 1.6 Ma and 1.2 Ma**, based on an interdisciplinary approach to the stratigraphic sequences exposed in the Gombore gully of **Melka Kunture, in the upper Awash Valley of Ethiopia**. Throughout the Pleistocene, the environment differed significantly from elsewhere in Africa because of the elevation at 2000 m, the cooler and rainy climate, the Afromontane vegetation, the development of endemic animal species, and the recurrent impact of volcanic activity. **At Gombore IB, dated ~1.6 Ma, remains of *Homo erectus/ergaster* have been discovered, associated with a rich early Acheulean assemblage.**

Acheulean lithics

- ▶ The Acheulean is the most long-lived technological tradition in Prehistory and is the one with the widest geographical distribution. It is recorded all over Africa, the Middle East, India, parts of South-Eastern Asia and Western Europe. As a proxy of hominin distribution, it accompanied hominins capacity to cope with extremely variable ecosystems and environments

Acheulean lithics at Tarragona, Spain

- ▶ Since the oldest known Acheulean lithic techno-typological features in Europe were reported at the site of Barranc de la Boella (Tarragona, Spain), 0.99–0.78 Ma.
- ▶ As a result, excavations in two of the **three openair localities** have significantly expanded the collection of lithic and faunal remains,
- ▶ A **extraordinary mammoth butchery site** recorded at the Pit 1 locality.
- ▶ The aim of this paper is to present a comprehensive update of the collection of large shaped tools and to assess its significance in the framework of the earliest occurrence of the Acheulean in Europe

Tarragona

- ▶ Large shaped tools appear in the three localities explored in the Unit II of Barranc de la Boella, including choppers (unifacial and bifacial) and standard Acheulean forms, such as picks, knives, and cleaver-like forms.
- ▶ Techno-typological and morphometrical analyses revealed a basic heavy-duty component obtained through simple shaping sequences coupled with significantly more elaborate tools produced on various large blanks (cobbles, slabs, or flakes).

Tarragona as a first Early Acheulean dispersion OoA

- ▶ Hence, the archaeological data from Barranc de la Boella provide insights into the first appearance of the Acheulean technology in Europe
- ▶ The results of this study revealed a technological assemblage unique in the known late Early Pleistocene archeological record from Europe, different from the rest of ancient Acheulean sites in this continent, which are dated at the Middle Pleistocene.
- ▶ This lends support to the hypothesis that Barranc de la Boella may represent a previously unrecognized Early Acheulean dispersion out of Africa connected to its first evidence at the gates of Eurasia, potentially moving over the northern Mediterranean coastal road to reach Western Europe.

The Western European Acheulean

- ▶ In the context of the *Western European Acheulean Project*, this study aims to characterize Acheulean technology in Western Europe through the analysis of handaxes and cleavers from 10 key sites (Britain 4, France 4, and Spain 2) to acquire a regional view of the occupation.
- ▶ Our findings indicate the existence of two main technological groups in the sampled record:
 - ▶ 1) northwestern and central France and Britain, from MIS 17/16 to MIS 11, and
 - ▶ 2) Atlantic edge (Atapuerca in Spain and Menez-Dregan in France), from MIS 12/11 to MIS 8.

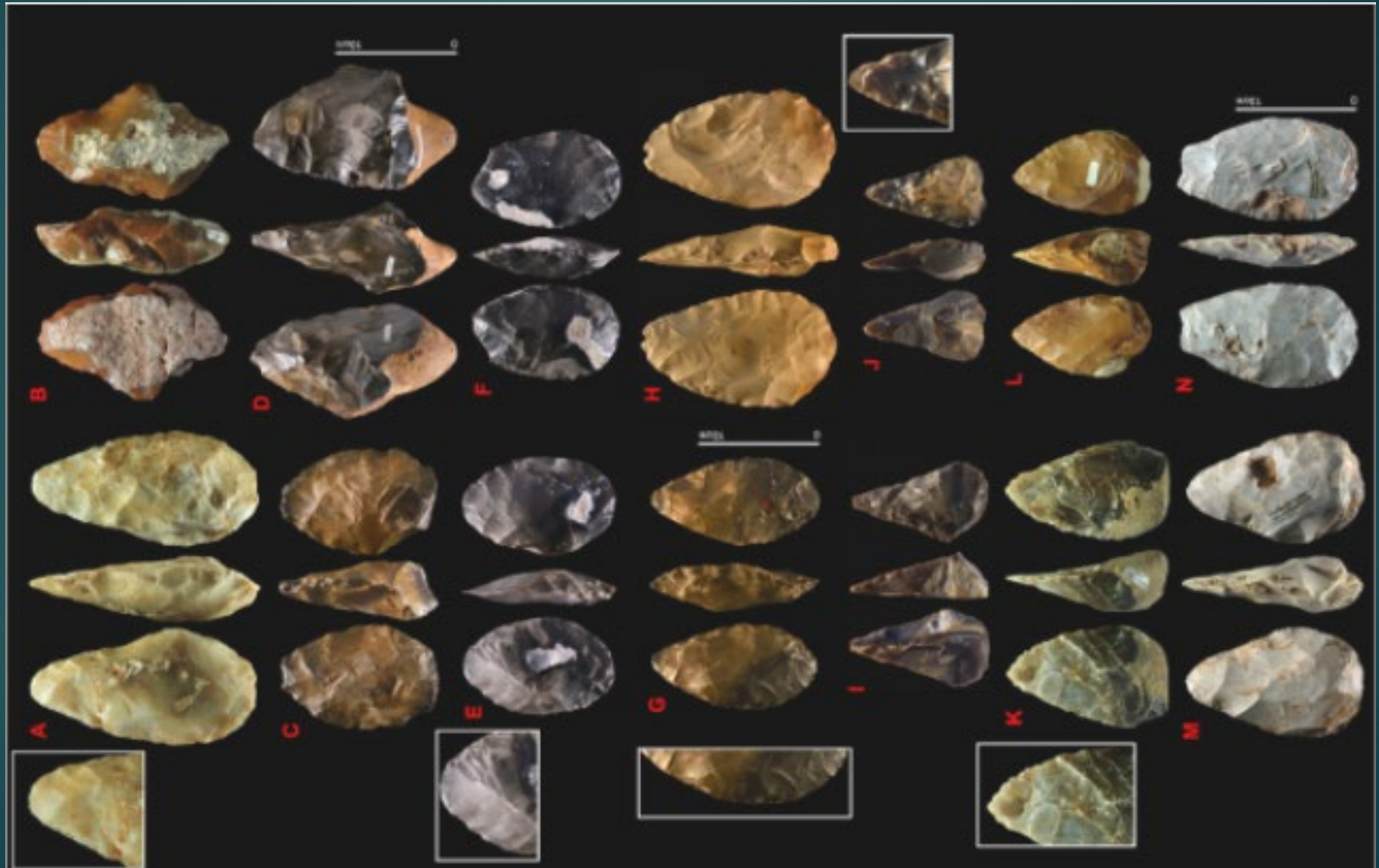
The Western European Acheulean

- ▶ Based on our technological analysis, the **shaping of handaxes and cleavers was developed through time as a continuum of accumulative actions, with longer and more complex shaping strategies over time.**
- ▶ Shaping technology shows traditions of manufacture over both time and geographical areas, which suggest cultural diffusion.

European Acheulean sites

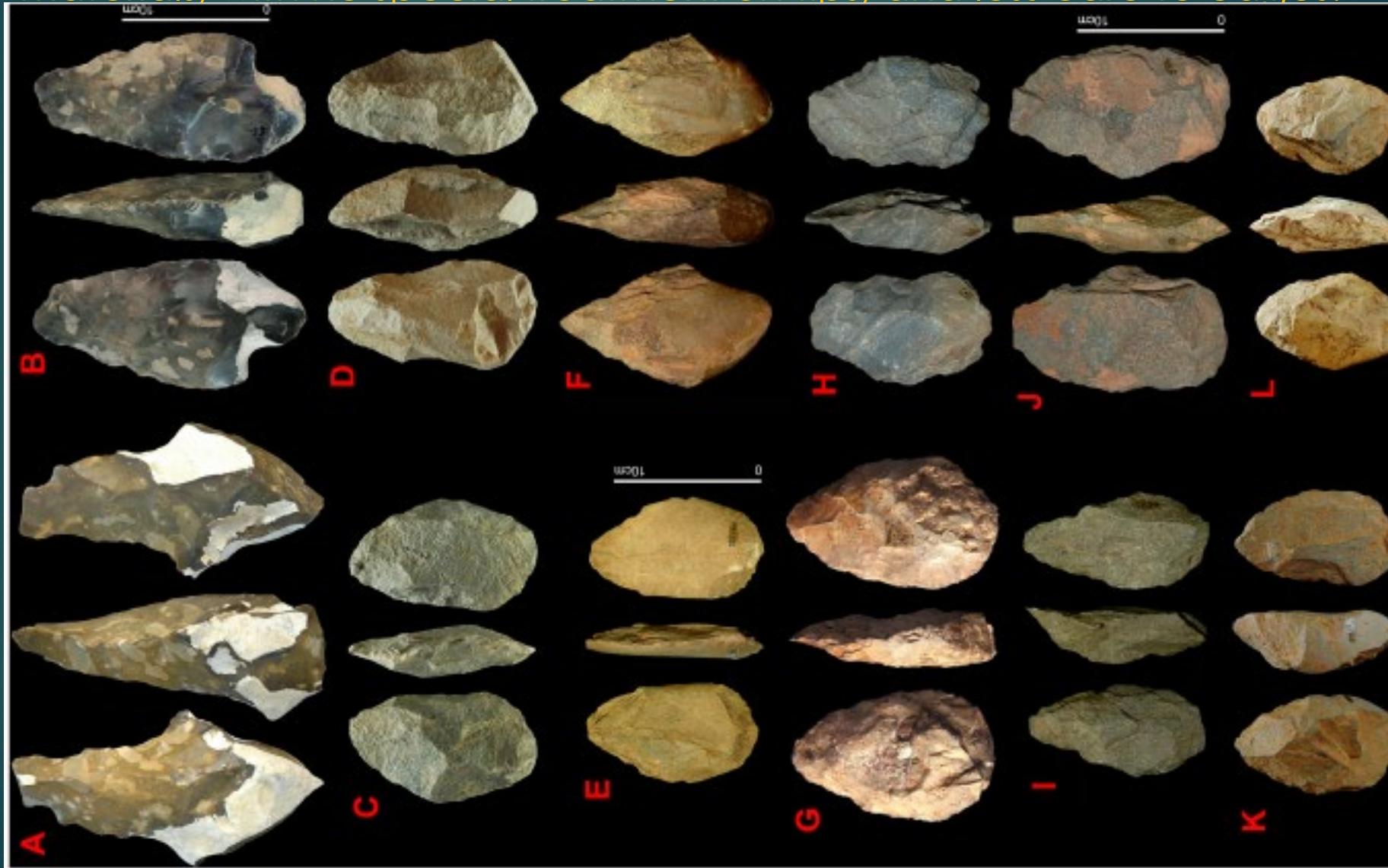


Group 1 Handaxes. A, B) la Noira stratum a (MIS 17e16); C, D) Brandon Fields (MIS 16e15); E, F) Boxgrove (MIS 13); G, H) Elveden (MIS 11c); I, J) Swanscombe-UMG (MIS 11c); K, L) la Noira stratum c (MIS 12); M, N) Saint-Pierre-les-Elbeuf (MIS 11). They show specific tip-shaping techniques, tranchet removals, and care to edges.

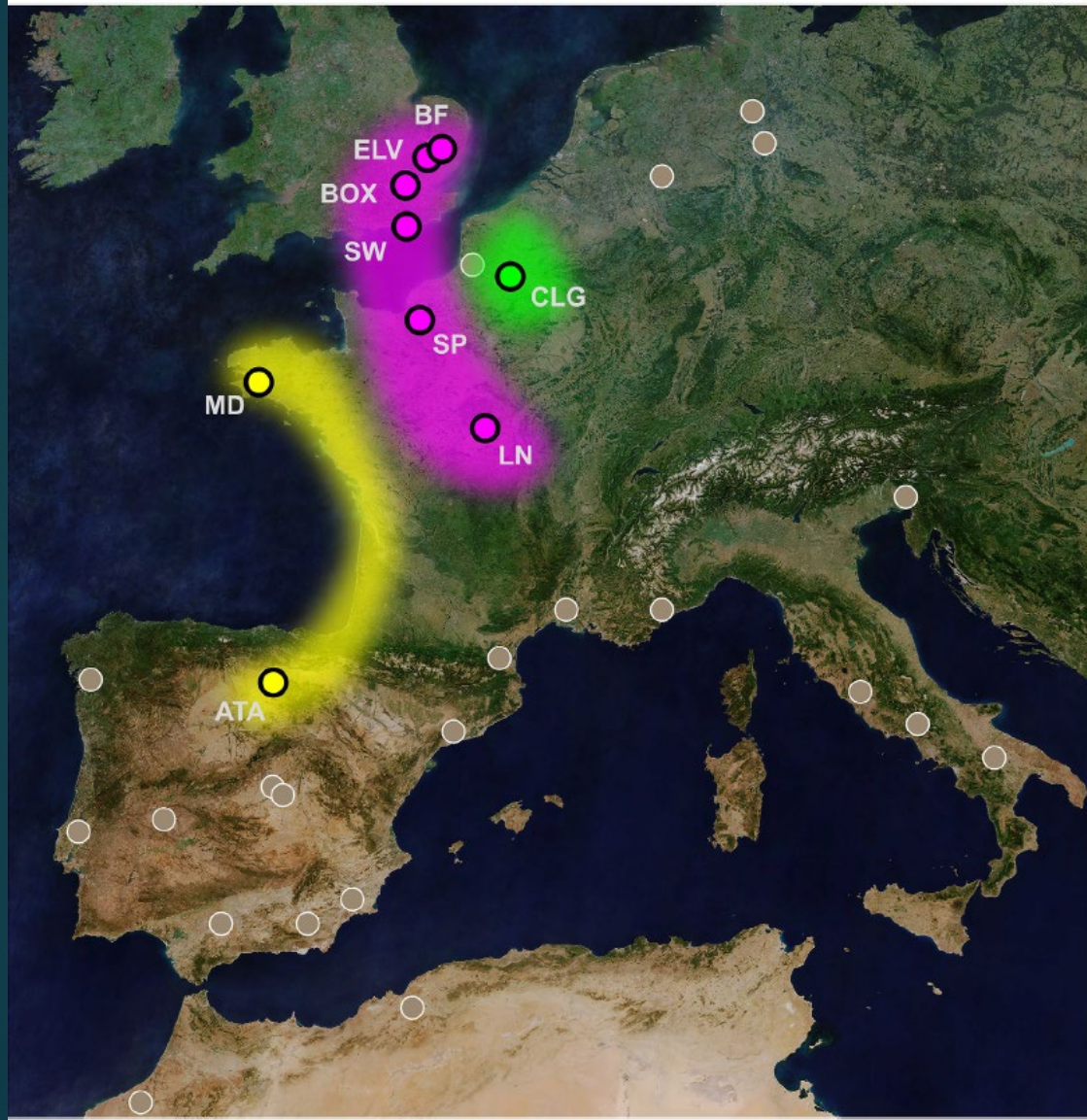


Handaxes from Group 2 and Group 3 sites. A, B) Cagny-la-Garenne I; C, D) Menez-Dregan; E, F) Galería-GIIa; G, H) GIIb; I) GIIa; J) GIIb; K, L) Gran Dolina-TD10.1.

