

A Review of Paleoanthropological  
Discoveries: 2000-2023

Denisovans and  
the New Neandertals

by

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## Denisovan:

A genome in search of a skeleton  
and an archaeology

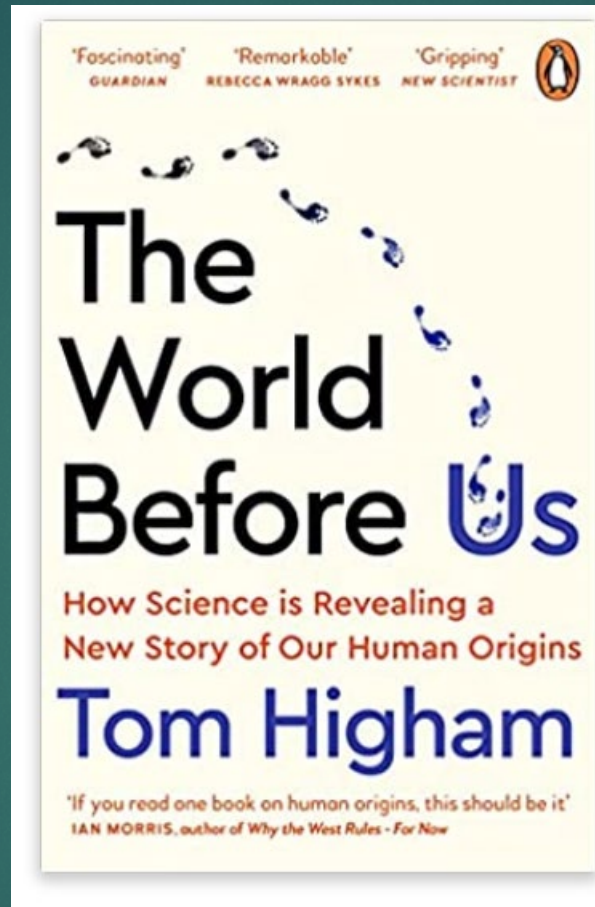
2010

LETTERS

## The complete mitochondrial DNA genome of an unknown hominin from southern Siberia

Johannes Krause<sup>1</sup>, Qiaomei Fu<sup>1</sup>, Jeffrey M. Good<sup>2</sup>, Bence Viola<sup>1,3</sup>, Michael V. Shunkov<sup>4</sup>, Anatoli P. Derevianko<sup>4</sup> & Svante Pääbo<sup>1</sup>





2022

# Denisova

- ▶ The **most important message of the Denisova story** is that **no fossil is unimportant**. Even the tiniest fragment that seems completely useless, like a fragment of a finger bone, can open up a completely new world of human evolution to us.
- ▶ Its first-time genetics illuminated something that had totally escaped paleontology.

# Entire scientific literature on the Denisovans

- ▶ 1997 to 2008: 3 Neandertal genome studies
- ▶ No books or textbook chapters on the Denisovans until 2022
- ▶ 2010-2023: 61 peer-reviewed journal articles about Denisovans + dozen science press descriptions (also large unavailable archeological literature on Denisova Cave in untranslated Russian journals)
- ▶ The 61 articles are the basis of majority of this presentation

# Denisova Cave, Siberia



# Denisovan summary

- ▶ 2010: First Denisovan genome: First species discovered solely via ancient DNA
- ▶ 76-52 Ka finger bone; D = a sister group to the Neandertals
- Separation between the common ancestor of Ns and MHs = 770 to 550 Ka.
- Neanderthals and Denisovans were more closely related to each other than either to MHs. Sister groups.
- Diverged from Ns ~475 to 370 Ka
- Denisovans stayed at Denisova Cave off and on from 200 to 60 Ka



# Denisovan summary

- **Current extant Denisovan fossil =**
  - Denisova cave molars (Denisova 2,4,8);
  - Partial phalange/finger bone (Denisova 3) = whole D genome
  - Denisova bone (Denisova 11 - Denny)
  - Xiahe mandible, 160 Ka – via protein analysis
  - Tibet Xujiayao 6 skull bones,
  - Molar from Laos – 150 Ka
  - 5 bones from Denisova Cave (Denisova 19-21) - 3 with identical D mtDNA; but different from D 3 above
  - D DNA from sediment in Denisova cave
- There were **at least 2 lineages of Denisovans**, one in Asia, one in SE Asia; and **perhaps a third**
- **We do not know when Denisovans went extinct (1 theory = 15 Ka)**

# A Genome in Search of a Fossil

- ▶ Excavations at Denisova Cave for the past 40 years led by Professors Anatoly Derevianko and Michael Shunkov from the Institute of Archaeology and Ethnography (Siberian Branch of the Russian Academy of Sciences) in Novosibirsk
- ▶ While Pääbo had screened dozens of Neanderthal samples to find a few with up to 4 percent primate DNA, this Denisovan finger bone had about 70 %.

## Denisovans: No skeleton

- ▶ Almost no D morphological information. No complete D crania or whole postcranial bones
- ▶ Almost no phenotypic morphological information exists about Denisovans
- ▶ Except for small fragmentary bones and 1 mandible, we have no fossil evidence for this group.
- ▶ But we do have several Denisovan mtDNA and nuclear genomes.

2008: **J. Krause** at Leipzig: Analysis of D finger bone



Denisova 3: Pinky bone, size of 2 grains of rice; 40 mg



2008: finger bone found in East chamber; large piece sent to Ed Rubin, UC Berkeley; small piece to Paabo at Leipzig lab

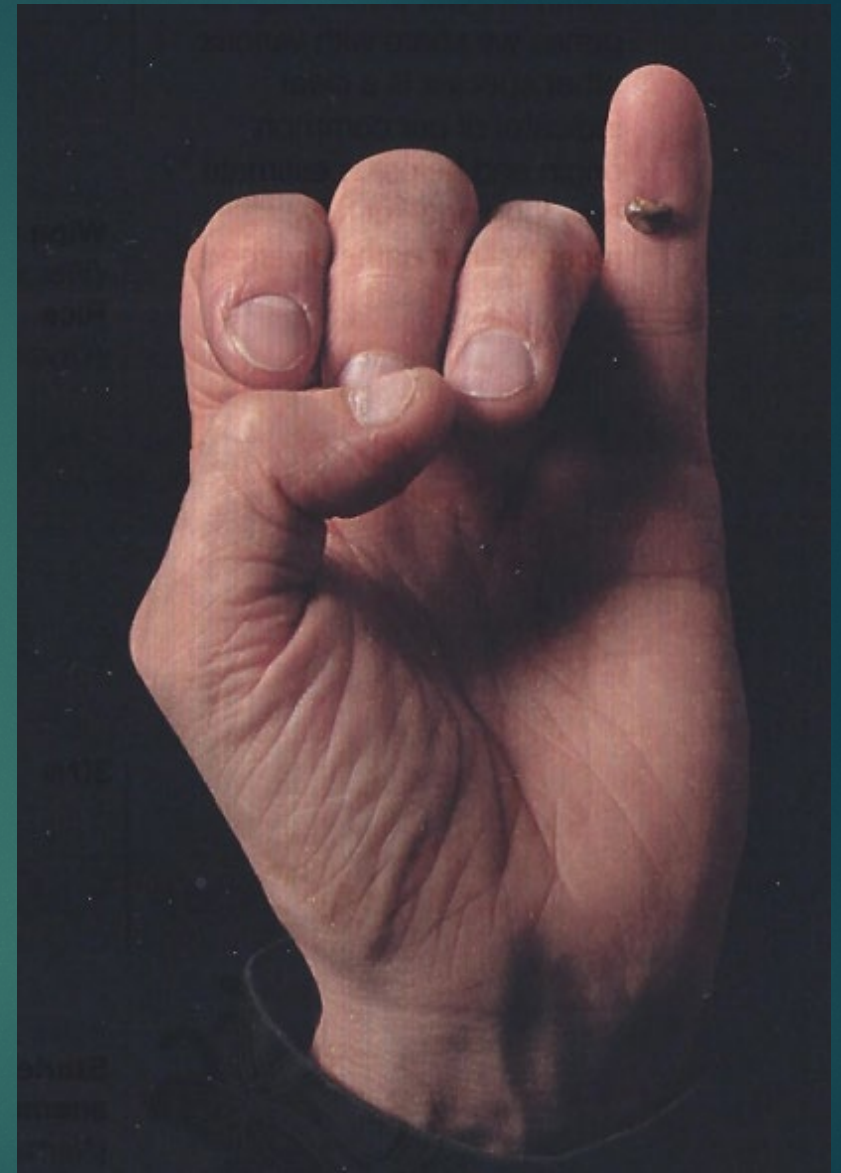


From a young woman aged 13.5 years. From the right hand and was indeed the final phalanx of the little finger, or 'pinky' bone. Dated 52 to 76 Ka. Had dark brown hair, brown eyes, along with dark skin

2008 Discovery:  
“X Woman” (girl), 83-63 Ka

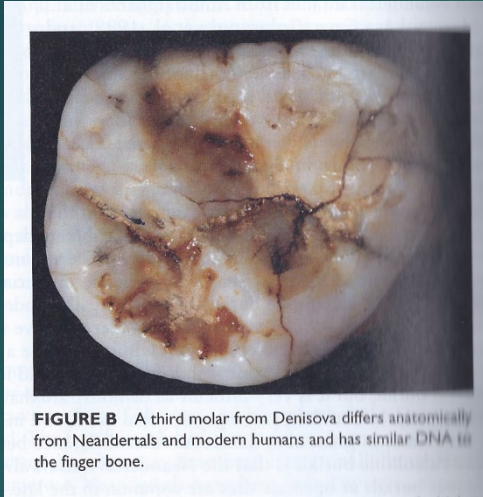


Pinkie bone, Denisova cave



Pääbo's hand & bone  
Laid around in lab for 6 months

# 2010: *Homo sp. Altai*, or *Homo sapiens ssp. Denisova*



A Denisovan molar, one of the three sources of DNA for the high-coverage genome sequencing. (Max Planck Institute for Evolutionary Anthropology)



**FRAGMENT OF A FINGER:** This replica of the Denisovan finger bone shows just how small of a sample the researchers had to extract DNA from.  
*Image: Image courtesy of Max Planck Institute for Evolutionary Anthropology*

Pinkie Bone, 30-48K,  
Denisova Cave

Krause et al. 2010: When the mitochondrial DNA of the bone was sequenced, it belonged neither to a Neandertal nor to a modern human. A new species, Denisovans



## \*\* Basic Denisovan facts

- ▶ It is unknown whether Denisovans actually lived in Denisova Cave
- ▶ They didn't bury their dead there, so any bone fragments found inside were likely regurgitated by predators like cave hyenas.
- ▶ Evidence of Denisovan and Neanderthal bone fragments and teeth layered in both cold and warm periods from approximately 300 to 50 Ka.
- ▶ Neanderthals and Denisovans were less genetically diverse than modern humans

## \*\* Basic Denisova facts

- ▶ Most Neanderthal remains have been found across western Eurasia; Denisovans bones have been discovered in Denisova Cave and Tibet
- ▶ D DNA has been found in Australian Aborigines, East Asians, Papua New Guineans, Tibetans, Native Americans, Peruvians and Icelanders
- ▶ Ns and Ds: Small population: both populations were very inbred
- ▶ Denisovan molars are very large (like *H. erectus*) and lack N derived traits

# Denisovan Genome

- ▶ Everyone with Denisovan ancestry also has some Neanderthal ancestry.
- ▶ Ds shared functional genes with Ns: immunity genes
- ▶ Parts of D nuclear DNA and all of D mitochondrial DNA are very divergent from MH and N DNA
- ▶ Ds interbreed with MHs of SE Asia: D DNA in Australian Aboriginals (5%); Highland, New Guinea (5%); Melanesia, New Britain, New Caledonia; Eastern Indonesia; Polynesia; in Mainland Asia & Americas (0.2%)

## Reich: Conclusions in 2010

- ▶ The Denisovans have:
  - ▶ some exceptionally archaic mtDNA
  - ▶ Different morphological dental features
  - ▶ D and Ns split before Ns developed their final facial morphology

# Sima de los Huesos mtDNA: Denisovan

- ▶ Sima de los Huesos:
  - ▶ mitochondrial DNA = Denisovan,
  - ▶ Nuclear genome = Neanderthal
- ▶ **Siberian Denisovan** individual has mitochondrial DNA twice as divergent from modern humans and Neanderthals as they were from each other despite being closer to Neanderthals in the rest of the genome.
- ▶ **Krause's idea:** several hundred thousand years ago, an early modern human population migrated out of Africa and mixed with groups like the one that lived in Sima de los Huesos, replacing their mitochondrial DNA along with a bit of the rest of their genomes and creating a mixed population that evolved into true Neanderthals. (Remember the HST N femur?)