Compared to Group 1, handaxes from Groups 2 and 3 have shorter shaping sequences on a larger variety of raw materials, with no special treatment on tips, and less care to edges.



European Acheulean lithic traditions



Map with the location of the sites included in this paper, in the context of other Acheulean sites in Western Europe.

The coloring of areas corresponds to Group 1 (pink), Group 2 (yellow), and Group 3 (green). Abbreviations: LN, La Noira; BF, Brandon Fields; BOX, Boxgrove; ELV, Elveden; SW, Swanscombe; SP, Saint Pierre-les-Elbeuf; CLG, Cagny-la-Garenne; MD, Menez-Dregan; ATA, Atapuerca.

Western Acheulean

- ▶ The appearance of developed handaxe technology in stratum a of la Noira suggests innovation through cultural diffusion,
- ▶ In France and Britain from MIS 17/16 to 11 (712 to 424 Ka), there is little evidence of sudden innovation in handaxe technology, but rather a steady progression of incremental steps and improvements in technique, producing greater control over tool design. Oval shapes clearly predominate in the record until MIS 13.
- ▶ From MIS 11, there seems to be more intense occupation across the continent, which corresponds with local adaptations. The apparent technological continuity implies that some populations survived on the fringes of the region despite the cold climate of MIS 16 and 12. In contrast, along the Atlantic edge of Europe (from MIS 11 to 8), there is the use of a diverse range of raw materials, where a simpler Acheulean technology developed.

Regional patterns

- ▶ There is a loss of definition in tool shape, generating more oval and wider forms, and with cleavers playing a significant role.
- ▶ These different regional developments appear to be due to traditions of manufacture through knowledge transfer and continuity in population, rather than simply responses to differences in raw materials.

The Neandertal nature of the Atapuerca Sima de los Huesos mandibles

- ▶ The recovery of additional mandibular fossils from the Atapuerca Sima de los Huesos (SH) site provides new insights into the evolutionary significance of this sample.
- ▶ The new and more complete specimens extend the known range of variation in the Atapuerca (SH) mandibles
- ▶ Pairwise comparisons of individual metric variables revealed the only significant difference between the Atapuerca (SH) hominins and Neandertals was a more vertical symphysis (jaw midline) in the latter.

SH and N mandibular differences

- ▶ Similarly, principal components analysis of size-adjusted variables showed a strong similarity between the Atapuerca (SH) hominins and Neandertals.
- ▶ Morphologically, the Atapuerca (SH) mandibles show nearly the full complement of Neandertal-derived features.
- ▶ Nevertheless, the Neandertals differ from the Atapuerca (SH) mandibles in showing a high frequency of the H/O mandibular foramen, a truncated, thinned and inverted gonial margin, a high placement of the mylohyoid line at the level of the M3, a more vertical symphysis and somewhat more pronounced expression of the chin structures

SH hominins

- ▶ Size-related morphological variation in the SH hominins includes larger retromolar spaces, more posterior placement of the lateral corpus structures, and stronger markings associated with the muscles of mastication in larger specimens.
- ▶ However, phylogenetically relevant features in the SH sample are fairly stable and do not vary with the overall size of the mandible.
- ▶ Direct comparison of the enlarged mandibular sample from Atapuerca (SH) with the Mauer mandible, the type specimen of *H. heidelbergensis*, reveals important differences from the SH hominins, and there is no morphological counterpart of Mauer within the SH sample, suggesting the SH fossils should not be assigned to this taxon.

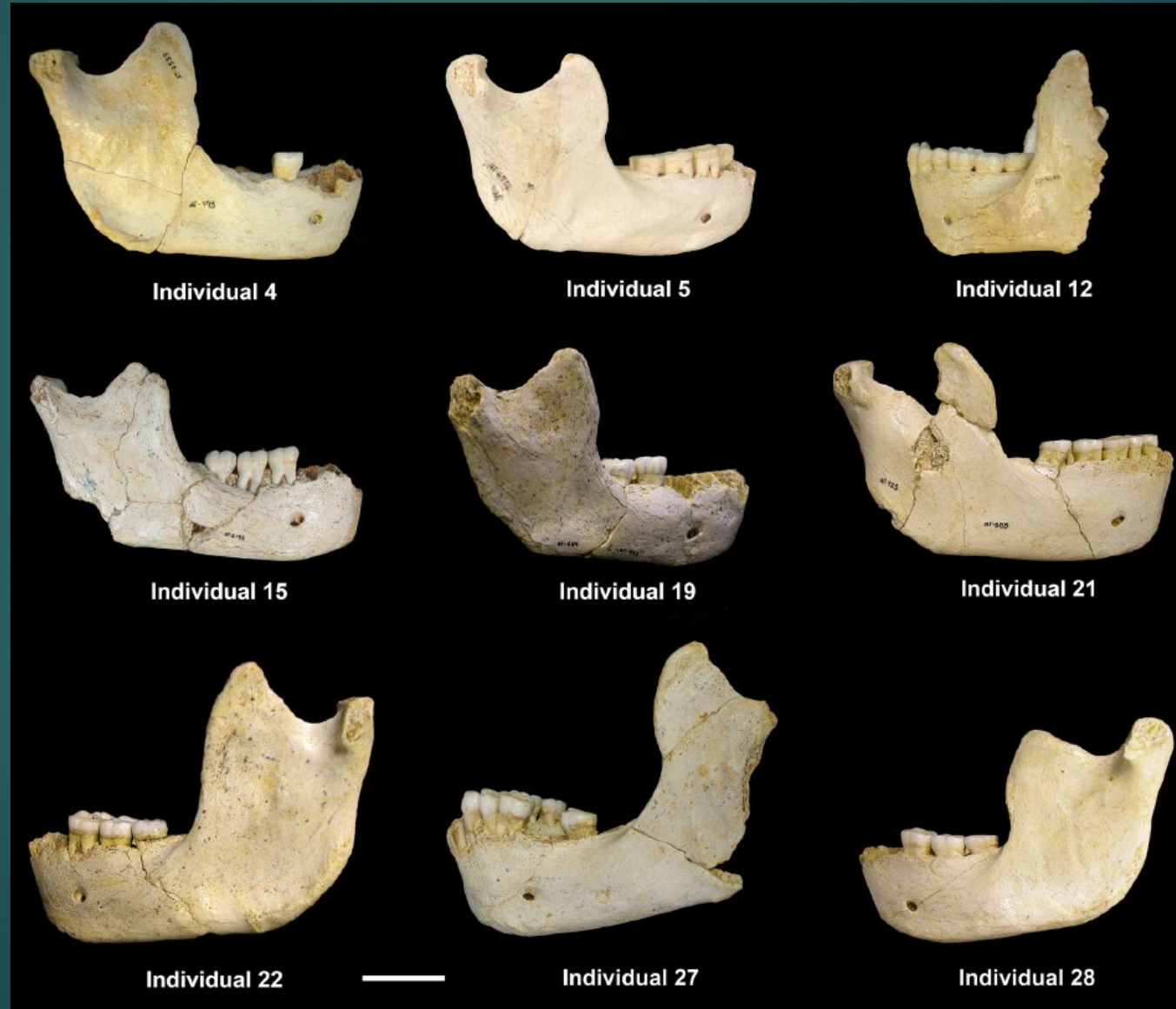
SH = derived N features

- ▶ The Atapuerca (SH) mandibles show a greater number of derived Neandertal features, particularly those related to midfacial prognathism and in the configuration of the superior ramus, than other European middle Pleistocene specimens.
- ▶ This suggests that more than one evolutionary lineage co-existed in the middle Pleistocene, and, broadly speaking, it appears possible to separate the European middle Pleistocene mandibular remains into two distinct groupings.
 - ▶ One group shows a suite of derived Neandertal features and includes specimens from the sites of Atapuerca (SH), Payre, l'Aubesier and Ehringsdorf.
 - ▶ The other group includes specimens that generally lack derived Neandertal features and includes the mandibles from the sites of Mauer, Mala Balanica, Montmaurin and (probably) Visogliano.

SH = within N clade

- ▶ Outside of the SH sample, derived Neandertal features in the mandible only become more common during the second half of the middle Pleistocene.
- ▶ The origin of the Neandertal clade may be tied to a speciation event reflected in the appearance of a suite of derived Neandertal features in the face, dentition and mandible, all of which are present in the Atapuerca (SH) hominins.

The more complete adult SH mandibles in lateral view.
Scale bar = 3 cm.



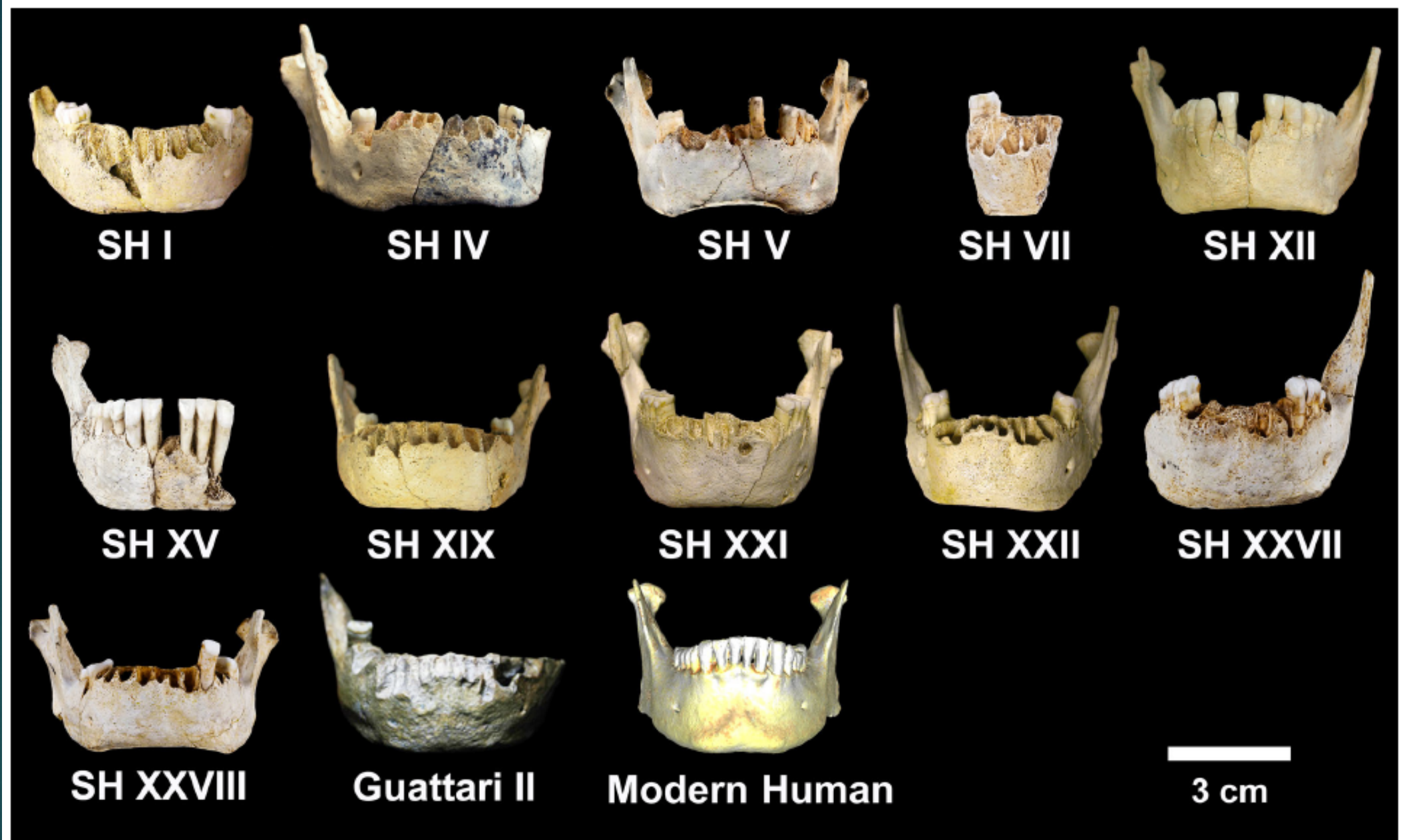


FIGURE 16 Symphyseal morphology in the adult SH mandibles compared with the Neandertal mandible Guattari II and a recent *H. sapiens* individual. *Source:* Image Credit: Javier Trueba, Madrid Scientific Films.

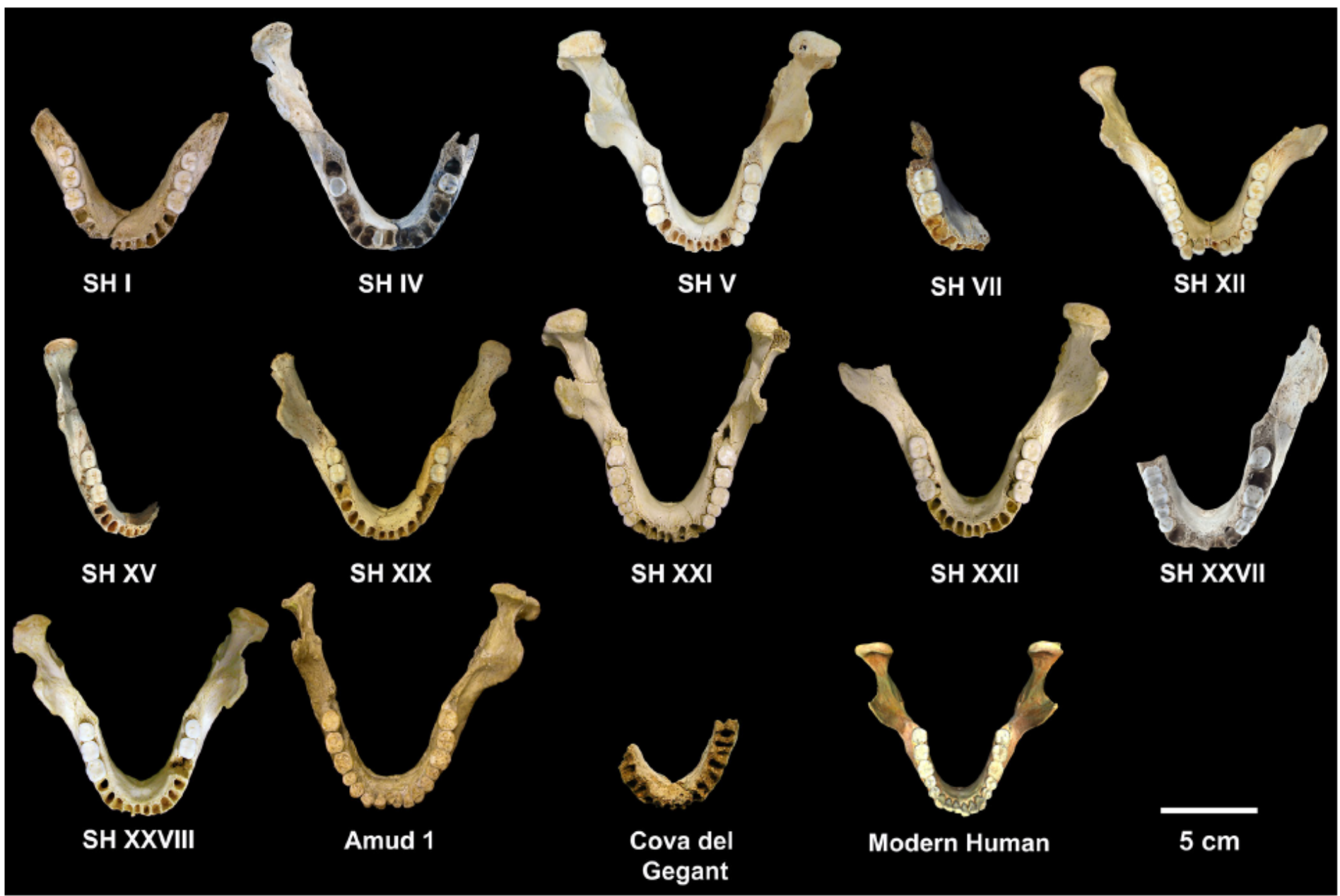


FIGURE 17 Superior view of the adult SH mandibles compared with the Amud 1 and Cova del Gegant Neandertals and a *H. sapiens* mandible. Source: Image Credit: Javier Trueba, Madrid Scientific Films.

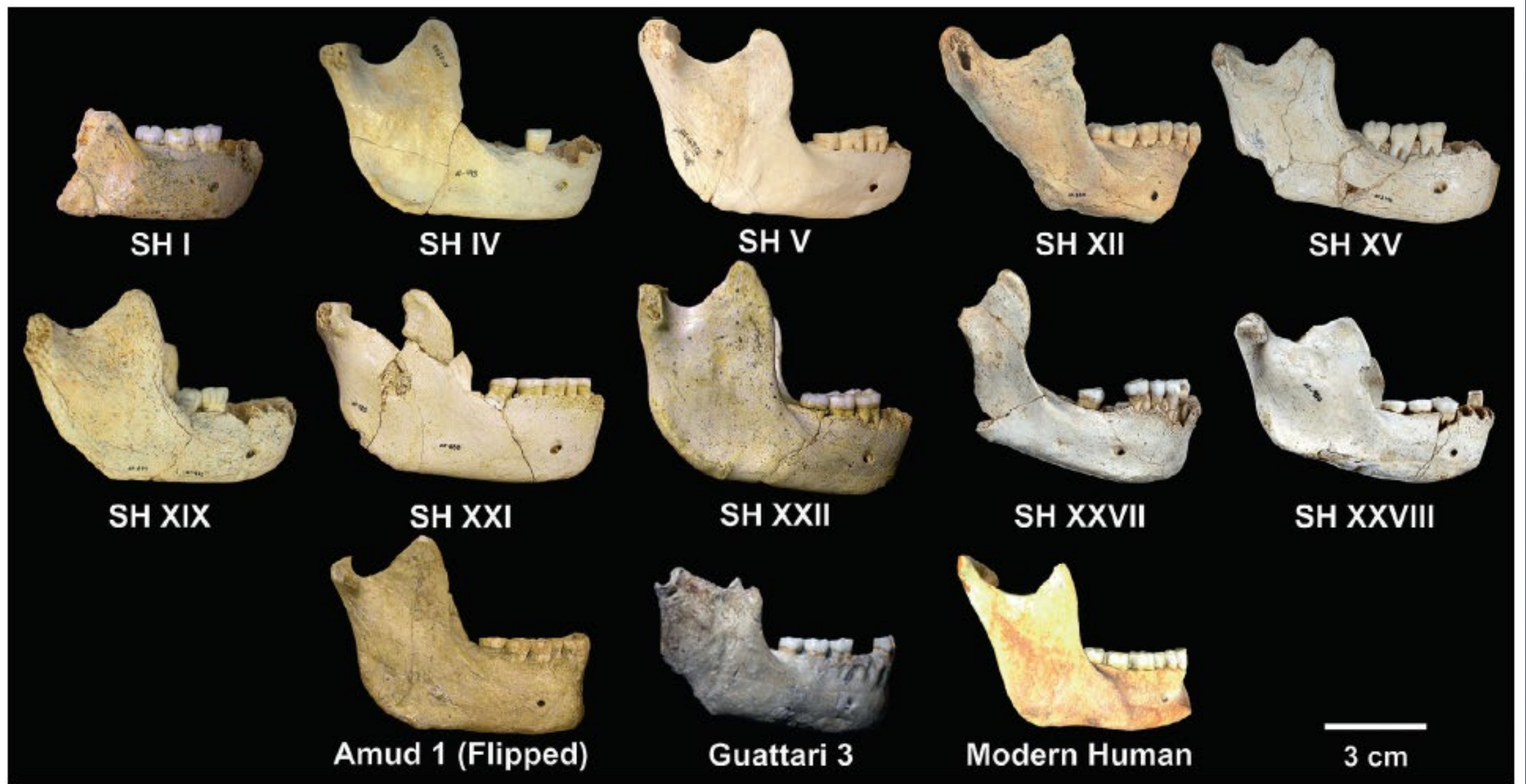


FIGURE 18 Morphology of the ramus and retromolar space in the adult SH individuals compared with the Amud 1 and Guattari 3 Neandertals and a *H. sapiens* individual. *Source:* Image Credit: Javier Trueba, Madrid Scientific Films.

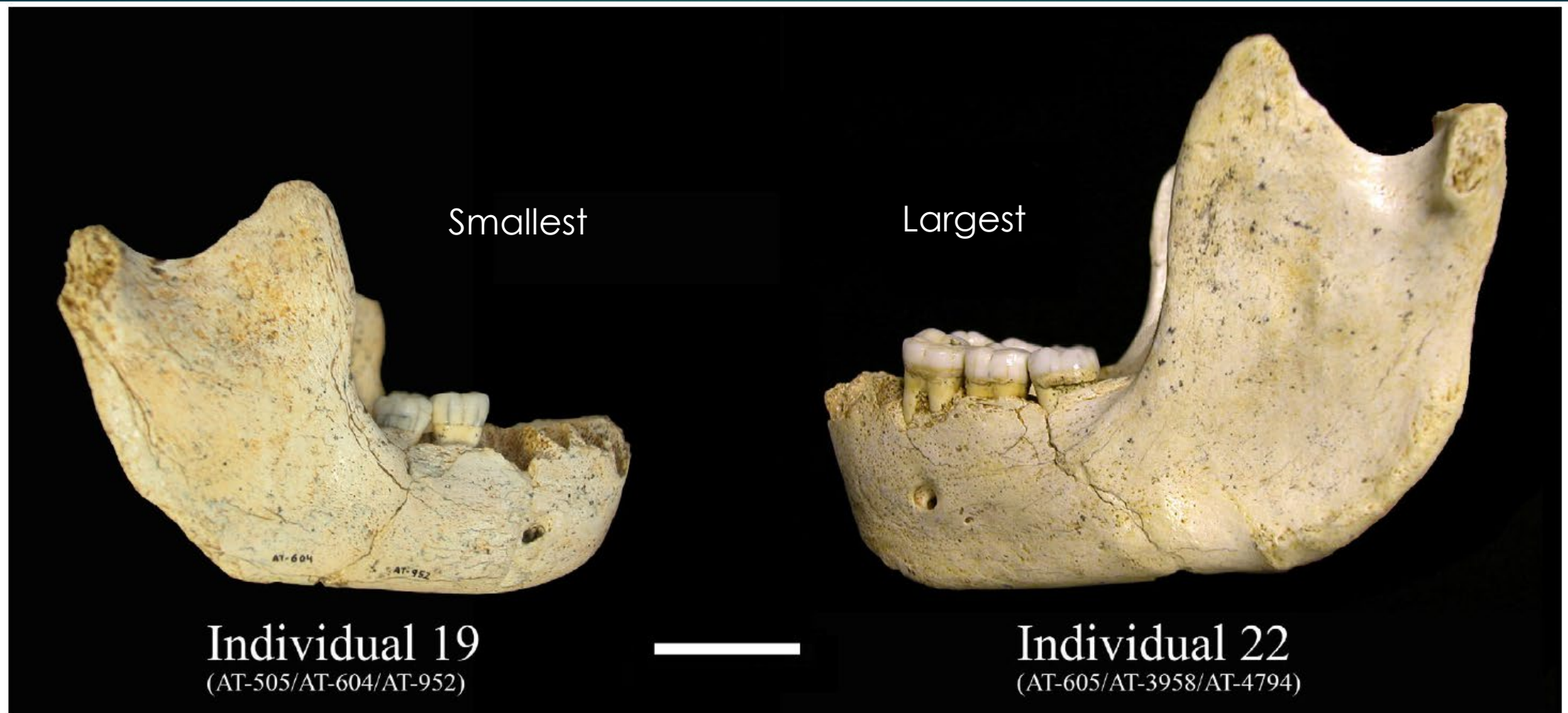


FIGURE 22 Comparison of the smallest (Individual 19) and largest (Individual 22) SH adult mandibles. The retromolar space is large in SH Individual 22, but the anatomical details of the ramus are similar between the two, suggesting a degree of morphological stability within the SH sample. Scale bar = 3 cm. *Source:* Image Credit: Javier Trueba, Madrid Scientific Films.

Mauer vs SH 28

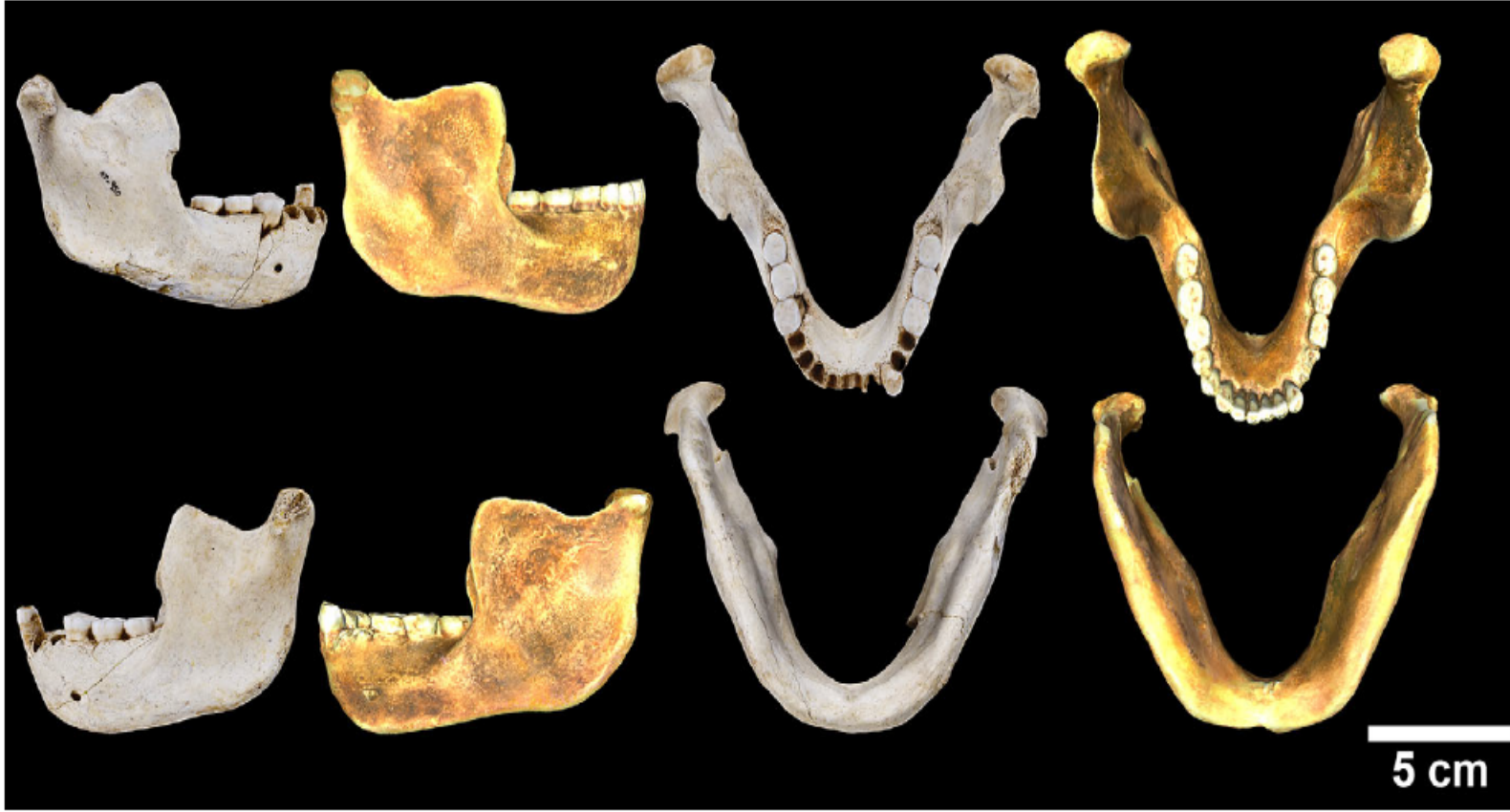


FIGURE 23 Comparison of Mauer (brown) and SH Individual 28 (light tan). While some superficial similarities are evident, clear differences can be seen in the presence of a retromolar space, medial insertion of the sigmoid notch at the condyle, pronounced medial pterygoid insertions and less pronounced gonial truncation in SH Individual 28. *Source:* Image Credit: Javier Trueba, Madrid Scientific Films.