# D mtDNA

- ▶ The Sima de los Huesos mtDNA sequence from the femur of a 430 Ka *H. neanderthalensis*:
  - ▶ Pääbo: from prior ancestor of N & D
  - ▶ authors posited that this mtDNA represents an archaic sequence which was subsequently lost in Neanderthals due to replacement by a modern-human-related mtDNA sequence.



Figure 2 | Femur XIII reassembled from three parts after sampling. The natural fractures are visible in the proximal third of the femur.

Neanderthal  
Ancestry  
In MHs –  
Fraction of N  
2%

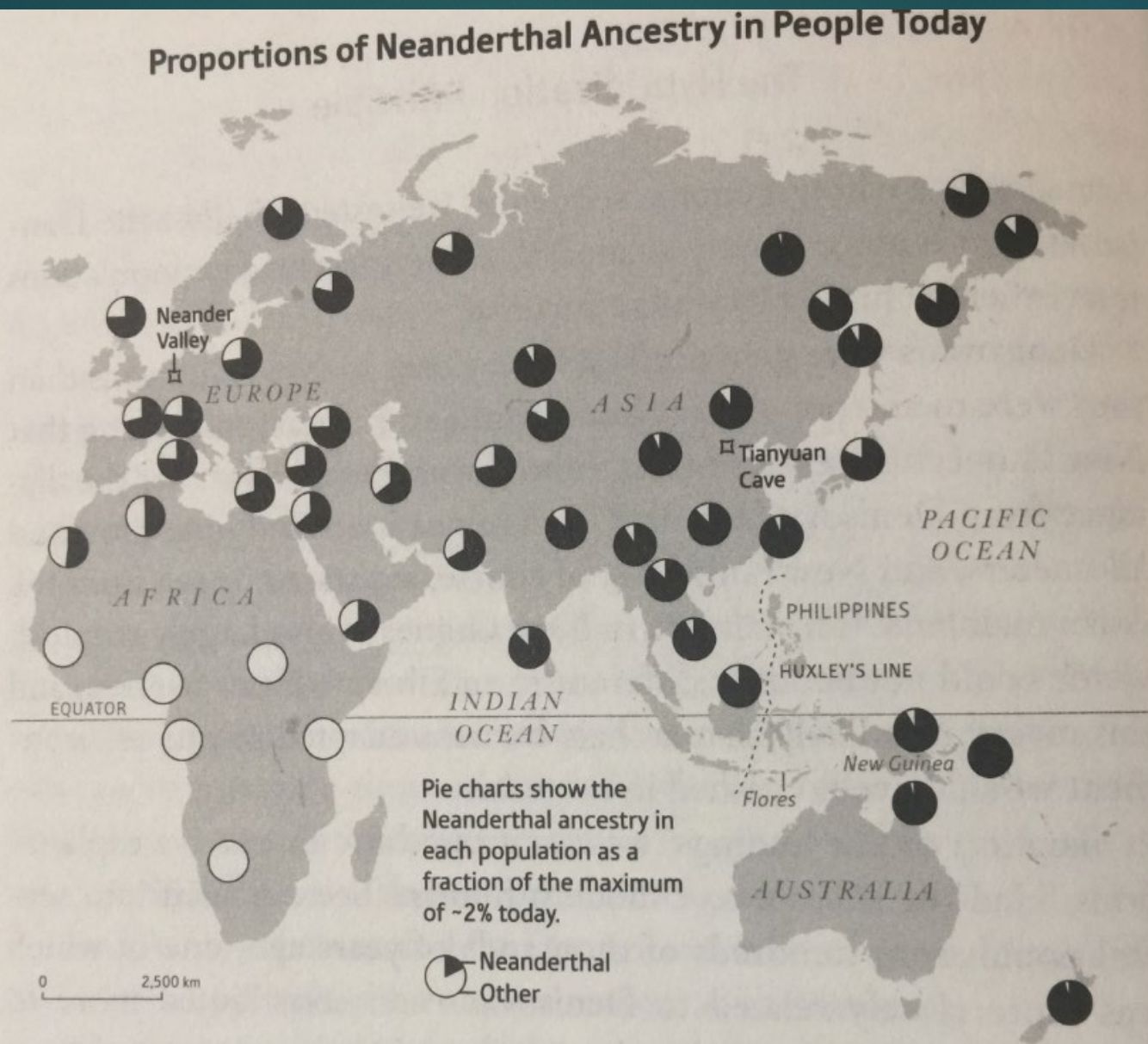


Figure 10. Approximate proportions of Neanderthal (left) and Denisovan ancestry (right) in representative present-day human populations as a fraction of the maximum detected in any group today. Today, Denisovan ancestry is concentrated east of Huxley's Line, a deep-sea trench that

# Proportions of **Denisovan Ancestry** (fraction of max 5%) in MHs Today





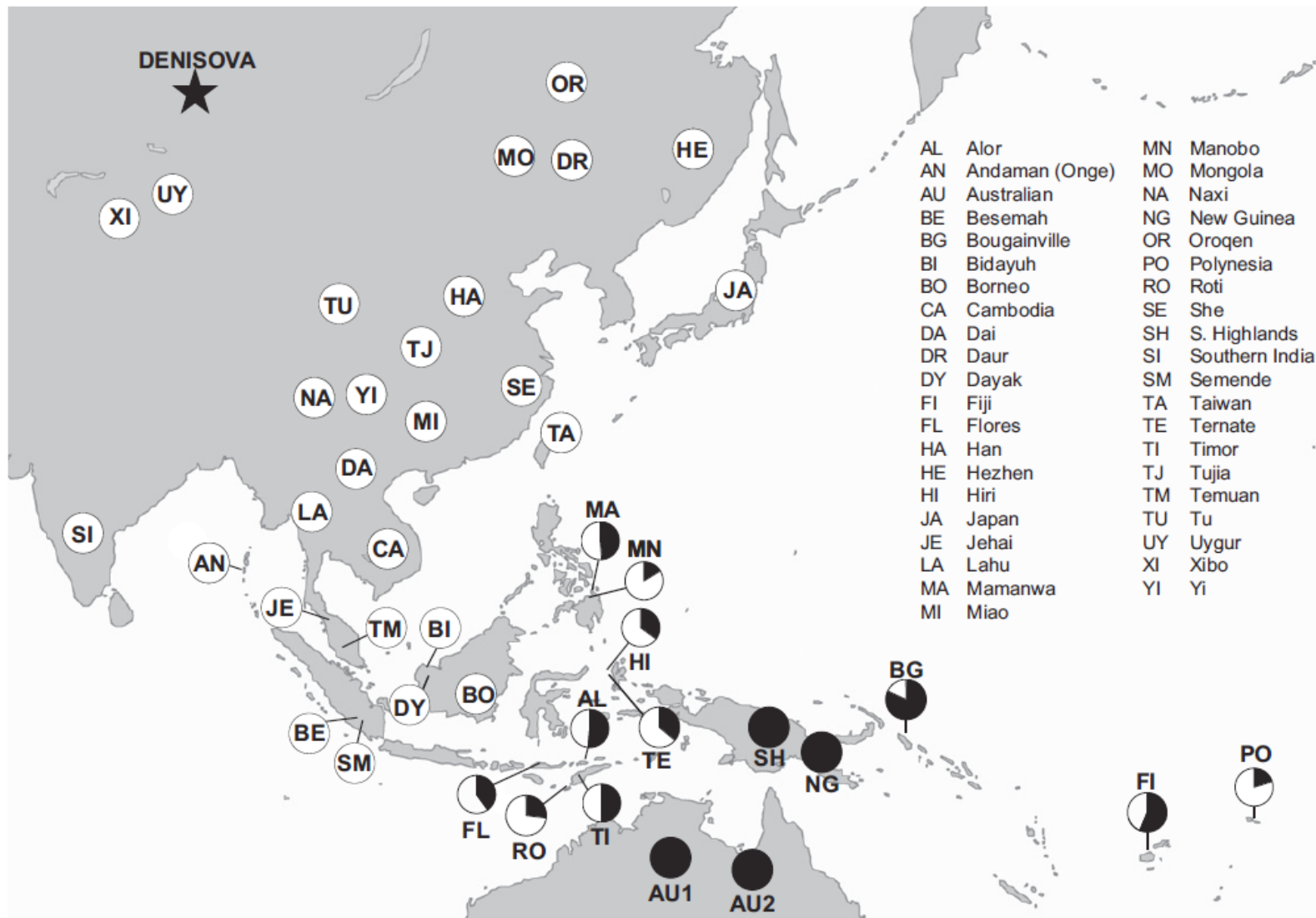
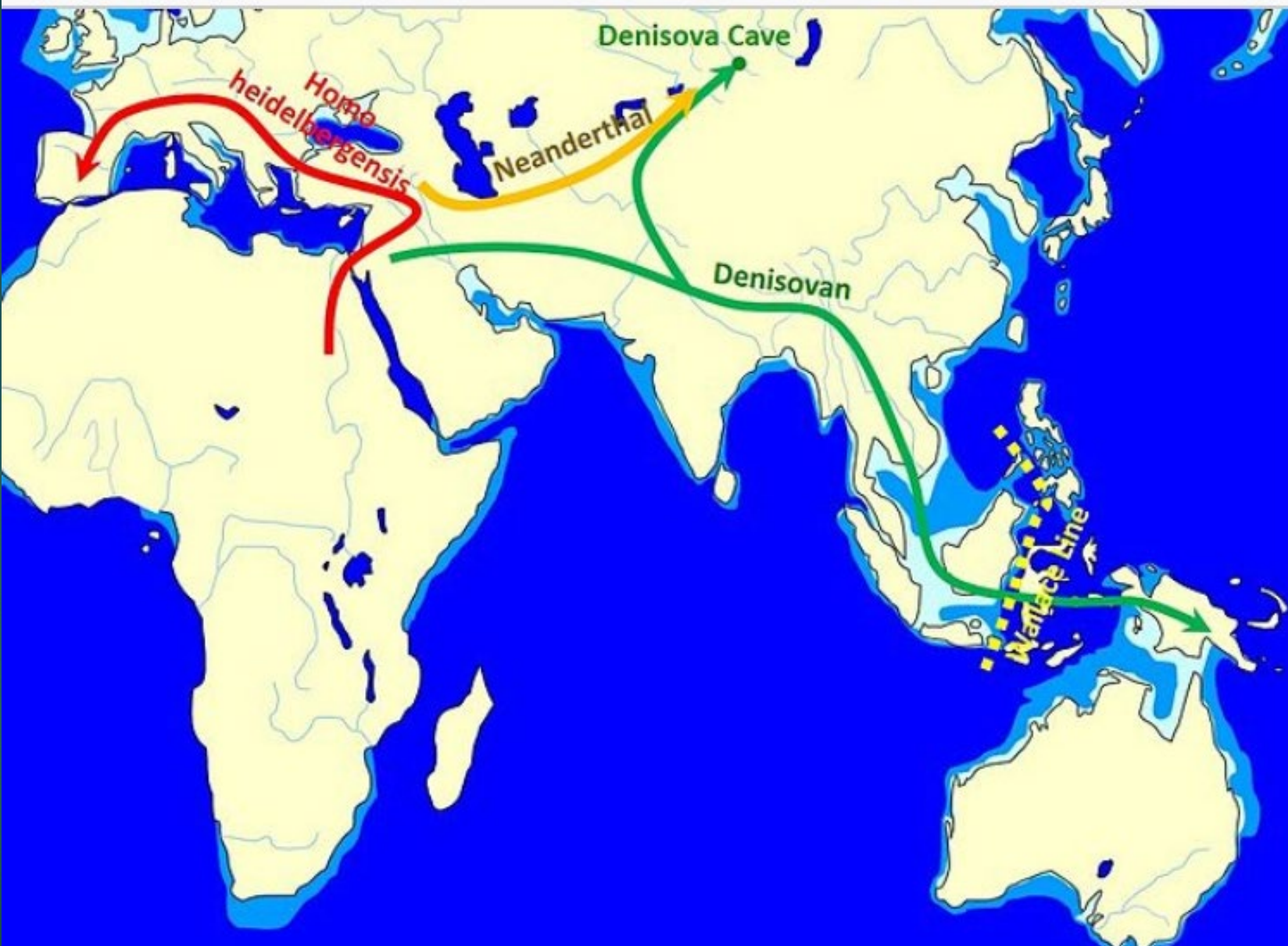