Are the SH hominins *H. heidelbergensis*?

- ▶ The Atapuerca (SH) hominins have previously been included in this taxon, mainly as a “chronospecies” with *H. neanderthalensis*.
- ▶ However, the type specimen of *H. heidelbergensis*, the Mauer mandible, lacks associated cranial remains, and this makes assigning crania to this taxon problematic.
- ▶ Thus, the only direct comparison that can be made between the Atapuerca SH hominins and Mauer is that based on the mandibular anatomy. The clear anatomical differences from Mauer suggest that the SH hominins should not be lumped in with this specimen in the same taxonomic category.
- ▶ Perhaps most importantly, the Mauer mandible does not show the lowered condyle considered characteristic of Neandertals and the SH hominins.

Are the SH hominins *H. neanderthalensis*?

- ▶ The type specimen of the N taxon (Feldhofer) does not preserve a mandible.
- ▶ Nevertheless, the mandibular evidence presented here has revealed a very close similarity between the Atapuerca SH sample and Neandertals.
- ▶ The main differences seem to be the lack of a few derived Neandertal features in the SH hominins, including a high prevalence of the H/O mandibular foramen, a thinned, truncated and inverted gonial margin, a high placement of the mylohyoid line at the level of the M3, multiple mental foramina, a more vertical symphysis and somewhat more pronounced development of chin structures. Thus, the Atapuerca SH mandibles exhibit most but not all the derived Neandertal features.

Are the SH hominins *H. neanderthalensis*?

50

- ▶ Neandertal-derived craniodental features are also present in the face, dentition and glenoid fossa in the SH hominins, and they can be considered fully Neandertal in these anatomical regions.
- ▶ Other aspects of the cranial remains, however, are clearly not Neandertal-like or show at most an incipient development of Neandertal features.

SH features

- ▶ The SH cranial remains differ from Neandertals in the reduced size of the postcanine dentition, the high and rounded cranial profile, large and projecting mastoid processes, the digastric groove morphology, incipient suprainiac fossa and lack of a bilaterally projecting occipital torus.
- ▶ In the inner ear, the bony labyrinth shows a Neandertal-derived pattern of semicircular canal proportions but lacks the low placement of the posterior canal while the cochlea in the SH hominins differs from Neandertals in its smaller volume and in the proportional lengths of the cochlear turns.
- ▶ The SH postcranial skeleton, then, shows some differences from the Neandertals.

SH genetics

- ▶ mtDNA evidence showed the *Atapuerca* SH hominins were most closely aligned with the Denisovans, while nuclear DNA evidence suggested a sister group relationship with the Neandertals.
- ▶ Thus, the combined anatomical and genetic evidence suggests the *Atapuerca* SH hominins share a close evolutionary relationship with, but remain distinct from, the Neandertals

SH conclusions

- ▶ However, phylogenetically relevant features in the SH sample are fairly stable and do not vary with the overall size of the mandible.
- ▶ The dating of the site to c. 430 kya indicates that midfacial prognathism, a suite of derived Neandertal features in the ascending ramus and corpus of the mandible, the expansion of the anterior dentition, the bulging, rhomboidal crown outline of the M1 and a flat articular eminence in the glenoid fossa were already present at a very early stage of the Neandertal evolutionary lineage.
- ▶ This is consistent with the idea that the derived Neandertal features appeared first in the splanchnocranium and only later in the neurocranium.
- ▶ These features seem to be largely absent in the earlier material from the Sima del Elefante (TE) and Gran Dolina (TD) sites, also in the Sierra de Atapuerca. The appearance of a suite of derived Neandertal features in the face, dentition and mandible, all of which are present in the Atapuerca (SH) hominins, reflects a speciation event at the origin of the Neandertal clade.

Descriptive catalog of *Homo naledi* dental remains from the 2013 to 2015 excavations of the Dinaledi Chamber, site U.W. 101

- ▶ More than 150 hominin teeth, dated to ~330–241 thousand years ago, were recovered during the 2013–2015 excavations of the Dinaledi Chamber of the Rising Star cave system, South Africa.
- ▶ These fossils comprise the first large single-site sample of hominin teeth from the Middle Pleistocene of Africa. Includes infants to older adults. Though scattered remains attributable to *Homo sapiens*, or their possible lineal ancestors, are known from older and younger sites across the continent, the distinctive morphological feature set of the Dinaledi teeth supports the recognition of a novel hominin species, *Homo naledi*. Here, a catalog, anatomical descriptions, and details of preservation and taphonomic alteration are provided for the Dinaledi teeth.

Organic geochemical evidence of human-controlled fires at Acheulean site of Valdocarros II (Spain, 245 Ka)

- ▶ Among the outstanding questions about the emergence of human-controlled fire is the systematic recurrence between the geochemical remains of fire and its preservation in the archaeological record, as the use of fire is considered a technological landmark, especially for its importance in food cooking, defensive strategies, and heating.
- ▶ Here we report fossil lipid biomarkers associated with incomplete combustion of organic matter at the Valdocarros II site, one of the largest European Acheulean sites in Spain dated to marine isotopic stage (MIS) 8/7 (~ 245 kya) allowing a multiproxy analysis of human controlled fire use. Our results reveal isolated cases of highly concentrated and diverse polycyclic aromatic hydrocarbons (PAHs) and alkylated PAHs (APAHs), along with diagnostic conifer-derived triterpenoids in two hearth-like archaeological structures.

Fire use

- ▶ The presence of combustion byproducts suggests the presence of anthropogenic (controlled) fires at Valdocarros—one of the oldest evidence of fire use in Europe—in association with Acheulean tools and bones.
- ▶ Hominins possibly used fire for two main activities, as a means of defense against predators and cooking. Suggest that human ancestors were able to control fire before at least 250 kya
- ▶ Past records of fire within human evolution:
 - ▶ The oldest evidence that relates hominins with fires was discovered in Africa with an estimated age of 1.5 Ma in the Swartkrans cave, South Africa, where 270 burnt bones were registered.
 - ▶ In GnJi 1/6 in Chesowanja 1.42 Ma, thermo-altered clays were identified, and at FxJj 20 Main in Koobi Fora (ca. 1.6 Ma) in Kenya, which contains oxidized sediments.

Fire use

- ▶ Yet, the **controlled use of fire at these locations has been widely doubted**. Recently, **at FxJj 20 AB in Koobi Fooru, Kenya, (ca. 1.5 Ma)**, a study reported evidence of thermally altered lithics, sediments, and bone fragments using FTIR analyses. **Another problematic site is 8E Gadeb (1.45–0.7 Ma) in Ethiopia**, where stones with signs of heat alterations were registered.
- ▶ Later, **~1 Ma, at Wonderwerk cave (South Africa)** evidence of fire is indicated by the presence of ashed plant remains, and burnt bones associated with Acheulean tools.
- ▶ **Outside of Africa, the earliest clear evidence of anthropogenic fires has been recorded in the Near East**. In Israel, at the open-air Acheulean site of **Gesher Benot Ya'akov (790 ka)** charred plants and thermally altered lithics were recorded in several levels.

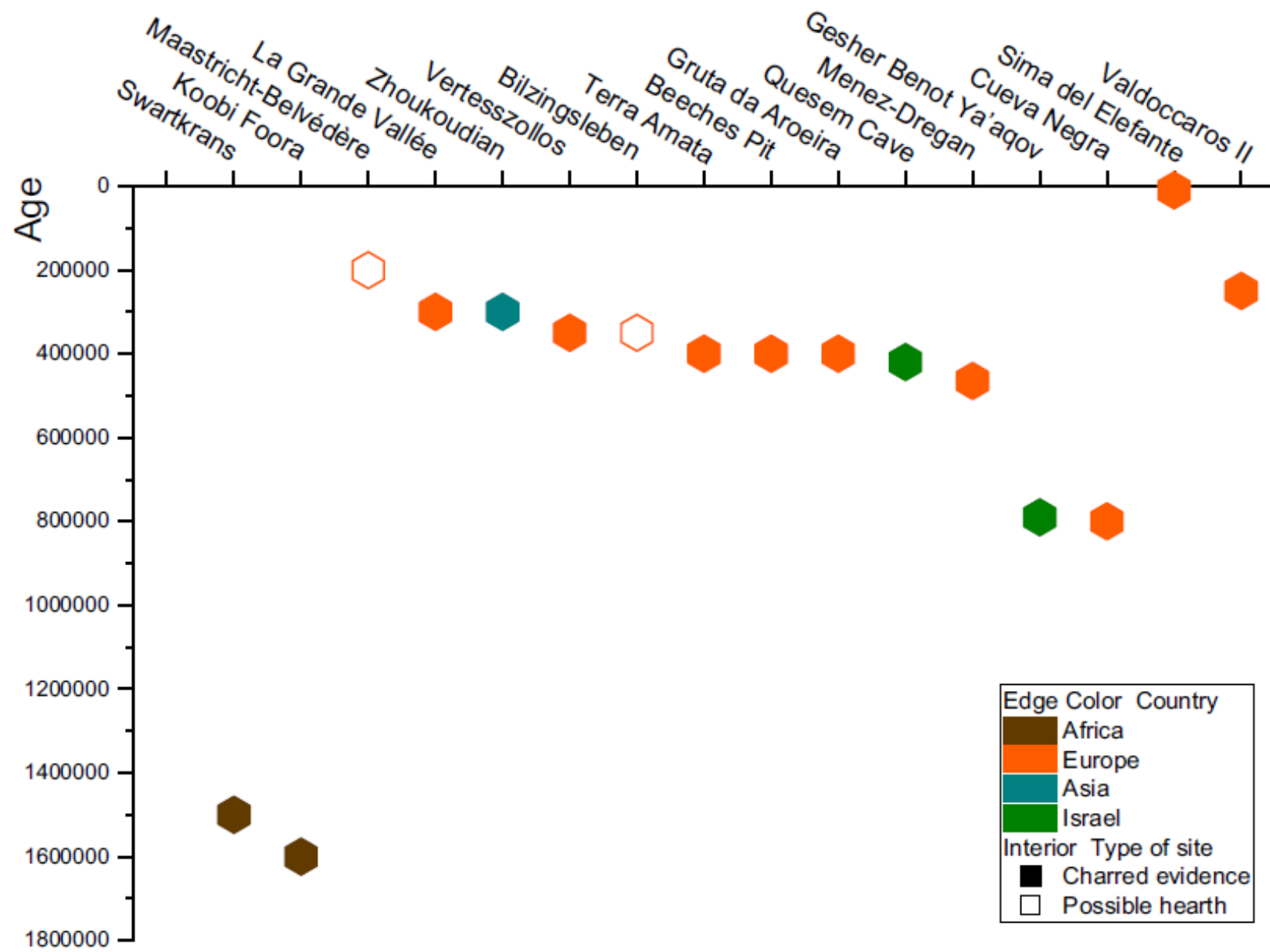


Figure 1. Timeline showing some of the most informative fire sites from Europe to Asia. The color-coding shows approximate the continent/country and the time extent of the archeological site.

Fire Use in Israel and Europe

- ▶ At Qesem Cave, which dated to 420–200 ka, wood ash was identified deriving from a fireplace associated with burnt bones and burnt lithics, and in Tabun Cave dated to 357–324 ka were recorded numerous burnt flints.
- ▶ In Europe, between MIS 13 and MIS 9, it is widely accepted that fire was continuously used, and some authors link the control of fire with the expansion of Acheulean technology in Europe, ca. 500–600 ka.
- ▶ Several sites with different evidence have been described: Vertesszollos (Hungary) close to 350 ka possible hearths and burnt bones; Menez-Dregan 1 (France) with fireplaces associated with charcoals and burnt tools (around 465 and 380 ka); La Grande Vallee (France) with burnt chert; Terra Amata (France) charcoal and burnt material; Bilzingsleben (Germany) dated between 350–320 ka and 414–280 ka, with accumulations of burnt remains forming semi-circular areas; and Schoningen (Germany) with possible hearths, burned sediments and wood; Beeches Pit (England) dated to MIS 11 with burnt flints, bones and thermally altered sediments, and Gruta da Aroeira (Portugal), dated to ca. 400 ka, with by-products of burning

Fire Use in open air and cave settings

- ▶ From about MIS 9, **extensive evidence of fire-use has been described in open air and cave settings**. In east Asia at Zhoukoudian, level 4 dated 292–312 ka contains some evidence for in situ use of fire; **Maastricht-Belvedere (The Netherlands)**, dated to 250 ka and associated with Middle Paleolithic industry concentrated several heat-altered fragments in two groups which suggested a potential structure for open-air combustion, although Roebroeks proposes a natural origin for such concentrations; at **La Cotte de Saint Brelade (Jersey)**, with a chronology, **ca. 230 ka**, high densities of burned bone were present in layers C and D though no evidence of hearths with a lithic assemblage associated to Late Middle Paleolithic.

Iberia fire use: various localities

- ▶ In the Iberian Peninsula, before MIS 13, indirect evidence of anthropogenic fires was found at level TE19 G at the **Sima del Elefante site (Atapuerca, Burgos)**, with a **chronology of less than 780 Ma**, and it consisted of dispersed fragments of charcoal and absent lithic industry. At **Cueva Negra del Rio Quipar (Murcia)**, dated **ca. 990–772 ka**, were found thermally altered bone and heat-shattered chert flakes and cores with only one handaxe. The Middle Pleistocene **Gruta da Aroeira (Portugal)** recorded **human-controlled fire, dated to ca. 400 ka**, in association with the Acheulean Technocomplex. The Middle-Late Pleistocene **Bolomor Cave (Valencia)** documented reiterative use of fire due to the presence of hearths at levels II, IV, XI, and XIII, in this level the hearths dated to MIS 7c (**228 ± 53 ka**). Such burned remains and thermo-altered sedimentary deposits were in the primary position and the lithic technology is framed within of Ancient Middle Paleolithic, no Acheulean technocomplex. At the **Abrigo de la Quebrada site (Valencia)**, levels with Middle Palaeolithic industry, dated between **40,500 and 83,200 B.P.**, were registered a high percentage of wood charcoal fragments.

Samples location and hearths at Valdocarros II (V-II).



Which leisure activities are better for you

- adult literacy activities such as **adult education classes, using computers, keeping a journal**
- mental acuity tasks like **completing quizzes and crosswords, playing cards/chess**
- creative hobbies like **woodworking, knitting or painting**
- more passive activities like **keeping up with the news, reading or listening to music**
- social network activities like **meeting and interacting with friends**
- planned excursions such as **going to a restaurant, museum or the cinema.**

Dementia reduction Results

- ▶ Found that participants who routinely engaged in adult literacy and mental acuity tasks such as education classes, keeping journals, and doing crosswords were 9-11 percent less likely to develop dementia than their peers.
- ▶ Creative hobbies like crafting, knitting and painting, and more passive activities like reading reduced the risk by 7 percent.
- ▶ In contrast, the size of someone's social network and the frequency of external outings to the cinema or restaurant were not associated with dementia risk reduction.
- ▶ The results remained statistically significant even when adjusted for earlier education level, and socioeconomic status. No significant variations were found between men and women.

Urban birds repurpose antibird spikes to craft imposing nests



Bird-repelling devices repurposed

- ▶ The metal spikes that bristle from city rooftops and balconies are meant to deter birds—but for some, they provide the perfect building material for a new home.
- ▶ Researchers have discovered nests that incorporate these antibird spikes at several sites across Europe. The nests were **built by carrion crows (*Corvus corone*) and magpies (*Pica pica*), members of the corvid family known for their intelligence.** The magpies—whose nest is shown above—used spikes mostly in their nests' domed roofs and oriented them to point outward in an apparent attempt to protect their eggs from predators such as crows.
- ▶ **Urban birds have been known to use litter and other debris—from barbed wire to hypodermic needles—to fashion nests in the past.** But this is the first time they have been observed repurposing a bird-repelling device for their own defense.

Rimrock Draw Rockshelter, Oregon



Rimrock Draw Rockshelter in southeastern Oregon, where the 18,000-year-old teeth and tools were unearthed. (Image credit: Greg Shine/BLM; [CC BY 2.0](#))

Stone tools and camel tooth suggest people were in the Pacific Northwest more than 18,000 years ago

- ▶ Stone tools and the teeth of an extinct camel and bison discovered in central Oregon show that people were living in North America 18,250 years ago.
- ▶ They took another sample from the camel tooth, as well as one from a bison tooth. When they were carbon-dated earlier this year, **all of the dates agreed: Rimrock Draw was almost certainly used by humans 18,250 years ago.**
- ▶ Limestone can throw off the carbon dating of an enamel sample, making it too old, while too much rain or groundwater infiltrating a sample can make it seem younger than its true age. But Rimrock Draw is basalt, rather than limestone, and Stafford ruled out additional contamination because of the volcanic ash that protected the camel and bison bones.

SR-9233
RIMROCK DRAW, OREGON
ENAMEL *CAMELOPS* CF. *HESTERNUS*

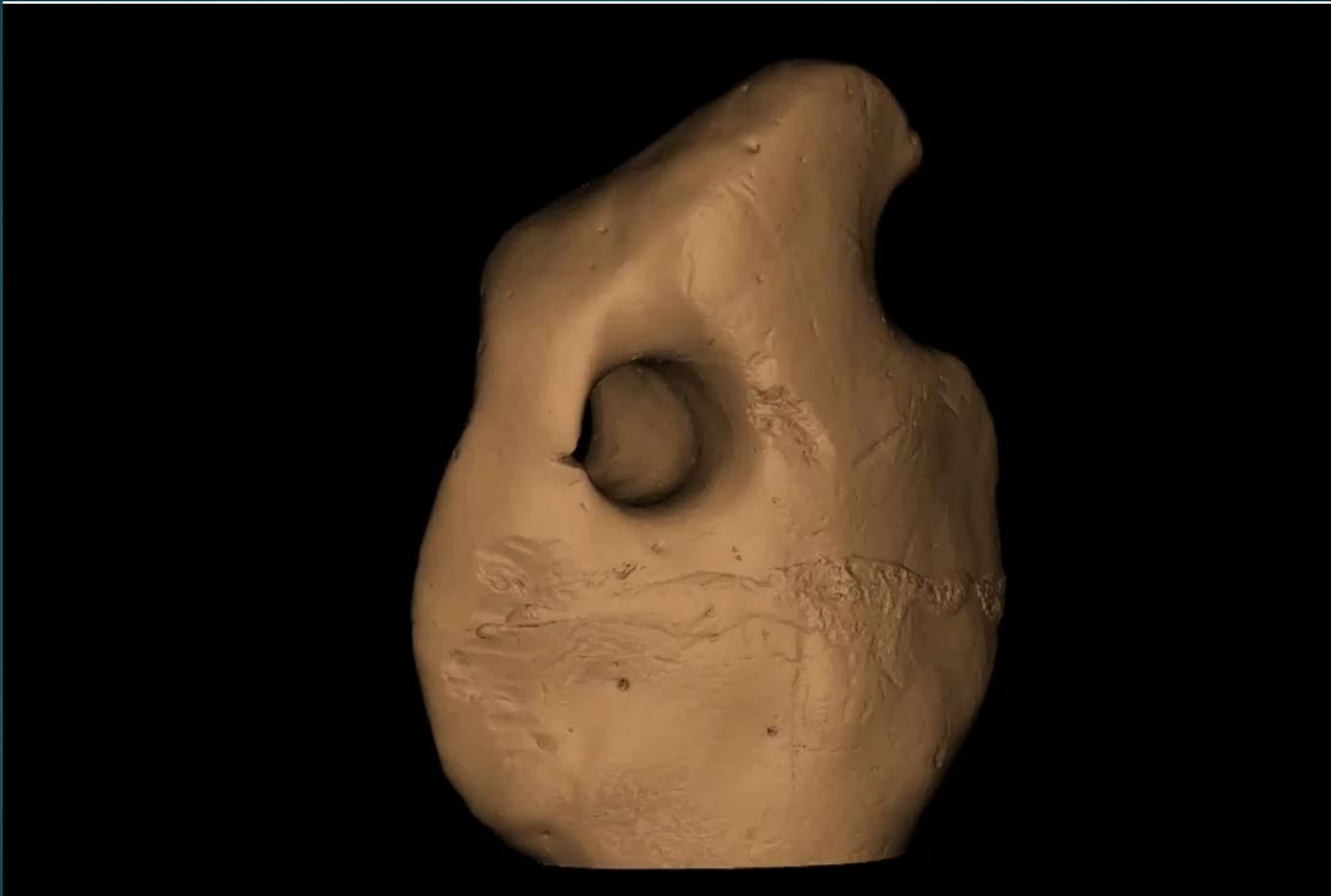


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Research

A thin section of tooth enamel from the now-extinct camelops from Rimrock Draw, Oregon.

Humans were in South America at least 25,000 years ago, giant sloth bone pendants reveal

- ▶ The date that humans arrived in South America has been pushed back to at least 25,000 years ago, based on an unlikely source: bones from an extinct giant ground sloth that were crafted into pendants by ancient people.
- ▶ Discovered in the Santa Elina rock shelter in central Brazil, three sloth osteoderms — bony deposits that form a kind of protective armor over the skin of animals such as armadillos — found near stone tools sported tiny holes that only humans could have made.
- ▶ The finding is among the earliest evidence for humans in the Americas,



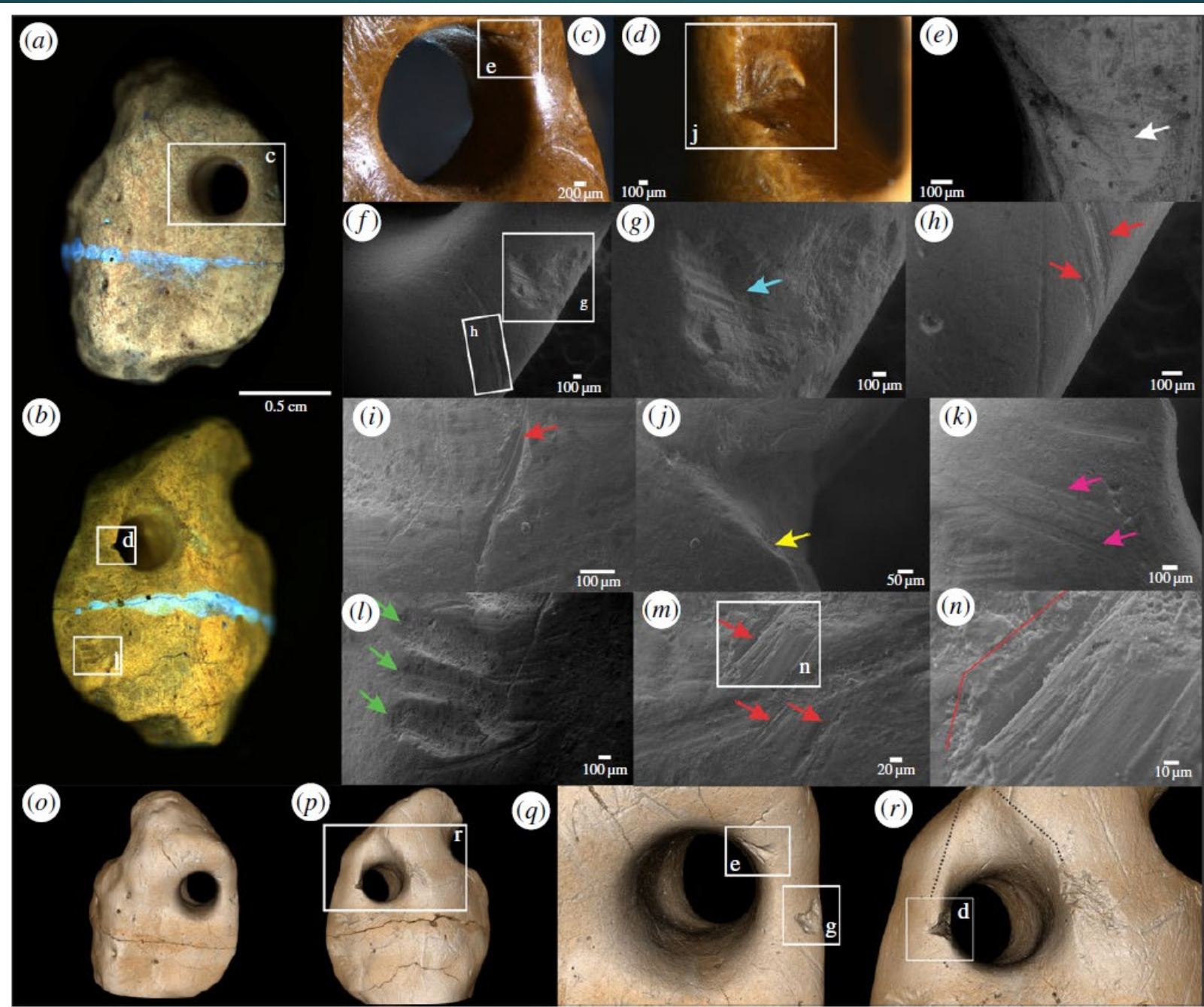


Researchers in Brazil found three giant ground sloth osteoderms that were polished and had holes in them.



It's possible that ancient humans wore these bones as pendants. (Image credit: Thaís Pansani)

BY INITIALS, IMAGE CREDIT, THIS PARSAN



Brazilian bone pendants

- ▶ The **Santa Elina rock shelter**, located in the Mato Grosso state in **central Brazil**, has been studied by archaeologists since 1985.
- ▶ Previous research at the site noted the presence of more than 1,000 individual figures and signs drawn on the walls, hundreds of stone tool artifacts, and thousands of sloth osteoderms, with **three of the osteoderms showing evidence of human-created drill holes.**
- ▶ The newly published study documents these sloth osteoderms in exquisite detail to show that **it is extremely unlikely that the holes in the bones were made naturally, with the implication that these bones push back the date humans settled in Brazil to 25,000 to 27,000 years ago.**

Peopling of the Americas during the Last Glacial Maximum

- ▶ Using a combination of microscopic and macroscopic visualization techniques, the team discovered that the osteoderms, and even their tiny holes, had been polished, and noted traces of stone tool incisions and scraping marks on the artifacts. Animal-made bite marks on all three osteoderms led them to exclude rodents as the creators of the holes.
- ▶ These are, so far, the only record of presumably personal artefacts from the LGM in the Americas. Their unique and diverse shapes, hole perforation sizes and presence of diverse anthropogenic traces suggest that different tools and techniques could have been employed during the production and finishing process of the final artefacts.
- ▶ The worn hole perforations and deformed surfaces, as well as attachment systems and use-wear traces, suggest their extensive use, probably as suspended ornaments.

These ancient flutes may have been used to lure falcons





12,000-year-old wind instruments made from bird bones are the oldest known from the Middle East

- ▶ Perforated bones excavated at an ancient settlement in northern Israel may be the oldest wind instruments found in the region. The small flutes could have been used to make music, call birds or even communicate over short distances.
- ▶ The instruments were unearthed from the remains of small stone dwellings at a lakeside site called Eynan-Mallaha, which was home to the last hunter-gatherers in the region until about 12,000 years ago.
- ▶ All of the flutes were made from the wing bones of waterfowl that spent winter months at the lake.
- ▶ Of the seven flutes found, the largest appears to be intact and is about 63 millimeters (2.5 inches) long.

may have sounded like | Science News



  *L. Davin et al/Sci Reports 2023*

Hawk lures

- ▶ Microscopic analyses of the instruments clearly show that the finger holes were carved by humans and were not the results of gnawing by rodents or tooth marks left by predators.
- ▶ Davin and his team used the wing bone of a modern-day female mallard to make a detailed replica of the ancient flute. When played, the instrument *produced high-pitched sounds similar to the calls of the common kestrel and the Eurasian sparrowhawk*, raising the possibility the instruments were used to lure birds.
- ▶ Evidence suggests the inhabitants of Eynan-Mallaha used the talons of these birds of prey as tools and may have worn them as ornaments.

Planning a trip during Middle Palaeolithic.

- ▶ The mobile toolkit debate and some considerations about expedient vs curated technologies in the light of new data from the Ciota Ciara cave (NW Italy)
- ▶ Since the term “personal gear” was introduced, the presence, in an archaeological lithic assemblage, of artefacts in allochthonous rocks (sourced from somewhere else) has been considered as a source of information about land mobility and techno-economic organization.
- ▶ Study of allochthonous raw materials from level 14 of the Ciota Ciara cave (north-western Italy). In a technological context described as markedly opportunistic, tools and unretouched flake, made in raw materials collected at a distance between 2 and 30 km, have been introduced in the site. A N site.

Exotic artefacts

- ▶ The results indicate that these “exotic” artefacts were part of a mobile toolkit and that they were multifunctional tools used for different activities (mainly butchering activities).
- ▶ We can hypothesize the transport within the site of finished products in the form of small, unretouched flakes and retouched tools, and, just sporadically, of small cores. The significant presence of Levallois radiolarite flakes in the Ciota Ciara toolkit is particularly interesting as the presence of this type of product in toolkits has already been reported by other scholars and for different European Middle Palaeolithic contexts.