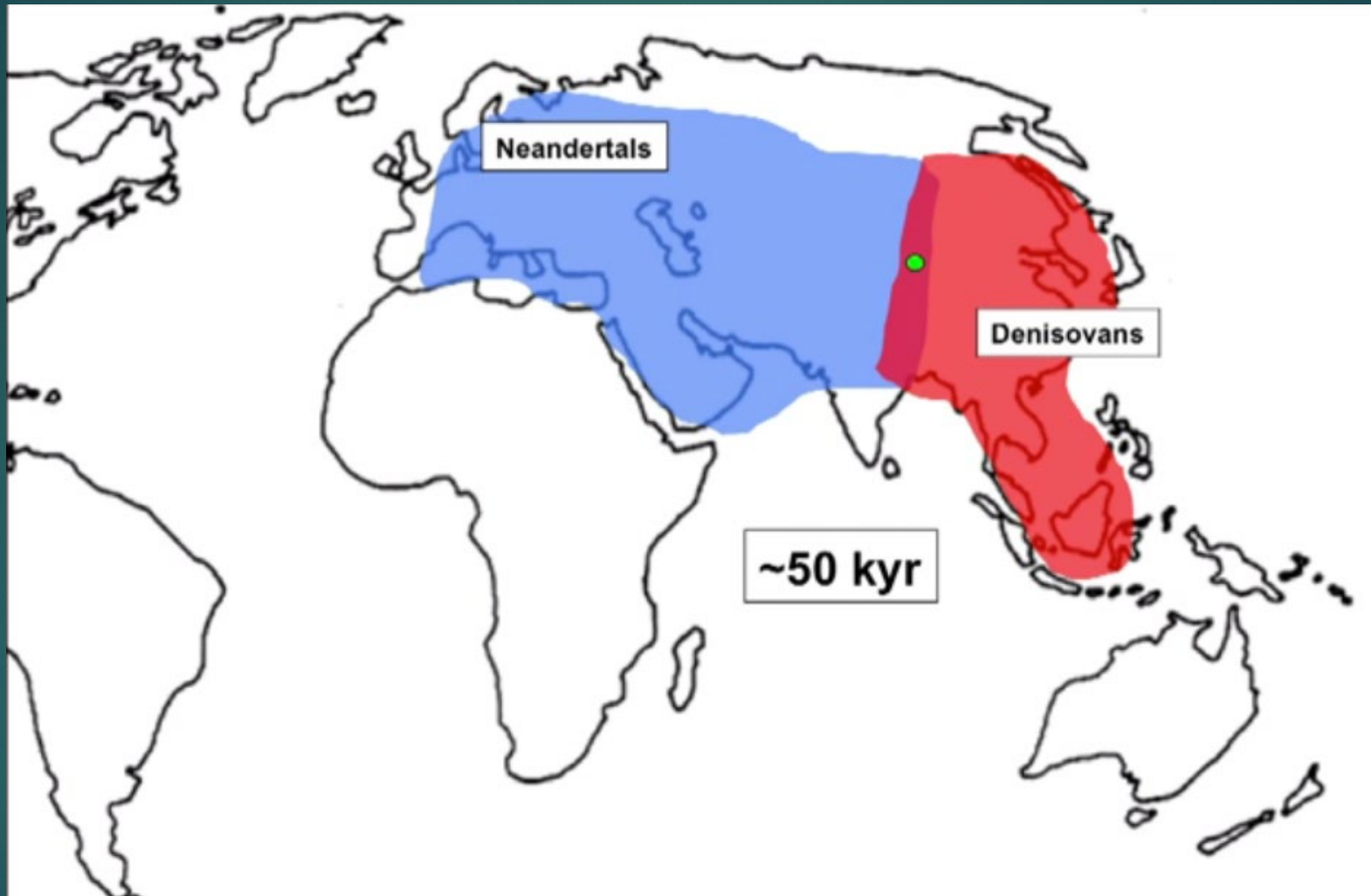
Figure 1. Denisovan Genetic Material as a Fraction of that in New Guineans

Black = proportion of Denisovan DNA

# Denisovan Range



# Neandertal & Denisovan Territories



What world looked like when MH came out of Africa: N in West, D in East;  
Both in southern Siberia

# Denisovans

- ▶ **Girl's fingertip. D3** - her mtDNA didn't match any known hominin group
- ▶ **Denisovans** - They existed at Denisova from around 50 to 150 ka, but as a population diverged from Neanderthals before 600 ka.
- ▶ In evolutionary terms they're closer to each other than either were to us, though not by much. Moreover, their DNA is more diverse than the Neanderthals', so either there were many more of them, or their overall population didn't suffer so many internal extinctions.

# What were Denisovans like?

- ▶ DNA indicates some had brown eyes, hair and skin, and their teeth weren't identical to Neanderthals'.
- ▶ Everything points to Denisovans as an Asian species.
- ▶ Proteins from a jawbone at Xiahe, Tibet - and 1,370mi. south-east of the Altai - are either Denisovan or from a close 'sister' population.
- ▶ D3's DNA suggested her ancestors had at some point interbred with Neanderthals,

# Denisova Cave: Paleolithic telenovela

- ▶ 1) 2010: The first and most famous of the specimens is the **distal phalanx from a fifth finger, Denisova 3 (X-Woman)**
- ▶ 2) 2012: **Denisova 4**, is a **third molar** representing a different individual from the 1<sup>st</sup> finger bone; came from a very endogamous population, one that had been small for a very long time.
- ▶ 3) 2014: **a toe bone**, older than D3; **a Neandertal; highly inbred**—as homozygous across its whole genome as people whose parents are half-siblings.
- ▶ 4) **Two molars (Denisova 4 and 8)** clearly **group with the original pinky (Denisova 3)** genome in their nuclear and mitochondrial DNA.

# Ds had huge teeth.

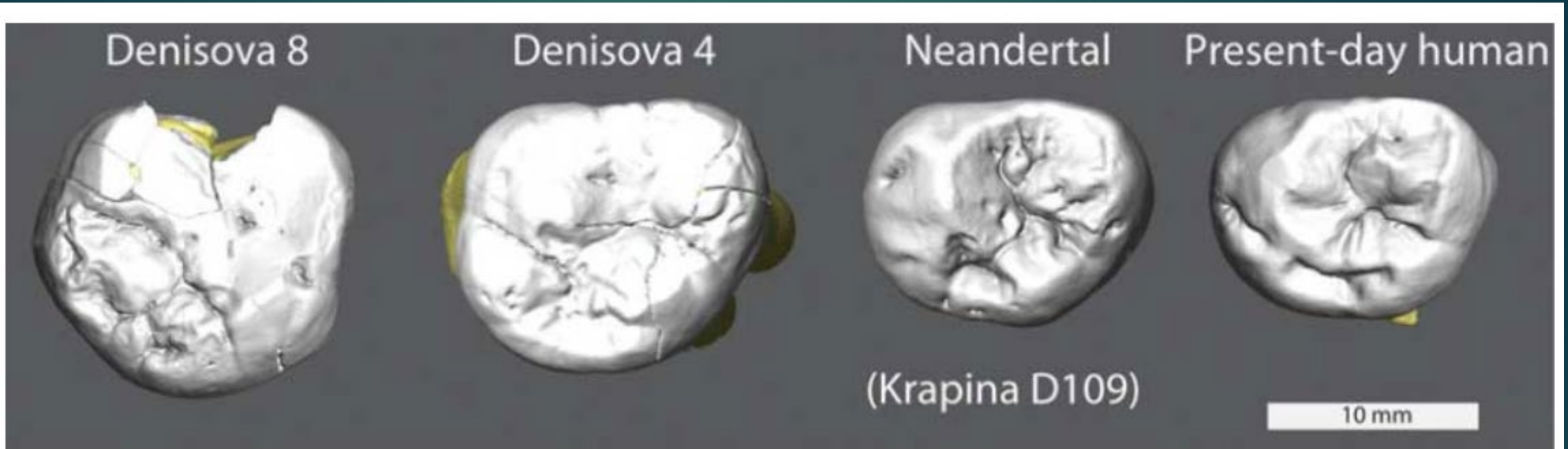


Figure 1 from Sawyer and colleagues 2015. Original caption: "Fig. 1. Occlusal surfaces of the Denisova 4 and Denisova 8 molars and third molars of a Neandertal and a present-day European."

They're big. Bigger than most living humans, bigger than any Neandertals, as big as some third molars of *Australopithecus*.

## “Denisovans”, not *H. altaiensis*

- ▶ There was a heated debate about what to call the new population, and decided to use a generic non-Latin name, “Denisovans,” after the cave where they were first discovered, in the same way that Neanderthals are named after the Neander Valley in Germany.
- ▶ This decision distressed some of the Russian colleagues, who lobbied for a new species name—perhaps *Homo altaiensis*, after the mountains where Denisova Cave is located.
- ▶ The geneticists, however, have remained reluctant to use a species name.



# Denisova Cave

- ▶ Europeans have N but no D DNA (except for Iceland?)
- ▶ Melanesians, N Guineans, Aborigines carry 4–6% D DNA, 2-3% N DNA
- ▶ Mainland Asians and Native Americans have 0.2% D DNA
- ▶ Half of the HLA immunity alleles of modern Eurasians represent archaic HLA haplotypes (both N & D)
- ▶ Ds = dark skin, brown hair, and brown eyes

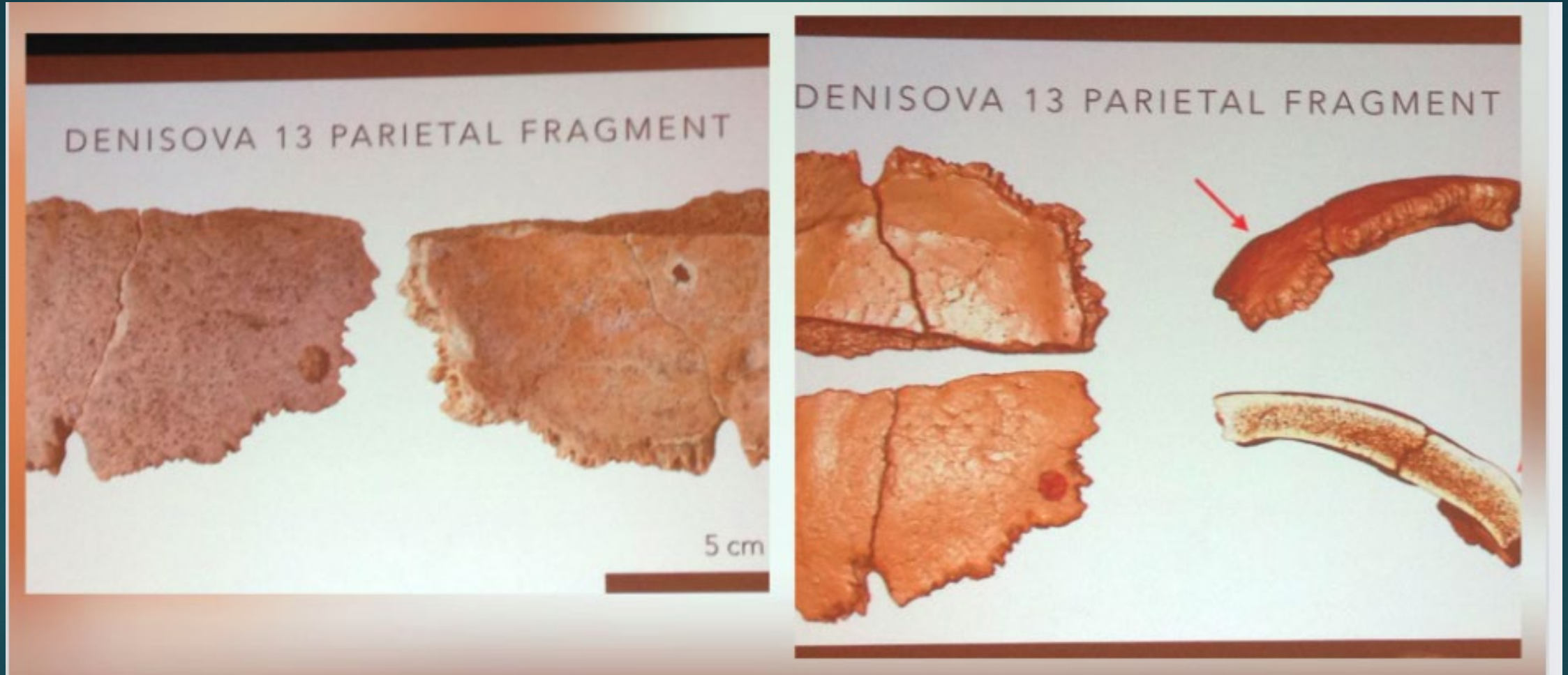
# Low genetic diversity in Ns and Ds

- ▶ Low genetic diversity: heterozygosity in Neanderthals as well as Denisovans:
  - ▶ among the lowest measured for any organism (similar to today's endangered 1000 gorillas who are highly inbred)
- ▶ Had significant local interbreeding, with local Neanderthal DNA representing 17% of the Denisovan genome.