Mobile Toolkit criteria

- ▶ The composition of the mobile toolkit depends on different factors like the frequency and the scale of the mobility or the availability of lithic raw materials and, based upon ethnographic data, some characteristics can be considered as common and diagnostic to define a Palaeolithic mobile toolkit: multifunctionality, transportability (i.e., a mobile toolkit is composed by a limited number of tools usually small and light) and maintainability (Kuhn, 1994).
- ▶ In Middle Palaeolithic contexts, blanks issued from the exploitation of non-local raw materials have been usually interpreted as part of mobile toolkits as well as the intensity of retouch has been considered as an indicator of transport through the landscape

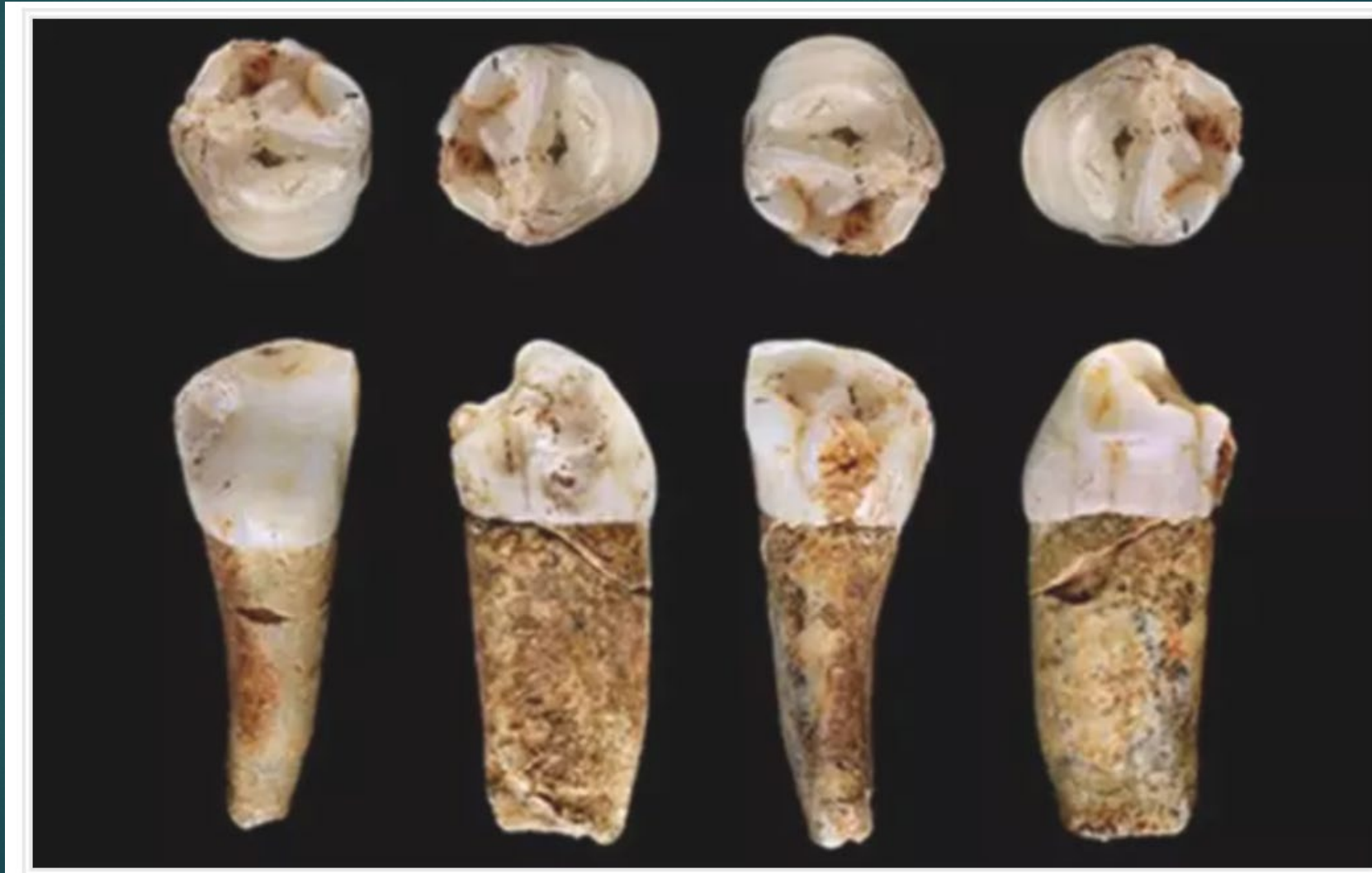
Expedient vs curated behavior in lithics

- ▶ Another debate is that opposing expedient and curated behavior (Binford, 1977, Binford, 1979). In lithic technology, curated and planned behaviors have been identified when lithic tools are produced in advance, for future needs, and when they attest a high technological investment in manufacture and maintenance; in these sense, mobile toolkits become an important component of curated technological behaviors and have been considered proper of prehistoric groups characterized by a high mobility.
- ▶ On the other hand, expedient behavior is usually linked to a low technological investment in the production and maintenance of lithic artefacts; they are produced when the need arises and are discarded in the same place; this behavior has been linked to a reduced mobility and to a great availability of lithic raw materials in the surrounding of the site

Neandertal food in Portugal

- ▶ Through the study of isotopes in the dental crown, it has been possible to determine the diet of humans who lived in the Almonda cave system (Portugal) in the Middle Paleolithic and Magdalenian periods.
- ▶ About 100 ka ago, Neanderthals ate goats in summer and larger fauna in winter (horse, deer, rhinoceros), which they searched over long distances, covering about 600 km².
- ▶ Magdalenian humans moved seasonally, ate rabbits, deer, ibex, and freshwater fish, and covered a smaller territory (about 300 km²), possibly because the increase in population density in the Upper Paleolithic could reduce the available territory.

Almonda Neanderthal premolar.



Ns vs MHs

- ▶ Neanderthal individuals occupied a subsistence territory of ~600 km², and likely subsisted on four geological catchments that were visited and revisited within a 10 to 15 km radius of the Almonda spring, consistent with a settlement–subsistence system leaning toward Binford’s “forager” model of mobility and with suggestions that Neanderthals may have had high basal metabolic rates, requiring them to make frequent but short-distance forages.
- ▶ In contrast, the Magdalenian individual subsisted primarily upon resources obtained, probably seasonally, from two geological catchments along a 20-km stretch of the right bank of the Almonda River, between the spring and the mouth, representing a subsistence territory of ~300 km².

Birch bark tar

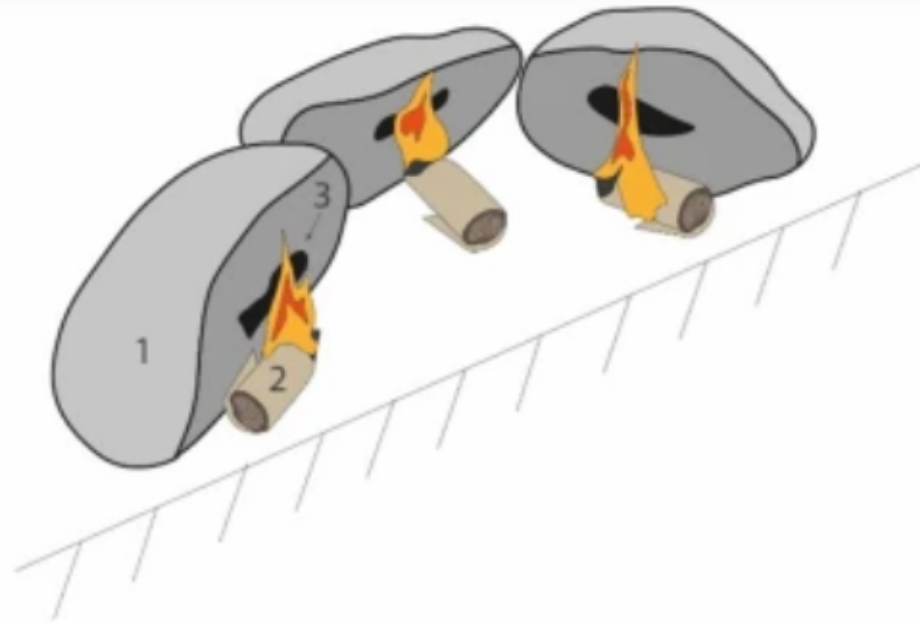


Experimental methods for the **Palaeolithic dry distillation of birch bark**: implications for the origin and development of Neandertal adhesive technology

- ▶ The **destructive distillation of birch bark to produce tar** has recently featured in debates about the technological and cognitive abilities of Neandertals and modern humans.
- ▶ The **abilities to precisely control fire temperatures and to manipulate adhesive properties are believed to require advanced mental traits**. However, the significance given to adhesive technology in these debates has quickly outgrown our understanding of birch bark tar and its manufacture using aceramic techniques.

Birch Tar distillation methods

- ▶ In this study, detail three experimental methods of Palaeolithic tar production ranging from simple to complex.
- ▶ Results indicate that it is possible to obtain useful amounts of tar by combining materials and technology already in use by Neandertals. A ceramic container is not required, and temperature control need not be as precise as previously thought.
- ▶ However, Neandertals must have been able to recognize certain material properties, such as adhesive tack and viscosity. In this way, they could develop the technology from producing small traces of tar on partially burned bark to techniques capable of manufacturing quantities of tar equal to those found in the Middle Palaeolithic archaeological record.



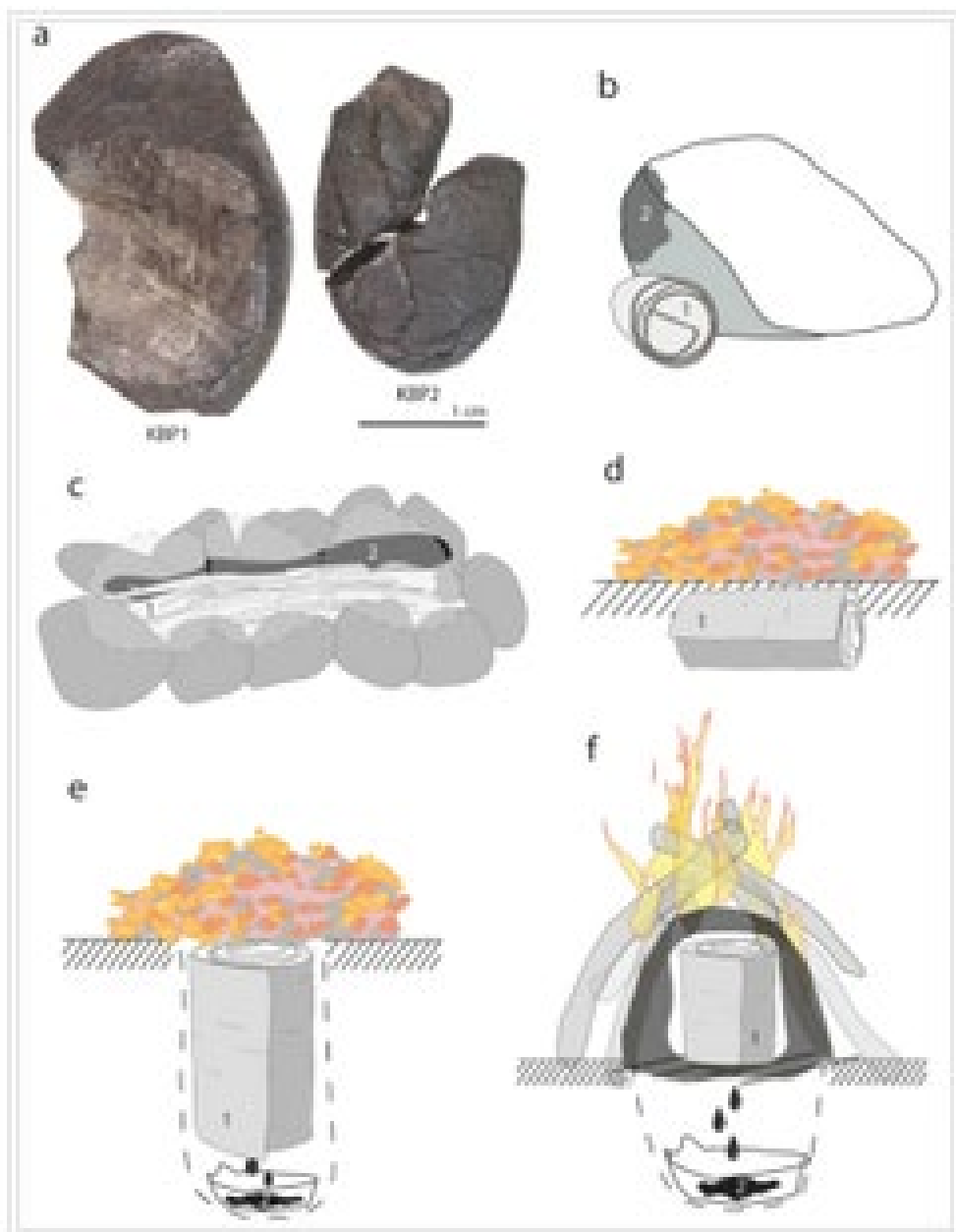
Experimental birch tar production with the condensation method. **(a)** Experimental set up of three large cobbles (1) with their flat surface slightly tilted to create an overhang. The bark fragments or rolls (2) were lighted and placed beneath the cobbles on which the condensed birch tar (3) is deposited. **(b)** Close up image of one cobble with a partially burnt bark roll and a shiny dark layer of tar accumulating on the cobble surface.

3 methods: Ash mound, Pit roll, raised structure

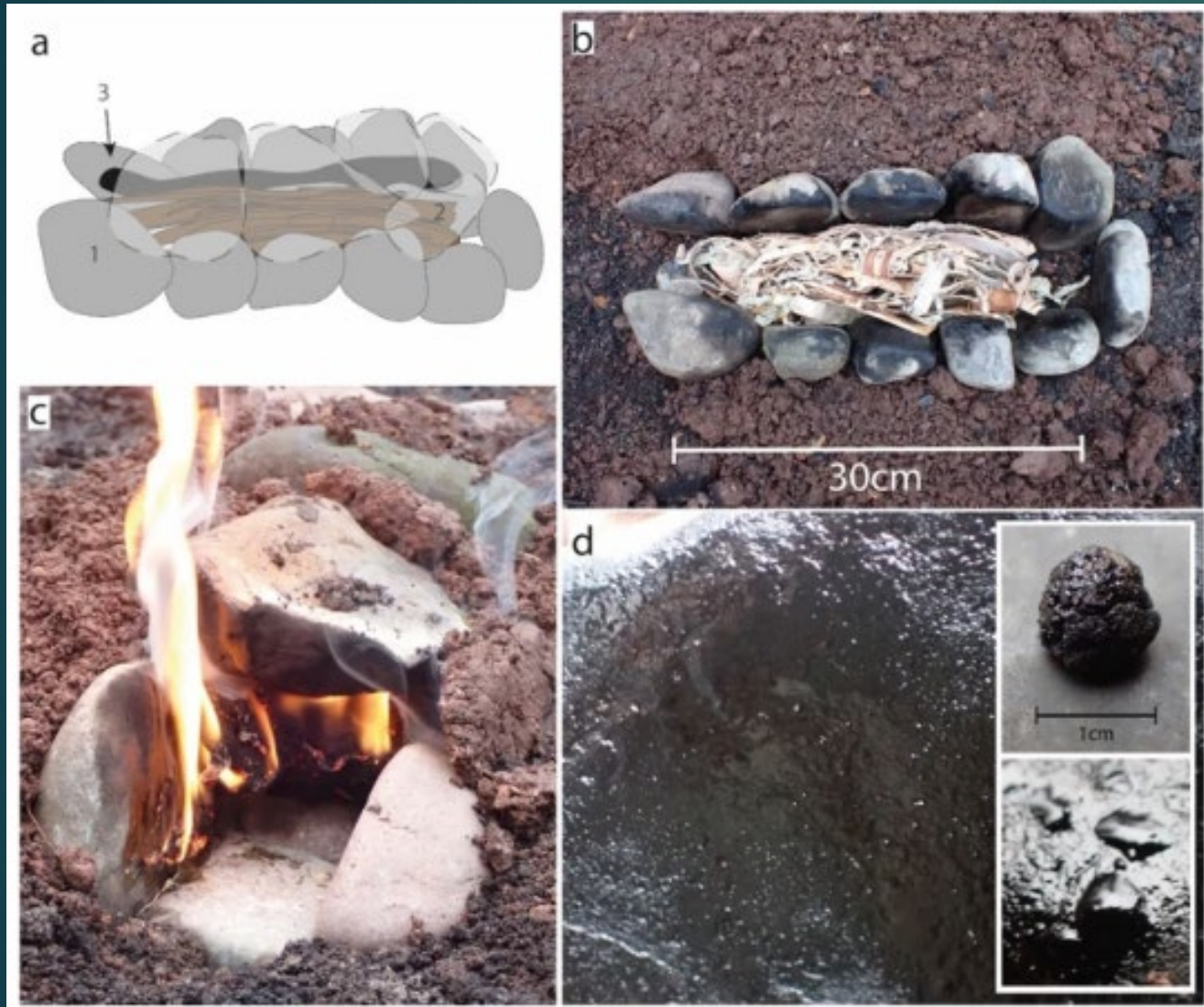
- ▶ Ash mound: Up to approximately 1.0 g of tar per 100 g of bark was obtained using the ash mound technique. Ambers and ash were placed over a bark roll, tied with fresh wood fiber to keep it tight. No vessel, pit or structure is required using this technique. Tar was collected between the bark layers and could be scraped off. Ash keeps the oxygen out, but too much will lower the temperature. Likewise, too many embers can raise the temperature and oxygen content and tar will burn before being collected.
- ▶ Pit roll: Techniques in which a roll of bark is ignited and placed burning side down into a small pit with a pebble at the bottom to collect the tar, were found to be unsuccessful. The temperature was never high enough or sustained for a long enough period of time to produce tar. The pebble used to collect the tar was blackened due to the burning roll being placed on top, but no tar was found. Rather than placing the burning end in a pit, we were successful when hot embers were placed on top of the bark to provide continuous heat.

Tar production

- ▶ Using the pit roll technique with capping embers and bark container, the maximum tar output was 2.4 g per 100 g of bark.
- ▶ Raised structure: A birch bark container was placed in a pit, an organic mesh covered the pit, and on the mesh we placed a large loose roll of bark. The bark was then covered with earth and a fire was lit over the mound. This method resulted in the most variable output of tar, but when successful it gave the highest yields by a large margin. Despite requiring the longest set-up and run-time, as well as using the most firewood, it was the most successful and efficient method. We achieved a maximum tar yield using this technique of 9.6 g per 100 g of bark, or a total of 15.7 g from one attempt.



Königsauere birch pitch and experimental production



Experimental birch tar production with the cobble-groove condensation method,

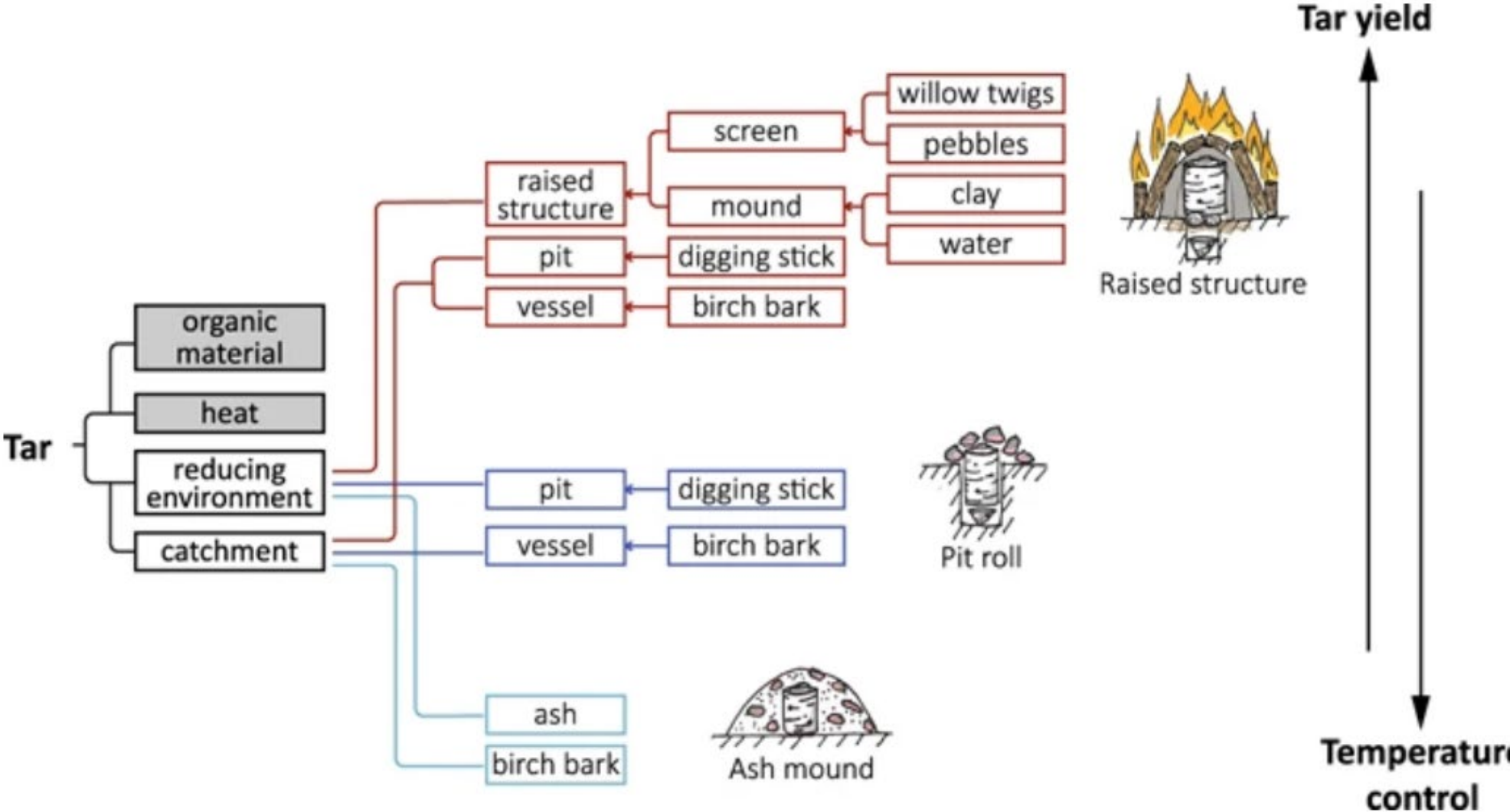
(a) Experimental set up of cobble-groove (1) showing the wall cobbles in dark grey, the ceiling cobbles with a dashed outline; the three bottom cobbles are hidden underneath the bark strips (2). The birch tar (3) is condensed onto the wall and ceiling cobbles,

(b) Photo taken during the fourth experiment with clearly visible dark spots on the cobbles,

(c) Frontal view of the upper opening of the structure during the burning procedure showing the bottom cobbles and the sediment chunks filling the gaps between the cobbles,

(d) Close-up photo of condensed tar on a cobble, photo of a 0.27 g-piece of tar produced in 22 min. and a close-up photo of

Figure 4



Depiction of the increase in complexity of each method and the associated increase in tar yield

Experiments

- ▶ While there are many potential methods of producing tar, we have demonstrated that there are at least three successful aceramic solutions, ranging from low to high-tech.
- ▶ A simple bark roll in hot ashes can produce enough tar to haft a small tool, and repeating this process several times (simultaneously) can produce the quantities known from the archaeological record.
- ▶ Small changes and additions to the production process would have allowed easier regulation of fire temperatures, and improved tar yield efficiency. Such a framework is consistent with the technology and resources available to Neandertals during the Middle Palaeolithic

Within N capabilities

- ▶ Considering that birch bark was available in Europe during the Pleistocene, and that Neandertals are known to have used wood resources and fire, it is now clear that Neandertals could have invented the transformative technology simply by recombining knowledge they already had.
- ▶ Such an invention must have been driven by curiosity and interest in properties like the tack and viscosity of the newly discovered material. Moreover, in order for tar production to become a perennial innovation, Neandertals must have been able to maintain the process of dry distillation as a useful technique for producing adhesives.

Archaeological evidence for two culture diverse Neanderthal populations in the North Caucasus and contacts between them

- ▶ Occupying the border between eastern Europe and West Asia, the Caucasus is important region regarding the Neanderthal occupation of Eurasia. On current radiometric estimates, the MP is represented in the Caucasus between about 260–210 ka and about 40 ka.
- ▶ Study identifies for the first time the archaeological evidence indicating contacts between two culture diverse MP Neanderthal populations in the North Caucasus and discuss the nature of these contacts.
- ▶ Basing on the lithic assemblages that we excavated at Mezmaiskaya cave in the north-western Caucasus (Kuban River basin) and Saradj-Chuko grotto in the north-central Caucasus (Terek River basin), dating from MIS 5 to MIS 3, and comparative data from other MP sites in the Caucasus, we identify two large cultural regions that existed during the late MP in the North Caucasus.



- Map showing distribution of the Eastern Micoquian industry in Eastern Europe and the west of North Caucasus and the Zagros Mousterian industry in the Zagros, Caucasus, and Armenian Highlands, including the east of North Caucasus. Squares indicate open-air sites and triangles indicate cave sites.

2 N cultures in Caucasus: Eastern Micoquian vs Zagros Mousterian

- ▶ The distinctive toolkits and stone knapping technologies indicate that the MP assemblages from Mezmaiskaya cave and other sites in the west of North Caucasus represent a Caucasian variant of the Eastern Micoquian industry that was wide spread in central and eastern Europe, while the assemblages from Saradj-Chuko Grotto and other sites in the east of North Caucasus closely resemble the Zagros Mousterian industry that was wide spread in the Armenian Highlands, Lesser Caucasus and Zagros Mountains.
- ▶ The archaeological evidence implies that two culture diverse populations of Neanderthals settled the North Caucasus during the Late Pleistocene from two various source regions: from the Armenian Highlands and Lesser Caucasus along the Caspian Sea coast, and from Russian plain along the Sea of Azov coast.

2 groups who occasionally had contact

- ▶ Basing on the current archaeological data about the MP in the North Caucasus, we propose that two culture different populations of Neanderthals settled the region from two various source regions:
 - ▶ from eastern Europe along the Sea of Azov coast and
 - ▶ from the Lesser Caucasus and Armenian Highlands along the Caspian Sea western coast.
- ▶ From late MIS 5 to mid MIS 3, a Neanderthal population bearing the Eastern Micoquian cultural tradition inhabited the western North Caucasus (Kaban River basin), whereas a Neanderthal population bearing the Zagros Mousterian cultural tradition inhabited the eastern North Caucasus (Terek River basin and the Caspian Sea northwestern coast).
- ▶ Irregular contacts existed between these two culture diverse Neanderthal populations in the North Caucasus.