# An Archaic Contribution to Ds: *Homo erectus*?

- ▣ Estimate that 2.7–5.8% of the Denisova genome comes from an archaic hominin which diverged from the other hominins 0.9–1.4 million years ago
- ▣ Second method estimates that 0.5–8% of the Denisovan genome comes from an unknown hominin which split from other hominins between 1.1 and 4 million years ago.
- ▣ The estimated population split time is also compatible with the possibility that this unknown hominin was *Homo erectus*.

## 2016 discovery: Denisova 13: 2 Parietal bone fragments



A palm-sized section of a braincase is the first Denisovan skull fossil ever found. Discovered in two pieces in Siberia's Denisova Cave; Mitochondrial DNA extracted from the skull pegged it as Denisovan.

## Information about Denisovans by 2016

- ▶ **By 2016: 5 Denisova specimens:** Finger bone (Denisova 3 – X woman), molar (Denisova 4 - male), toe bone (Denisova 5, Altai Neandertal), 2<sup>nd</sup> molar (Denisova 8), Deciduous molar (Denisova 2)
- ▶ EPAS1 gene in Tibetans is a Denisovan variant
- ▶ FAM178B gene in Bajau boat people of SE Asia which prevents the build-up of carbon dioxide is Denisovan
- ▶ More Denisovan ancestry in East Eurasians than in West Eurasians;

What's special about Tibetans? Live at 13,000 feet above sea level; 40% less oxygen



Only humans to possess this **EPAS1 variant**. A Denisovan gene.  
87% of Tibetans have it. Denisovans got to Tibet before 5000 Ka.

# EPAS1

- ▶ Interbreeding with Denisovans introduced DNA, including the section surrounding the EPAS1 gene, at some point in eastern Asia.
- ▶ The Tianyuan Man's genome showed us that this probably happened some time before he lived (40 Ka). **Han Chinese and Tibetan people share remarkably similar levels of Denisovan DNA (0.4 per cent)**, which suggests that it is likely that the introgression from Denisovans came into their ancestral population, rather than later into the Tibetans only.
- ▶ When the descendants of those modern humans began to settle in the Tibet plateau, the EPAS1 variant started to sweep through the population because it was highly advantageous.
- ▶ Interestingly, we see the **same pattern in the region's animals** (which also all have EPAS1).

# Tibetan animals also have a EPAS1 variant

- ▶ The **Tibetan mastiff**, for example, owes its ability to survive at high altitude on the Tibetan plateau to an introgression from grey wolves that were already living there. **Tibetan cattle** derived a hypoxia-related gene variant to help them cope with altitude by interbreeding with local yaks, from whom they derive just over 1.2 per cent of their genome.
- ▶ It seems every animal is in on the game of taking advantage of prior adaptation, through genetic admixture. Humans are no exception.



# Sherpas: lower hemoglobin levels: Denisovan Gene

Mt. Everest, 1953: Edmund Hilary & Sherpa Tenzing Norgay (Denisovan DNA) & fastest Darwinian evolution



Hypoxia gene, *EPAS1*, positive selection in Tibetans; hemoglobin & oxygen at high altitude; 3000 year divergence



Tibetans have an autosomal dominant Denisova gene for higher oxygen saturation.

Women estimated with high probability to have high oxygen saturation genotypes have more surviving children.

EPAS1: decrease in hemoglobin levels; less blood viscosity; lead to a reduced number of red blood cells, thinning the blood and reducing the risk of strokes at high altitude. DNA methylation is also involved.

# Convergent Evolution: High altitude & Oxygen



Sherpas

Quechua of Andes



Amhara of Ethiopia

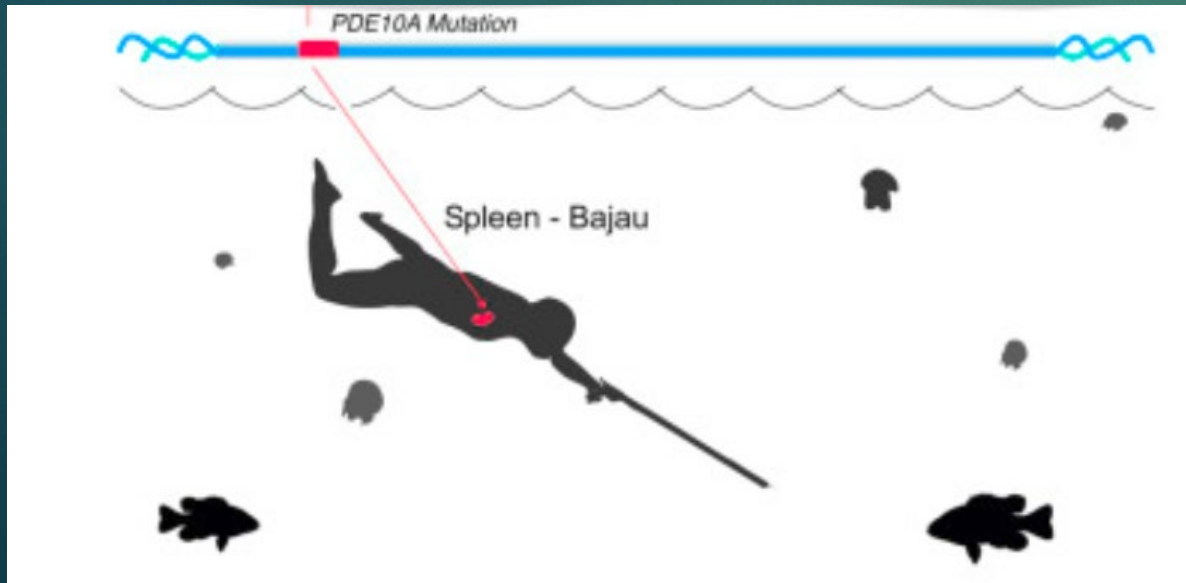
Elevation in hemoglobin concentration is not a universal response to high-altitude hypoxia at altitudes. Oxygen saturation has no heritability in the Andean natives.

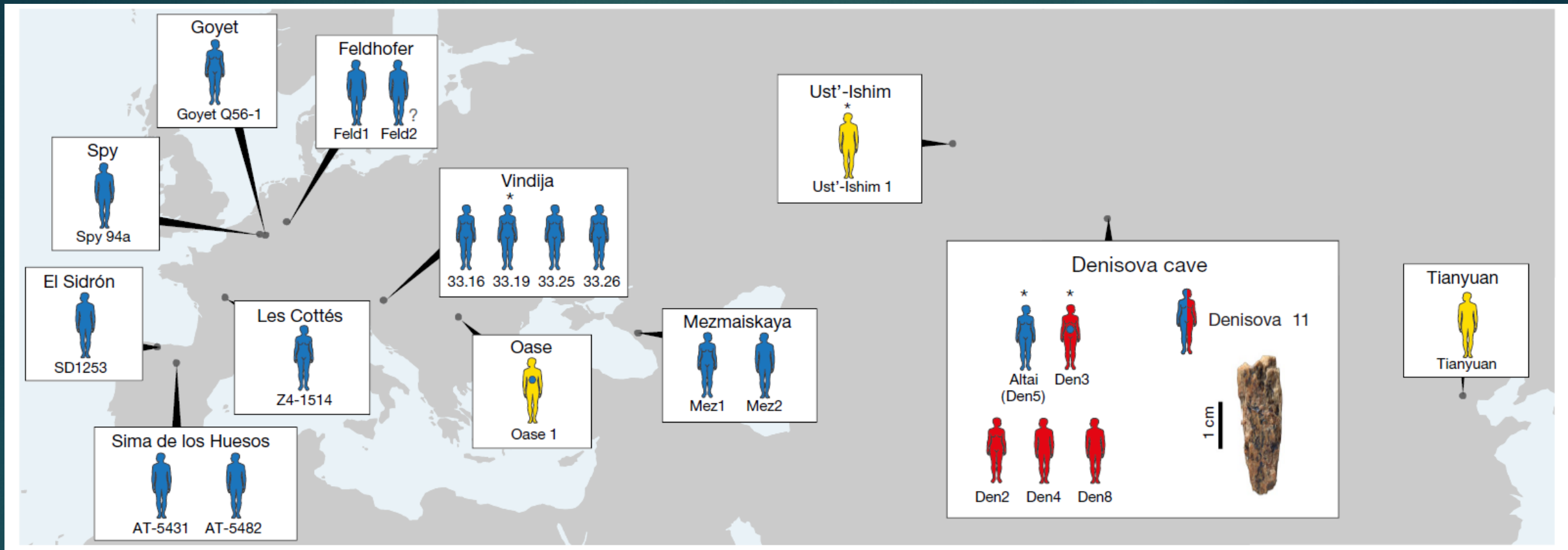
East African highlanders of Ethiopia do not have EPAS1. Adaptation to high altitude arose independently due to **convergent evolution** in high-altitude Amhara populations in Ethiopia and Peru.

# World's Best Freedivers -- Bajau people of Southeast Asia



- **Extraordinary breath-holding abilities;** Freediving several hundred feet down to fish
- Some spend as much as **60 percent of the day diving for food.**
- To deal with hypoxia, **50% larger spleen**, which stores oxygenated red blood cells
- **FAM178B gene** which prevent the build-up of carbon dioxide is **Denisovan in origin**





Location of Neanderthals, Denisovans and ancient modern humans with genomes dated to approximately 40 Ka or earlier.

Blue = Neanderthals; red = Denisovans; yellow = ancient modern humans.

Note that Oase 1 has recent Neanderthal ancestry (blue dot) that is higher than the amount seen in non-Africans.

### 3 Denisovan lineages

- ▶ Two other distinct Denisovan genetic lineages, related to but distinguishable from the one found in Denisova Cave, have been identified in modern populations.
- ▶ Papuans carry alleles derived from two separate Denisovan introgressions, and a third Denisovan lineage is found in East Asia.
- ▶ The two Denisovan lineages found in Papuans separated more than 350 Kya.

## 2 Denisova Lineages

- ▶ Evidence now suggests that there were **at least two distinct populations of Denisovans.**
  - ▶ East Asians show evidence of introgression from two distinct Denisovan populations;
  - ▶ South Asians and Oceanians carry introgression from one Denisovan population
- ▶ 2018: evidence for a **second introgression event from Denisovans found in various modern East Asian populations:** the Han Chinese, Japanese people and the Dai people.
- ▶ The D DNA in these East Asian populations is actually **closer to the sequenced Denisovan genome than that found in Papuans.** Thus, the Papuans must have derived their elevated Denisovan DNA component from a separate introgression event.

## 3<sup>rd</sup> D lineage

- ▶ Denisovans were composed of multiple lineages.
  - ▶ One was closely related to the Siberian Denisovan and has a genetic legacy found primarily in East Asians.
  - ▶ The other was more distantly related to the Siberian Denisovan and had DNA nowadays mostly seen in Papuans and South Asians.
- ▶ A third Denisovan lineage: this third lineage separated from the other two about 363,000 years ago, and was about as different from the other Denisovans as it was from the Neanderthals. Primarily in **New Guineans.**

## 2019 - 3 lineages of Ds

- ▶ Genetic remnants of two of those populations appear in modern aboriginal groups in Papua New Guinea, who interbred with one genetically distinct Denisovan population around 46 Ka.
- ▶ Interbreeding with a second line of Denisovans took place ~30 Ka and possibly as recently as 15 Ka
- ▶ If the latter estimate proves correct in further studies, Denisovans were the last surviving hominins who were not *Homo sapiens*. Those last survivors likely inhabited Papua New Guinea or a nearby island



## 3 lineage names: D0, D1, D2

- ▶ D0 = D population in Siberia.
- ▶ In the samples from people in New Guinea, Denisovan DNA from populations that were different from those living in the cave in Siberia. They describe them as D1 and D2
- ▶ D1 and D2 were so distantly related to D0 that they had to have diverged at least 283,000 years ago.
- ▶ D2 was so distant that it likely split off at ~363 Ka. Such distant divergence makes D1 and D2 as different from D0 as they were from Neanderthals.
- ▶ D2 might even have to be reclassified to give the group its own name.

In 2014, Russian collaborators sent Pääbo's team 2,000 badly damaged bone fragments from the Denisova cave.

**Samantha Brown**, for her Ms thesis, drilled 1308 of these bone fragments; discovered only 1 hominin bone (1.68g) coded DC1227)

► Tom Higham, her supervisor, was first told of the identification by the Oxford lab, then he replied at 8 AM, conveying a little of the crazy excitement of that moment:

FUCK FUCK FUCK!!!!!!

WOW FUCK!!

SHIT!!


REALLY??????????

(i'm trying to keep calm here)

... FUCK

# DNA analysis of one Denisova bone fragment (coded DC1227).

50



Denny is the daughter of a Neanderthal mother  
and a Denisovan father...

## Headlines:

**Hybrid Neanderthal love child found in cave in Siberia**

**Prehistoric humans did hanky-panky, shows study**



TRIPPER AND  
THE STRAITS  
MAYOR'S  
DYNAMO  
MAYORIAL  
STRATEGY

Slon *et al.* 2018; *Nature*

Brown *et al.* 2016. *Nature Sci. Reports*

# 2018: Denisova 11 = 13 yo Girl's bone: N-D hybrid, 90 Ka



mtDNA: Neanderthal

Nuclear DNA: a genetic F1 hybrid = N mother- D father

# Denisovans: Denny, D 11

- ▶ Re-enter D 11, the tiny limb fragment from a young teenager who had lived around 90 ka.
  - ▶ mtDNA placed her as a Neanderthal.
  - ▶ nuclear DNA instead showed her father had been Denisovan.
- ▶ 'Denny', as she was nicknamed, is the only first-generation hominin hybrid ever found.
- ▶ Finding the child of a union between different kinds of hominin implies that interbreeding can't have been that uncommon.
- ▶ At least one of her father's ancestors had encountered Neanderthals too, albeit thousands of years and many, many generations before.

# Denisovans

- ▶ Father's N ancestor wasn't from the same genetic population as Denny's N mother.
- ▶ Mother was more closely related to a 55 Ka Neanderthal from Vindija cave in Croatia than to the next door 'Altai Neanderthal', who lived in Denisova Cave 30,000 years before Denny. This suggested that either western Neanderthals had migrated to the Altai or that Neanderthals from the east had moved to Europe and replaced the Neanderthals there.
- ▶ No Neanderthal fossils or DNA have ever been found from farther east, and no Denisovans from farther west. This cave was literally at the edge of their two worlds.

# What is DNA methylation

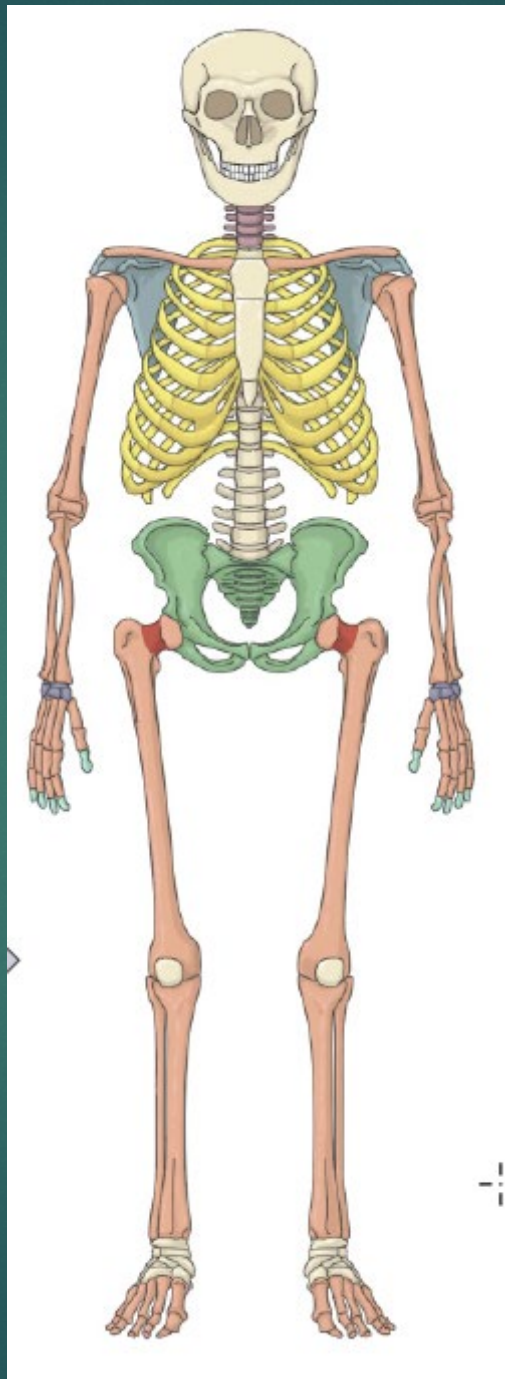
- ▶ **DNA methylation** is a biological process, **via experience**, by which methyl groups are added to specific parts of the DNA molecule.
- ▶ Methylation can change the activity of a DNA segment without changing the DNA sequence.
- ▶ When located in a gene promoter, DNA methylation typically acts to repress gene transcription/expression. One way evolution tamps down on gene activity is methylation.
- ▶ In intergenic regions it is linked to the activity of enhancers and insulators. Turns on gene activity
- ▶ Two of DNA's four bases, cytosine and adenine, can be methylated. Cytosine methylation is widespread.

# Reconstructing the **DNA Methylation Maps of the Neandertal and the Denisovan**

- ▶ We reconstructed the full DNA methylation maps of the Neandertal and the Denisovan by harnessing the natural degradation processes of methylated and unmethylated cytosines.
- ▶ Comparing these ancient methylation maps to those of present-day humans, we identified ~2000 differentially methylated regions (DMRs).



Proposed  
Denisovan  
skeleton  
using methylation  
data

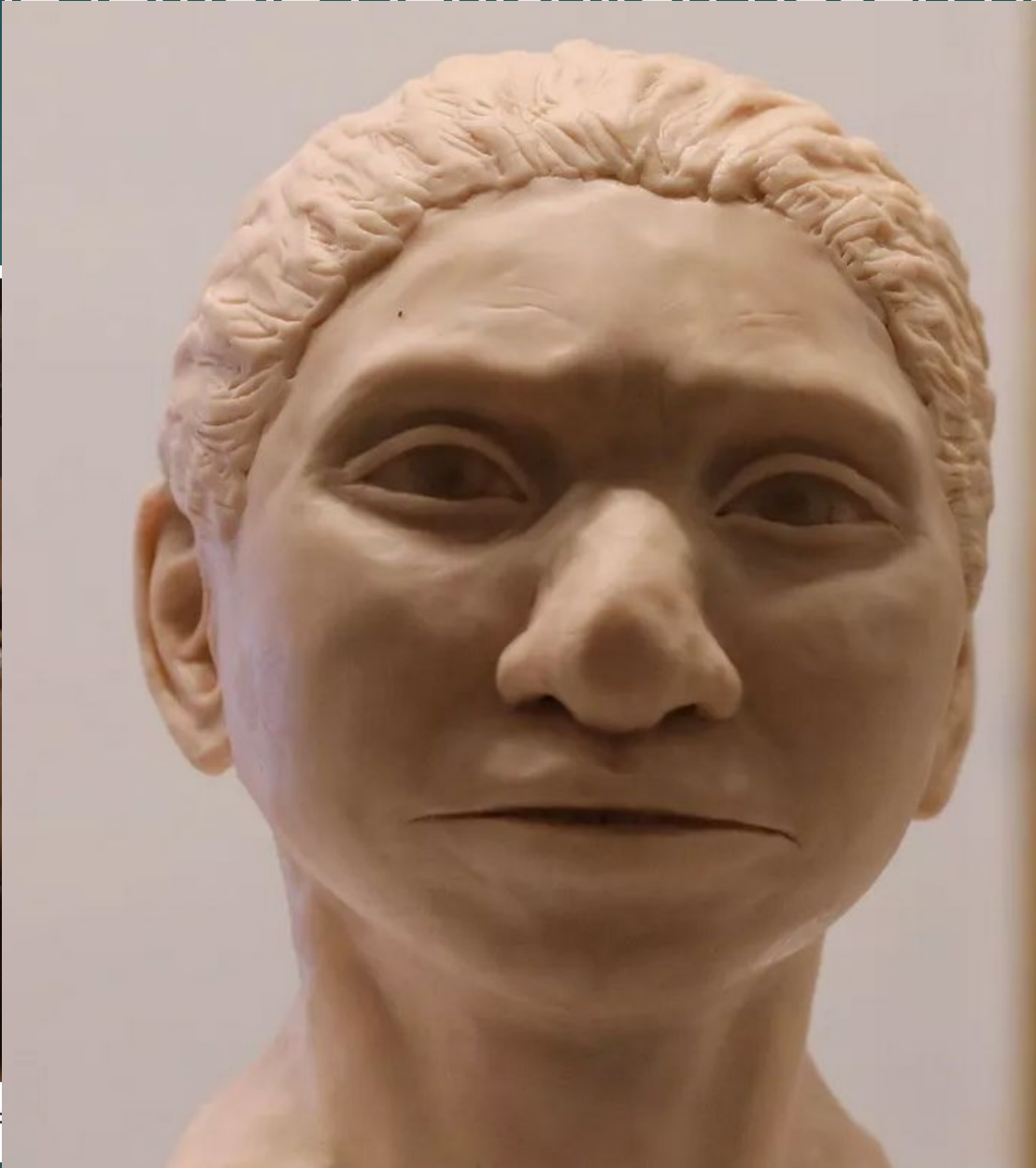


# Portrait of a juvenile female Denisovan based on a skeletal profile rec



This image is based on reconstructed skeletal features of a Denisovan

MAAYAN HAREL



## Information about Denisovans by 2019

- ▶ 6 Current Denisova specimens:
  - ▶ Finger bone (Denisova 3 – X woman),
  - ▶ molar (Denisova 4 - male),
  - ▶ toe bone (Denisova 5, Altai Neandertal) = best N genome
  - ▶ 2<sup>nd</sup> molar (Denisova 8),
  - ▶ Deciduous molar (Denisova 2) = 227-129 Ka
  - ▶ Denisova 11 - Denny
- ▶ 430 Ka Sima de los Huesos hominins are early Ns= D mtDNA and N nDNA

## Information about Denisovans by 2019

- ▶ Denisovans are now considered the last surviving extinct relatives of modern humans.
- ▶ Ds have 17% N Dna; and 6-8% superarchaic lineage (*H. erectus*?)
- ▶ Melanesians show genetic similarities to both Neandertals and Denisovans; Aboriginal Australians have ~ 4.0% D DNA
- ▶ **D-related DNA** in E Asians is much lower than in New Guineans: about 0.2% of E Asian DNA, rising up to 0.3-0.6% in parts of S Asia.

# Denisovans

- ▶ Negritos of Philippines have the most D DNA; Ayta Magbukon display ~30%–40% greater Denisovan ancestry than Australopapuans. Consistent with an independent admixture event into Negritos from Denisovans
- ▶ WARS2 and TBX15 Denisovan genes, associated with adipose tissue differentiation and body-fat distribution in humans, in Inuits

## Information about Denisovans by 2019

- ▶ Pacific Islanders and Aboriginal Australians: 3% to 6% D DNA
- ▶ ~7% of Papuan genome is from earlier forms of humans:
  - ▶ 2.5 % from Ns;
  - ▶ later gene flow brought ~4.8 % of D DNA into the Papuans
- ▶ Ds persisted longer than the N extinction period

# Information about Denisovans as of 2020

## ▶ Icelandic study of 27,566 Icelanders genomes:

- ▶ contain N and D DNA; amount of archaic variants in modern genome = Vindija Neanderthal (51%), Altai Neanderthal (13%), Denisovan (3%)
- ▶ Raises the possibility that there were Denisovan-like groups west of the Altai mountains

## ▶ Study of Denisova Cave sediments:

- ▶ Unclear if Ds actually lived there
- ▶ scant evidence for the use of fire.
- ▶ Hyenas are most likely the main accumulating agents of the faunal remains, given the dominance of their coprolites in the cave sediments

## 2020: use of new technology

- ▶ FINDER project: sift thru 40 K bones via collagen testing – ZooMS – 1 in 2000 bones are hominin in Denisova Cave
- ▶ Dating via optical analysis of sediment grains
- ▶ Sediment DNA
- ▶ New methodology: methylation based prediction of D skeleton



## \*\* Dating of Denisova Occupations

103 layers of sediment: continuous presence since 300 Ka; No Denisovan remains have been dated directly