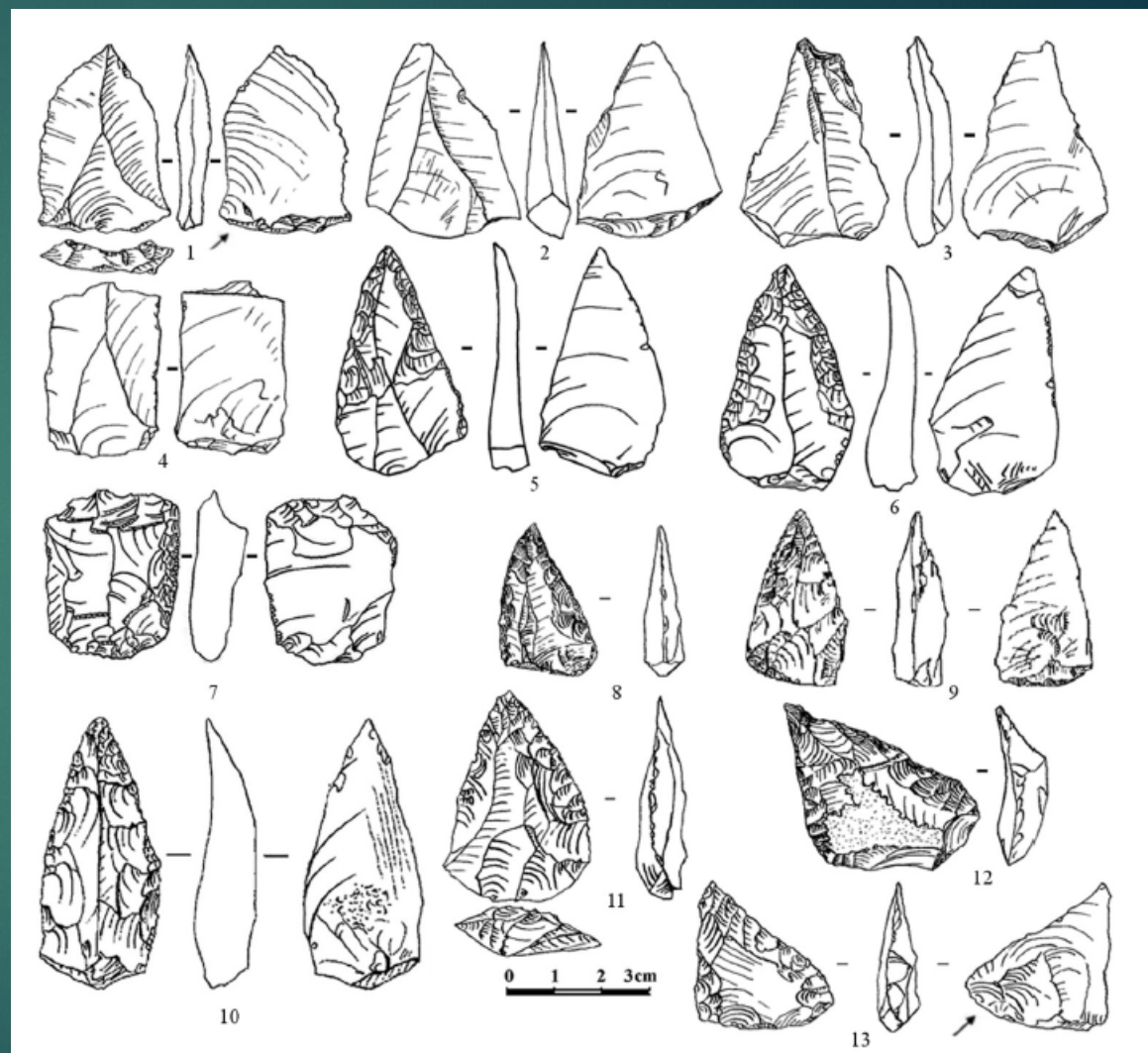
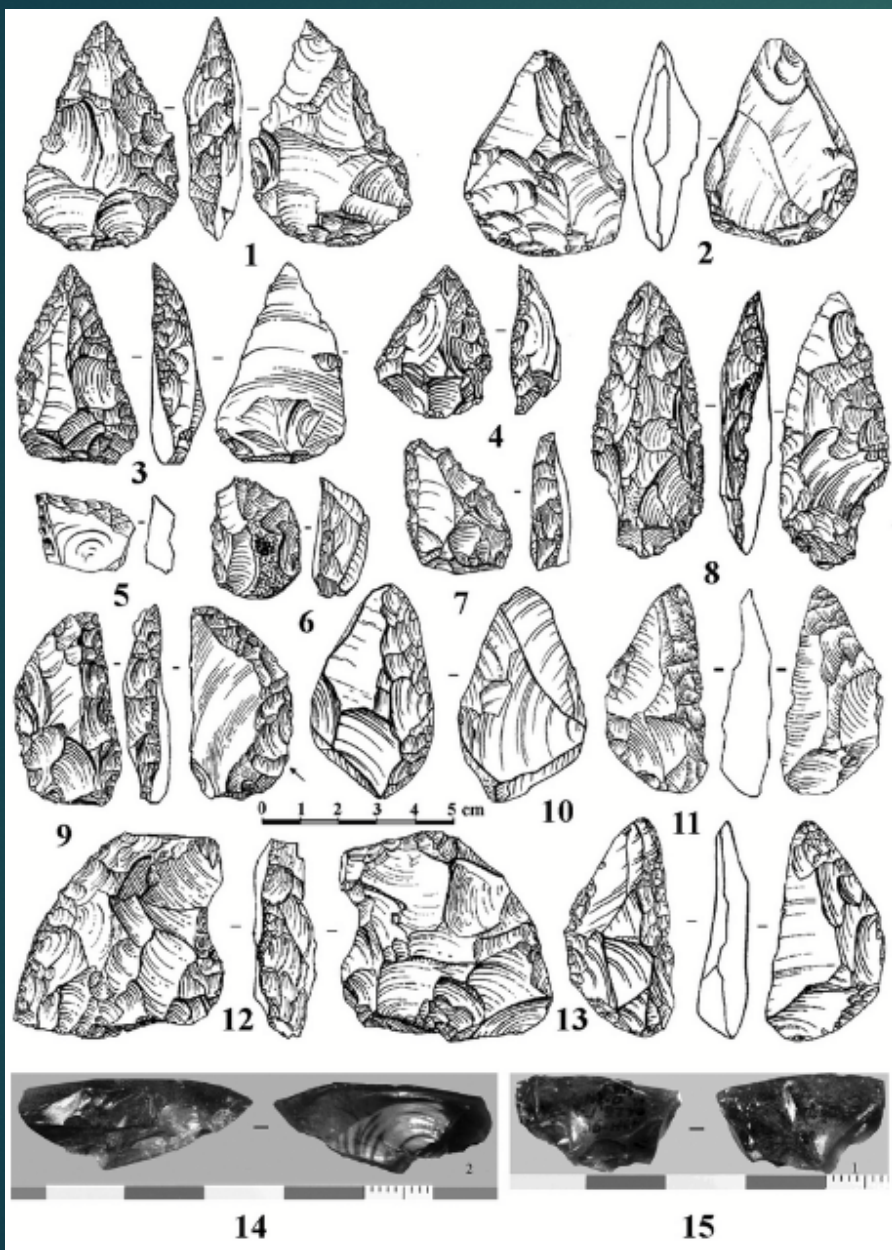
Mezmaiskaya cave and Kabana Saradj-Chuko grotto

100

- ▶ Based on the results of a comparative analysis of MP lithic assemblages dating from MIS 5 to MIS 3, which were recovered in two cave sites—Mezmaiskaya cave in the north-western Caucasus and Saradj-Chuko grotto in the north-central Caucasus, we offer a hypothesis that two culturally distinct populations of MP Neanderthals that had different origins inhabited the North Caucasus from MIS 5 to the end of Neanderthal history in MIS 3.
- ▶ Also, we discuss the archaeological evidence from Mezmaiskaya Cave and Saradj-Chuko Grotto that indicates contacts between these two culture diverse Neanderthal populations, and substantiate our conclusion about the character of these contacts.

Mezmaiskaya cave

Saradj-Chuko grotto



Obsidian clues for mobility

- ▶ In addition, rare (0.1% of the total artefacts) small obsidian artefacts (flakes and chips) were found in layers 3 and 2B4 at Mezmaiskaya Cave. The obsidian sourcing analysis indicated that the obsidian artefacts originate from the Zayukovo (Baksan) obsidian source in the north-central Caucasus, located approximately 250 km south-east from Mezmaiskaya.
- ▶ It should be noted that in the entire Caucasus obsidian artefact transport over 200 linear km have only been observed in UP sites. The findings of obsidian artefacts in MP/Eastern Micoquian layers at Mezmaiskaya suggest a high mobility pattern of the Eastern Micoquian Neanderthals, which was probably the highest among the MP/Neanderthal entities defined in the Caucasus.

Obsidian artefacts as clues

- ▶ The extreme rarity of obsidian artefacts found at Mezmaiskaya indicates that these obsidian items entered the cave not as a result of regular lithic raw material procurement by local Neanderthals or their exchange with the Neanderthal population in the Zayukovo obsidian source area, but as exotic pieces made from unusual lithic raw material, probably as a result of movements of individual groups across the landscape.

On the Quina side: A Neanderthal bone industry at Chez-Pinaud site, France

- ▶ Did Neanderthal produce a bone industry? The recent discovery of a large bone tool assemblage at the Neanderthal site of Chagyrskaya (Altai, Siberia, Russia) and the increasing discoveries of isolated finds of bone tools in various Mousterian sites across Eurasia stimulate the debate.
- ▶ We assessed the bone tool potential of the Quina bone-bed level currently under excavation at Chez Pinaud site (Jonzac, Charente-Maritime, France) and found as many bone tools as flint ones: not only the well-known retouchers but also beveled tools, retouched artifacts and a smooth-ended rib.

N bone industry

- ▶ Their diversity opens a window on a range of activities not expected in a butchering site and not documented by the flint tools, **all involved in the carcass processing.**
- ▶ The re-use of 20% of the bone blanks, which are mainly from large ungulates among faunal remains largely dominated by reindeer, raises the question of blank procurement and management.
- ▶ From the Altai to the Atlantic shore, through a multitude of sites where only a few objects have been reported so far, evidence of a Neanderthal bone industry is emerging which provides new insights on Middle Paleolithic subsistence strategies

Bone tools from the Chez-Pinaud site, 2019–2020 excavations.



Historical theory that Neanderthal did not produce a bone industry

- ▶ The discovery of more than 1,200 bone tools at the Neanderthal site of Chagyrskaya (Altai, Siberia, Russia) challenges the claim that Ns did not use bone artifacts.
- ▶ The cave deposits, accumulated in late Marine Isotope Stage (MIS) 4 or early MIS 3, contained 74 human remains and a lithic industry attesting to an occupation of the site by Neanderthals with cultural and genetic affinities to Micoquian groups from Central and Eastern Europe.
- ▶ Around 60,000–50,000 years BP, Neanderthals repeatedly came to the site during the early cold season to process the carcasses of hunted Bisons. A technological and functional analysis of the faunal remains identified more than 1,000 retouchers and approximately 100 bone tools belonging to other functional categories.

Tabon Cave, Palawan, Philippines: cordage & basket making

- ▶ Human presence in Tabon dates back almost 39,000 years, from the oldest fossils of anatomically modern humans in the Philippines and associated stone tools, to extensive jar burials attributed to the Philippine Metal Age.
- ▶ In this paper, we report indirect evidence of manufacture of basket or tying materials on three stone tools discovered at the Late Pleistocene site of Tabon, Palawan Philippines identified through use-wear analysis.
- ▶ The appearance and distribution of use-wear on these artefacts is similar to that observed on experimental tools used to thin plant fibers, following a technique that is still widespread in the region and that we recorded in detail among Pala'wan indigenous communities.
- ▶ Our results add to the growing set of discoveries showing that cordage, baskets and mats were an integral part of late Pleistocene material culture in Southeast Asia and elsewhere. To our knowledge, they constitute the oldest evidence of textile and rope technology in the region, together with the banana fibers found on stone tools from Leang Sarru, Indonesia.

The invisible plant technology of Prehistoric Southeast Asia: Indirect evidence for basket and rope making at Tabon Cave, Philippines, 39–33,000 years ago

- ▶ A large part of our material culture is made of organic materials, and this was likely the case also during prehistory. Amongst this prehistoric organic material culture are **textiles and cordages**, taking advantage of the **flexibility and resistance of plant fibers**. While in very exceptional cases and under very favorable circumstances, fragments of baskets and cords have survived and were discovered in late Pleistocene and Holocene archaeological sites, **these objects are generally not preserved, especially in tropical regions**.
- ▶ We report here indirect evidence of basket/tying material making found on stone tools dating to 39–33,000 BP from Tabon Cave, Palawan Philippines. The distribution of use-wear on these artefacts is the same as the distribution observed on experimental tools used to thin fibers, following a technique that is widespread in the region currently

Weaving at 39 Ka

- ▶ The goal of this activity is to turn hard plant segments into supple strips suitable as tying material or to weave baskets, traps, and even boats.
- ▶ This study shows early evidence of this practice in Southeast Asia and adds to the growing set of discoveries showing that fiber technology was an integral part of late Pleistocene skillset. This paper also provides a new way to identify supple strips of fibers made of tropical plants in the archaeological record, an organic technology that is otherwise most of the time invisible.
- ▶ Early stone tools known as Flake Assemblages II and III correspond to human use of the cave between 39,000- and 33,000-years BP

Plant fiber thinning

- ▶ Diagnostic use-wear pattern characteristic of thinning plant fibers were determined on three stone tools from Tabon Cave dating back 39–33,000 years. We were able to identify this pattern because it is identical to the use-wear distribution observed on experimental flakes used to process rigid plant segments, turning them into supple strips suitable for weaving or as tying materials. The use-wear pattern is characterized by a specific distribution of striations, micro-polish, and micro-scars on the surface of stone tools
- ▶ For many decades, researchers working in Southeast Asia have formulated the hypothesis that simple and non-standardized lithic artefacts had been complemented by plant implements made of bamboo.
- ▶ In contrast, our results constitute evidence for the existence of perishable plant-based technology in prehistoric Palawan, even though the number of archaeological artefacts displaying this thinning pattern is still limited.

Use-wear traces

- ▶ They show that early plant technology did indeed exist in tropical regions during the Pleistocene, but it was not focused simply on the manufacturing of bamboo tools. This complements our discovery that some of the denticulate stone tools from Tabon Cave had been used to split plants. Split plants form component parts of many objects nowadays, including flooring, musical instruments, and darts.
- ▶ It is also in line with the results of Riczar Fuentes and colleagues who **found residues of banana tree fibers on artefacts from Sulawesi**, Indonesia, considered by the authors **as evidence for making ropes, baskets, traps, or other woven items**, and the use-wear traces observed by Elspeth Hayes and her colleagues on **18–11,000 year old artefacts from Liang Bua, Flores Island**, Indonesia, which they interpreted as related to fibrecraft.

Traceology

- ▶ The identification of plant thinning in the archaeological record of Tabon Cave through our microscopic use-wear analysis has several implications.
- ▶ It shows that traceology can be used to make organic technology visible in the archaeological record, even if the perishable final products themselves were not preserved. The results of our study suggests, furthermore, that the technology of processing plant fibers and manufacture of cords, weavings, and basketry already existed 39–33,000 years ago in Southern Palawan
- ▶ The supple plant strips obtained may have been used as **tying materials, to make baskets or traps, as Pala'wan communities do nowadays**, or they could have been used for other purposes. **Strings and cords can be used to hold ornaments like beads or shells**, something that has been practiced by our species for 120,000 years, and for complex technologies such as **bow hunting**. Langley and her colleagues showed that **bone points had been hafted and shot using bows as early as 48,000 years ago in Sri Lanka.**

Fiber knowledge

- ▶ In fact, the human groups who inhabited Tabon Cave had **developed a botanical knowledge deep enough to know which plants within their environment had fibrous, flexible, and solid properties, and could be turned into ropes, baskets, and other fibrecraft.** Bamboo and palms are particularly appropriate for these
- ▶ As early as 39–33,000 years ago, the Late Pleistocene inhabitants of Palawan possessed an elaborate organic technology and were processing plant fibers to make cordage, baskets, traps, or other composite objects.
- ▶ More than 30,000 years later, **this botanical knowledge and technological know-how are still alive** and allow many communities all over Southeast Asia to produce objects necessary to answer their everyday needs in a sustainable way.