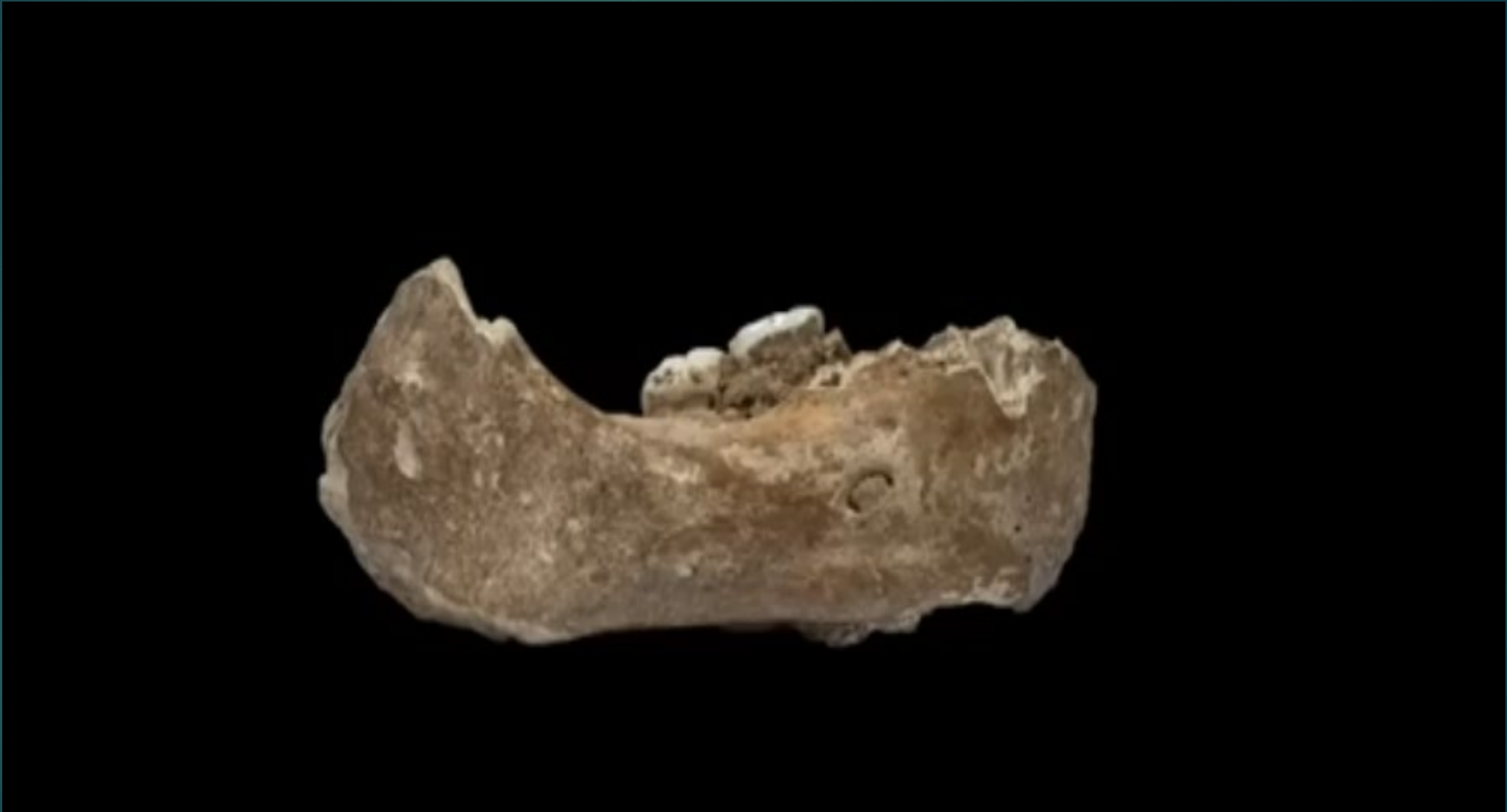
- ▶ Beginning at 300 Ka: Ns or Ds tools
  - ▶ 287 Ka: oldest stone tools (non-Mousterian) by ??, MIS 9
  - ▶ 217 to 185 Ka: oldest Denisovan DNA, MIS 7
- ▶ 287 (200 conservatively) to 55 Ka: Denisovans – fossils and DNA
  - ▶ 49 to 43 Ka: Pendants
  - ▶ 55 Ka: D skeletal
- ▶ 190 to 100 Ka: Neandertals – fossils and DNA
  - ▶ 205 to 172 Ka: Neanderthal DNA
  - ▶ ~118 to 79 Ka: Denny
- ▶ 140-110 Ka: Ns & Ds overlap
- ▶ No evidence of MHs in Late Pleistocene. Only later.

## \*\* 8 Denisovan Fossils: Discovery/Publication Dates

1. 2008/2010: Denisova 3: distal fifth finger bone (X-woman), girl
2. 2000/2012: Denisova 4: third molar, male
3. 2010/2015: Denisova 8: upper third molar, male
4. 1984/2017: Denisova 2: deciduous lower molar (milk tooth), girl
5. 2012/2018: Denisova 11: Denny
6. 2014/2019: Denisova 5: Neandertal toe bone: Altai Neanderthal
7. 2016/2019: Denisova 13: parietal bone fragment
8. 1980/2019: Xiahe Mandible

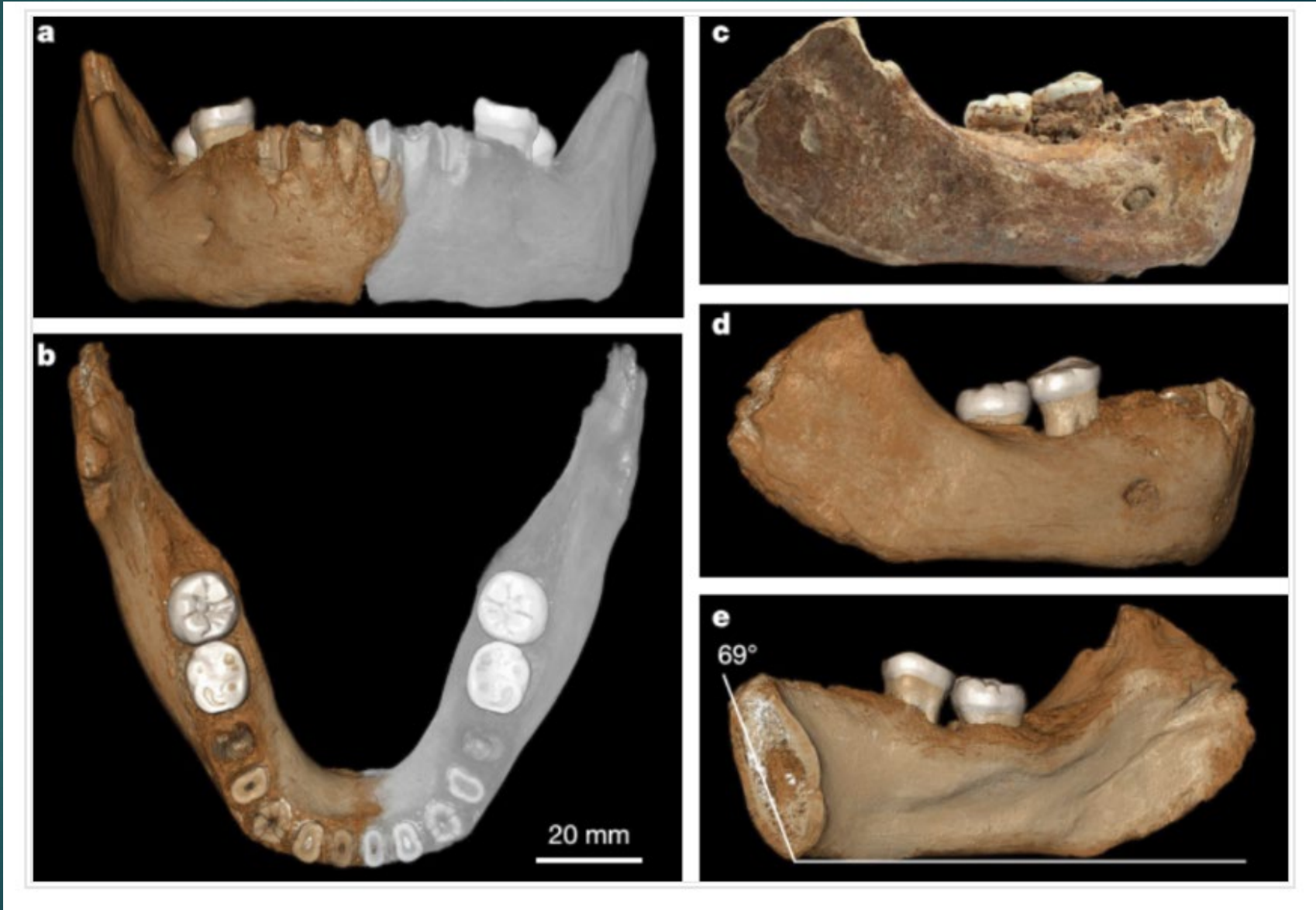
All the Denisovan material fit in a very, very small box.

2019: Denisovan jawbone at 3000 meters:  
Baishiya Cave, Gansu, China



# Denisovan jaw, 160 Ka, Tibet, 10,000 feet

Xiahe mandible

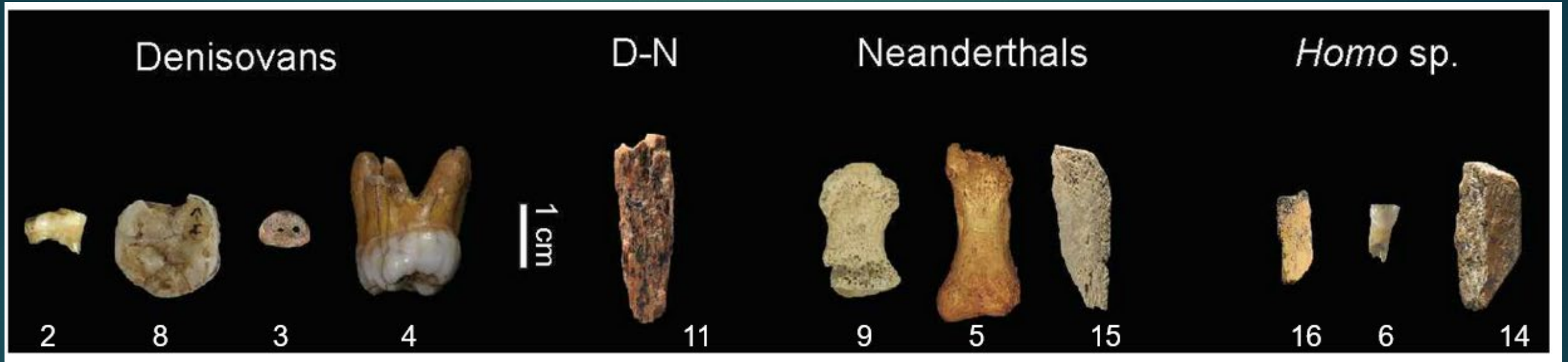


No chin

# Denisovan mandible: protein analysis

- ▶ A 160 Ka Denisovan right half of a mandible with 2 teeth
- ▶ Found in the Karst Baishiya cave in Xiahe (China) at 3280 meters of altitude
- ▶ First time an ancient human has been identified solely through the analysis of proteins.
- ▶ Although no traces of DNA were preserved in the fossil, it was possible to extract proteins from one of the molars. A phylogenetic analysis concludes that the individual belonged to “a population closely linked to the Denisovans of Siberia.”
- ▶ But this work was based on only two amino acid positions in the proteome, of which one matched the Denisovan. But the shape and anthropological analysis of the specimen seem to support Xiahe being Denisovan.

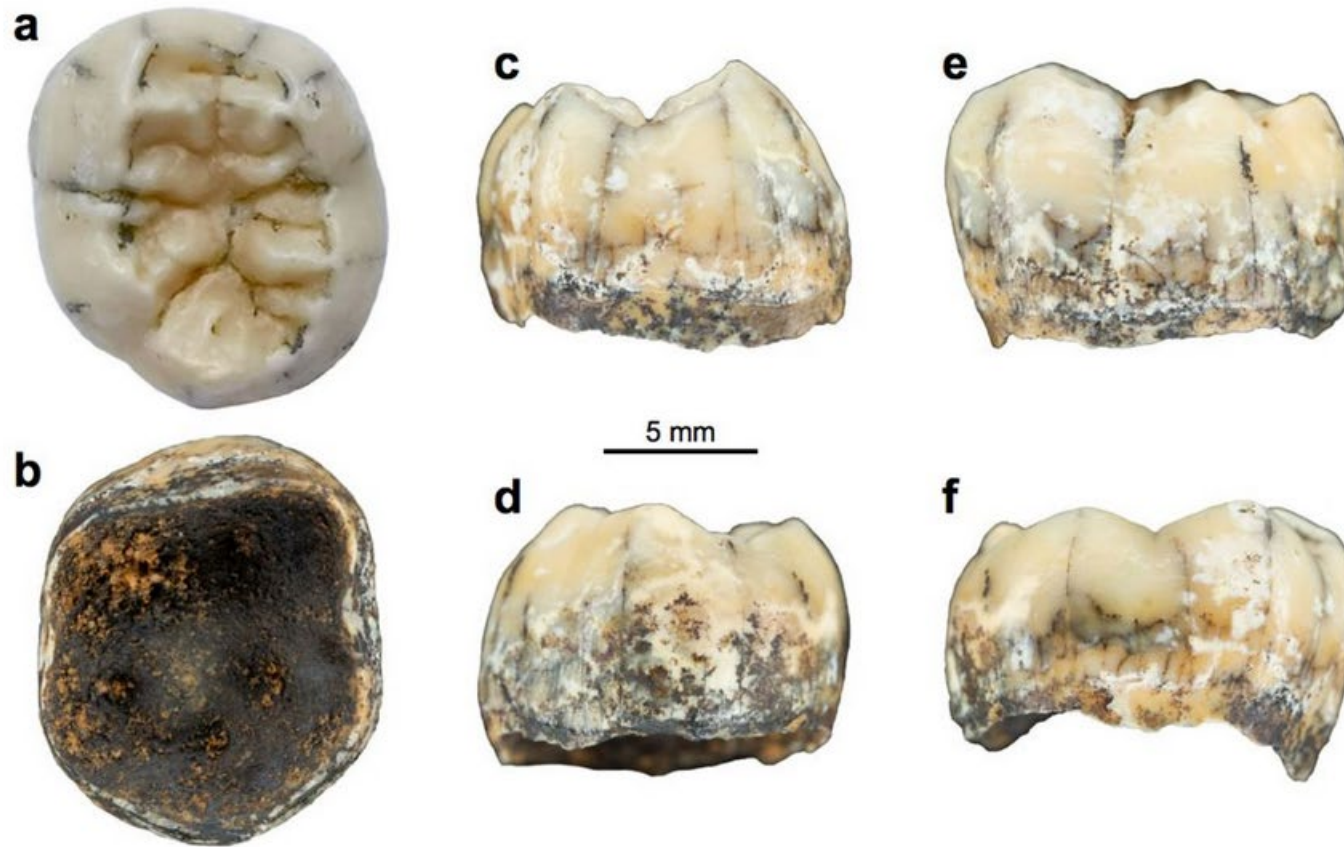
# Current 11 Denisovan Specimens: Fit on the palm of your hand



Almost all **less than 2 cms.**(less than 1 inch); mostly **acid etched** (digested and regurgitated or pooped out by hyenas); some have hyena DNA.

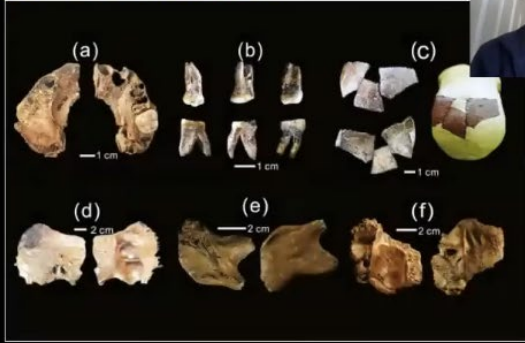
All from different individuals; mostly children.

# Molar from Laos, 164 Ka



Researchers in Laos uncovered an ancient molar that may have belonged to a 3-year-old Denisovan girl who lived up to 164,000 years ago. (Image credit: Demeter, E. et al. Nature Communications)

# Other 'Denisovans' in Asia?



Denisovan??

Xujiayao



Denisovan?

150 Ka

## Scientists hail stunning 'Dragon Man' discovery

By Pallab Ghosh  
Science correspondent



Picture credits — Wei Gao and Chuang Zhao



# The Dali skull and other candidates: Denisovan?

**Dali**



**Harbin**



Harbin:

309 to 138 Ka

8.7 in × 6.5 in  
vs MH 6.9 in  
× 5.7 in

Largest hominin  
skull

1,420 cc

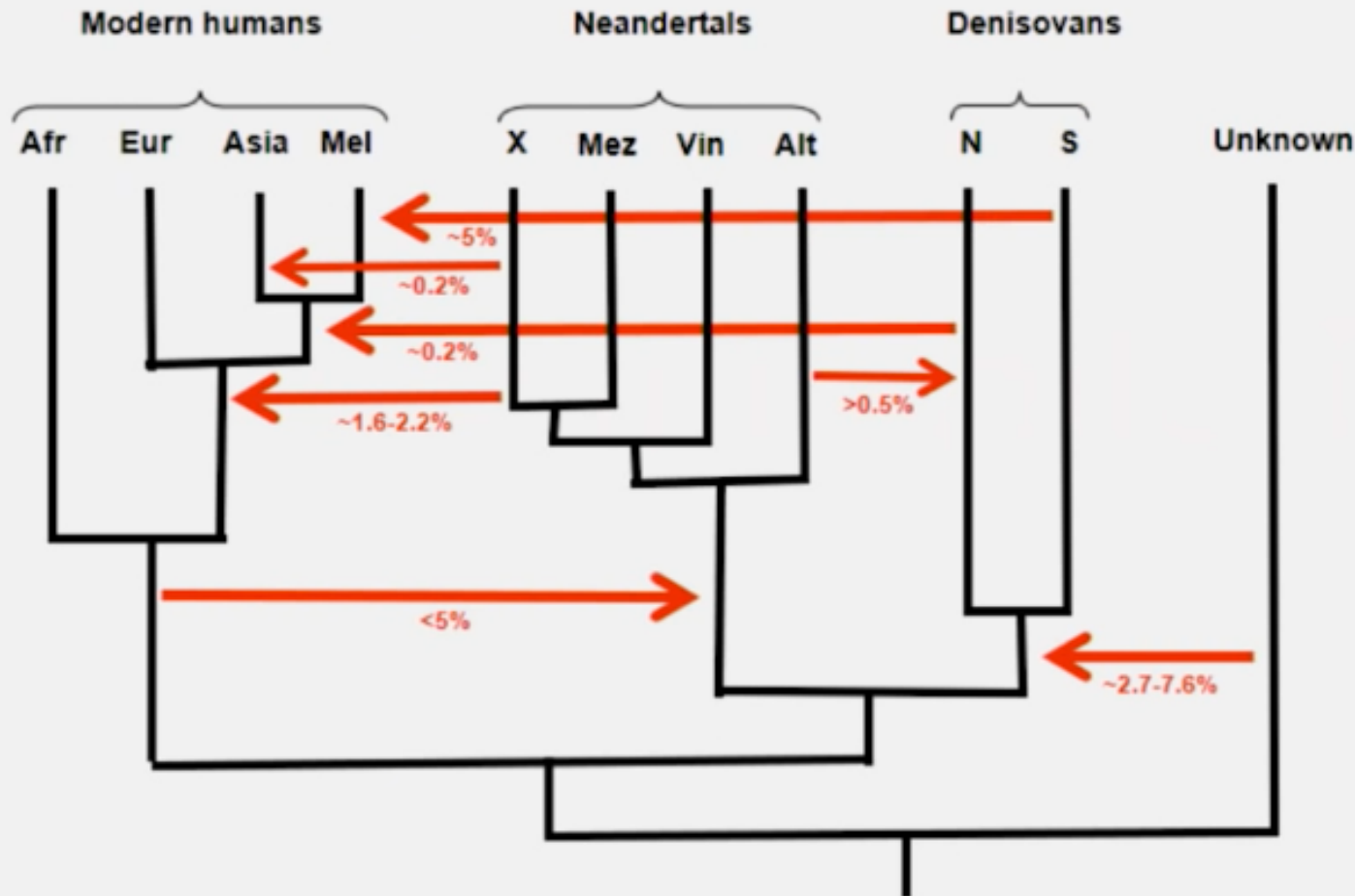
upper left  
second molar is  
enormous

Close to Xiahe  
Denisovan  
mandible



Harbin, 1;  
Dali (pics  
2,3,5) and  
Jinniushan  
(4)

We have always mixed! (when we have met...)



7 gene flow events/  
genetic  
introgressions:

2 D into MH

2 N into MH

1 N into D

1 MH into N

1 superarchaic (*H. erectus?*)  
into D

# Akkuratov, 2018: Papuan New Guinea

- ▶ 3% to 6% of the DNA of Pacific Islanders and Aboriginal Australians deriving from Denisovans
- ▶ ~7% of Papuan genome is from earlier forms of humans:
  - ▶ 2.5 % from Ns;
  - ▶ later gene flow brought ~4.8 % of D DNA into the Papuans;
- ▶ Unclear why D Dna is not more present in Mongolia, China, Cambodia, or mainland Asia; did MHs admix with Ds and take southern coastal Asian route before MHs populated rest of Asia and then met Ds in Indonesia

# Denisovans

- ▶ D DNA is present in Southeast Asia and Oceania, and in very small amounts (around 0.1-0.2%) in East Asian, South Asian and Native American populations.
- ▶ Find D DNA in Melanesia, Papua New Guinea, Bougainville, Australia, Polynesia, Philippines
- ▶ A major enduring question is **where this admixture took place**, as the Denisovan individual from Siberia is only distantly related to the source population of hypothetical 'southern Denisovans'.

World's **oldest stone bracelet** found in 11th layer of Denisova cave. Made from green-hued chlorite



# Immune system of modern Papuans shaped by DNA from ancient Denisovans

- ▶ First study to comprehensively shed light on the functional legacy of Denisovan DNA in the genomes of present-day humans.
- ▶ Found that in Papuans, Denisovan DNA—but not Neanderthal DNA—appears to strongly and consistently affect immune cells and functions.
- ▶ Denisovan DNA sequences successfully regulated nearby genes.

# Denisovan DNA

- ▶ The new study suggests that Denisovan DNA sequences altered the immune response in early modern humans living in New Guinea and nearby islands, potentially helping them adapt to their local environment.
- ▶ In Papuans, Denisovan DNA, but not Neanderthal, strongly and consistently affects immune cells and immune-related processes of potential evolutionary relevance.
- ▶ In vitro testing of introgressed variants confirms these predictions, suggesting Denisovan variants can impact gene regulation in vivo.



# N and D Immunity alleles

- ▶ Genes associated with immunity appear to be amongst the most positively selected genes introgressed to modern humans from our archaic cousins.
- ▶ Around 400 gene variants inherited from Denisovans are concerned with either immunity or diet.
- ▶ One of the variants with the highest frequency in living Papuans so far identified is called TNFAIP3. TNFAIP3 codes an immune controller protein called A20.
- ▶ This gene are associated with overactive immunity in autoimmune conditions such as arthritis, multiple sclerosis, inflammatory bowel disease and psoriasis.

## D immunity alleles

- ▶ The distribution of this variant in modern people is striking: people east of Wallace's Line have an extremely high frequency while those to the west have virtually none.
- ▶ In Island Southeast Asia and Oceania, between 25 and 75 per cent of people are carriers. Elsewhere in the world, there are none.
- ▶ Interestingly, the I207L variant was also found in the Denisovan girl from the Altai, Denisova 3, suggesting that it must date prior to the separation of the various Denisovan populations in East Asia and after the split from Neanderthals, since the Neanderthal genomes from Denisova Cave do not have it.

## D introgression phenotypic effects, esp. in East Asians

- ▶ Denisovan DNA associated with the **heritability of coronary artery disease**.
  - ▶ Two related cardiovascular phenotypes, **myocardial infarction, and coronary atherosclerosis** were previously associated with N DNA
- ▶ **Denisovan/Neanderthal loci**: associated with “**shortness of breath walking on level ground**”, which is a trait related to cardiovascular health.
- ▶ Also associated with **cellular stress responses**.

## D introgression phenotypic effects

- ▶ **Neanderthal alleles** explained a significant proportion of variance in risk in **coronary atherosclerosis**.
- ▶ **“Vascular/heart problems diagnosed by doctor”** was associated with a Denisovan-Neanderthal introgressed SNP
- ▶ Denisovan-introgressed allele was associated with a metabolic phenotype, **albumin/globulin ratio, related to immunity function**

# Ds and Inuit

- ▶ Denisovan introgression can also help us to explain **aspects of the lifestyle and adaptation of the Greenland Inuit**. To explore genes linked with adaptation to life in extreme Arctic conditions, researchers explored the genomes of Greenlanders to find genes that had high levels of positive selection in that population.
- ▶ One of the most positively selected signals in the Inuit studied comprised two genes called WARS2 and TBX15.
- ▶ These are linked with body fats and body-fat distribution, in particular to a type of fat called brown fat. This is common in newborn children, where it enables the bearer to generate heat by burning calories. TBX15 influences the body's reaction to cold climatic conditions

# Denisovan introgression has shaped the immune system of present-day Papuans

- ▶ 56 genomes from Papuan individuals.
- ▶ D in regulatory regions: Denisovan variants strongly affecting elements active within immune-related cells. We identify 16,048 and 10,032 high-confidence Denisovan and Neanderthal variants
- ▶ Only genes predicted to be regulated by Denisovan aSNPs are strongly involved in active immune responses.
- ▶ D variants of OAS2 and OAS3

# Bibliography

- ▶ Neanderthal Man – Svante Pääbo, 2015
- ▶ Who We Are and How We Got Here – David Reich, 2018
- ▶ The World Before Us - Tom Higham, 2018

# Marine isotope stages (MIS): dates

- MIS 1 – 12 Ka, end of the Younger Dryas marks the start of the Holocene.
- MIS 2 – 29 Ka (Last Glacial Maximum)
- MIS 3 – 57
- MIS 4 – 71
- MIS 5– 130, usually sub-divided into a to e:
- MIS 5e – 123 Ka (peak of Eemian interglacial): very warm
- MIS 6 – 191
- MIS 7 – 243
- MIS 8 – 300 Ka
- MIS 11 – 424
- MIS 20 – 814
- MIS 21 – 866
- ▶ The list continues to MIS 104, beginning 2.614 million years ago.



# +++ What's New with the Neandertals?

NEANDERTALS 2.0

THE NEANDERTHALS REINVENTED

## The Classic Other



## That difference...

- ▶ Rebecca Wragg Sykes, author of *Kindred*:
- ▶ “The Neanderthals induce something similar, a mirror image of us in so many ways, yet somehow aslant. Their liminal quality, at some anthropic edge, produces an uneasy tension. We mentally flinch at the same time as being drawn towards them, because they force us to reconsider how we mark the borders of humanity.
- ▶ There is no cognitive chasm between us, just as there was no reproductive barrier.”

# Their extinction does not define the Neandertals

- ▶ Neanderthals are often defined by their extinction. Because they went extinct, they must have been doing something wrong.
- ▶ However, as evidence continues to mount that shows that Neanderthals practiced what has been considered exclusively modern human behavior (plant consumption, fishing and fowling, ornamentation, etc.), it is important to remember that Neanderthals prospered for over 400,000 years in some of the most difficult ecology that existed.

## LCA of N and MH

- ▶ Sima de los Huesos N fossils dated to 430 ka pushes back the divergence between the Neanderthal and *H. sapiens* lineages to about 700 ka ago
- ▶ LCA of N and MH is usually thought of as *H. heidelbergensis*; but the African Kabwe/Broken Hill cranium of *H. rhodesiensis/heidelbergensis* has shown that this specimen could be dated to only about 300 ka, much younger than the expected age for an ancient African ancestor of ours.
- ▶ Given the recent discovery of Jebel Irhoud early MH in Morocco dated to 315 KA, it appears that *H. heidelbergensis* may not be ancestral to MHs in Africa.

# LCA of Neandertals

- ▶ There is currently not enough evidence to establish the exact nature of our LCA with the Neanderthals from about 700 ka, nor where it lived.
- ▶ C. Stringer & others now think that *H. heidelbergensis* in Europe is ancestral to Neandertals, but not to MHs in Africa

## *H. heidelbergensis* as ancestral to Neandertals in Europe

- ▶ The fossils of European Heidelbergers do seem to document a gradual consolidation in Europe of the distinctive Neandertal morphology.
- ▶ The inhabitants of Europe during the last glacial advance (MIS 5d, 4, and much of 3) were the archetypal, textbook-case Neandertals that Howell dubbed “classic” Neandertals.
- ▶ Examples include Monte Circeo (Guattari), Neandertal 1 from Germany, Spy from Belgium, the Gibraltar skulls, and the southwestern French series (La Chapelle-aux-Saints, La Ferrassie, La Quina, Le Moustier, etc.).

# Classic Neanderthals

- ▶ F. C. Howell argued that these “classic” specimens exhibited Neandertal features at their most extreme because these people were the most thoroughly adapted of all Neandertals to a cold periglacial climate.
- ▶ Some of the most complete Würm specimens (La Chapelle, Guattari 1, La Ferrassie 1) **are among the largest Neandertals known and have very large cranial capacities**

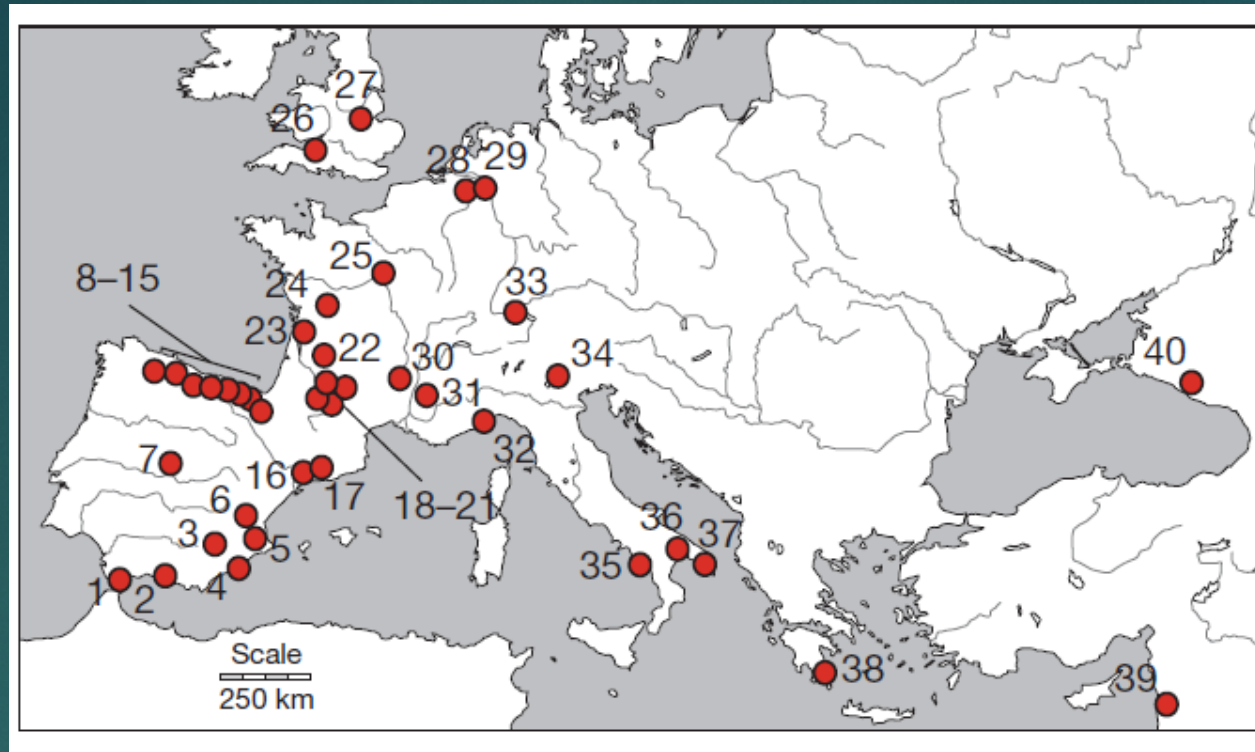


## Interbreeding: MHs have 1-2% N genes

- ▶ In 2010 a draft sequence of the Neandertal nuclear DNA provided clear evidence of interbreeding between Neandertals and modern humans.
- ▶ Originally noted as 1-4%; a revised estimate now suggests 1.5–2.1%.
- ▶ In sum, interbreeding and assimilation are now supported by genetic data
- ▶ Gene flow from Ns to modern humans occurred, ~50 Ka.

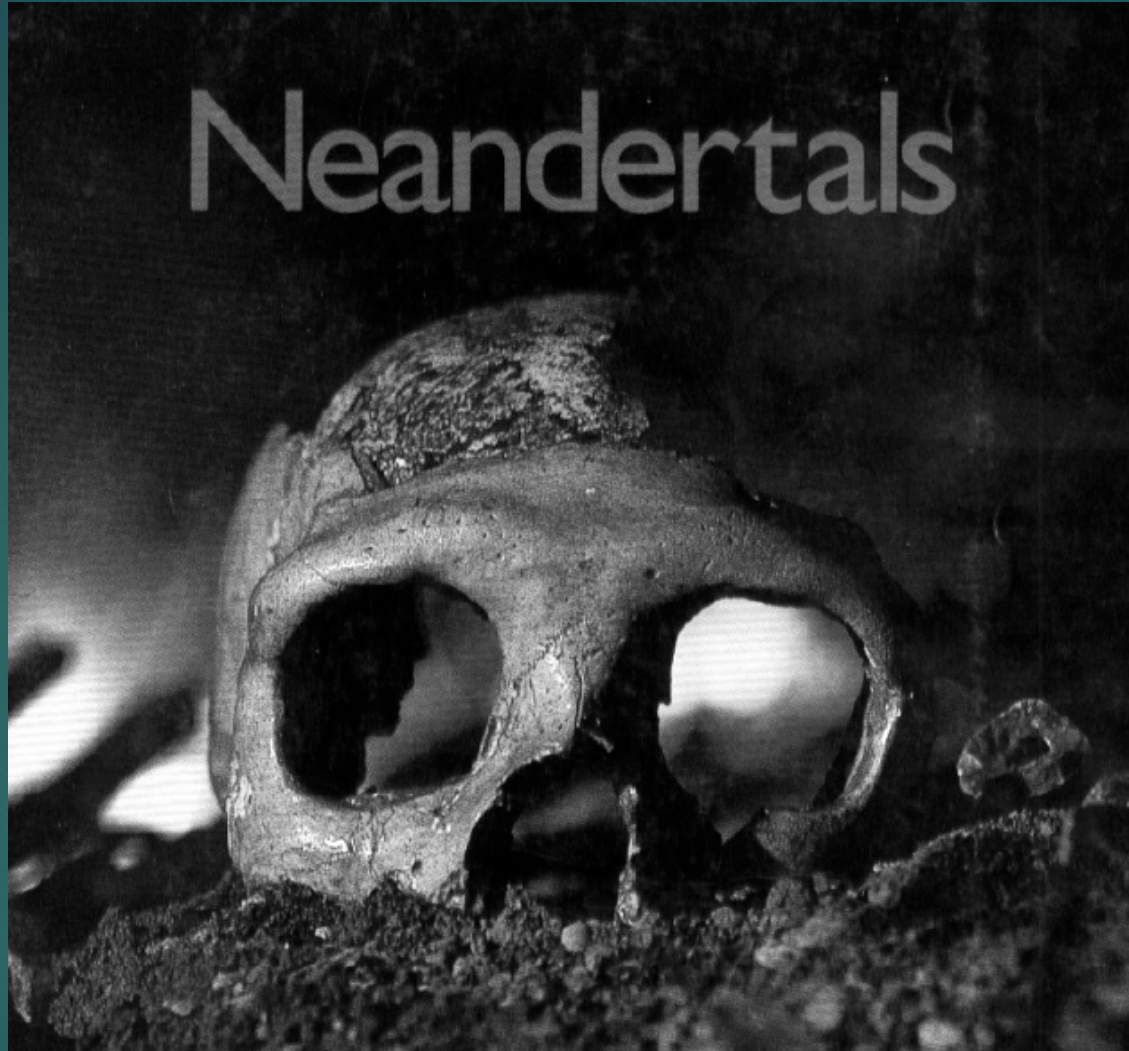
# Foundational statistics

- ▶ Two modern humans share 99.9% of our human genome. A difference of 0.1%.
- ▶ A Neandertal and a modern human share 99.7%. Only 0.3% difference
- ▶ They are significantly similar to us. They are just as human as we are, with some slight differences.
- ▶ They are Kindred.
- ▶ Another pathway in being human.



1: **Gorham's Cave**; 2: Zafarraya; 3: El Nino; 4: Sima de las Palomas; 5: **El Salt**; 6: Quebrada; 7: Jarama VI; 8–15: La Vina, **El Sidròn**, La Guelga, Esquilleu, Morin, Arrillor, Labeko Koba, Lezetxiki; 16: **Abric Romani**; 17: L'Arbreda; 18–21: Pech de l'Aze', **Le Moustier**, **La Ferrassie**, **La Chappelle**; 22: **La Quina**; 23: **Saint-Ce'saire**; 24: Les Cotte's; 25: Arcy-sur-Cure; 26: Hyaena Den; 27: Pin Hole; 28: **Spy**; 29: Grotte Walou; 30: Ne'ron; 31: **Mandrin**; 32: Bombrini/Mochi; 33: Geissenklo"sterle; 34: **Fumane**; 35: Castelcivita; 36: Oscurusciuto; 37: Cavallo; 38: Lakonis; 39: Ksar Akil; 40: **Mezmaiskaya**.

# Neandertals



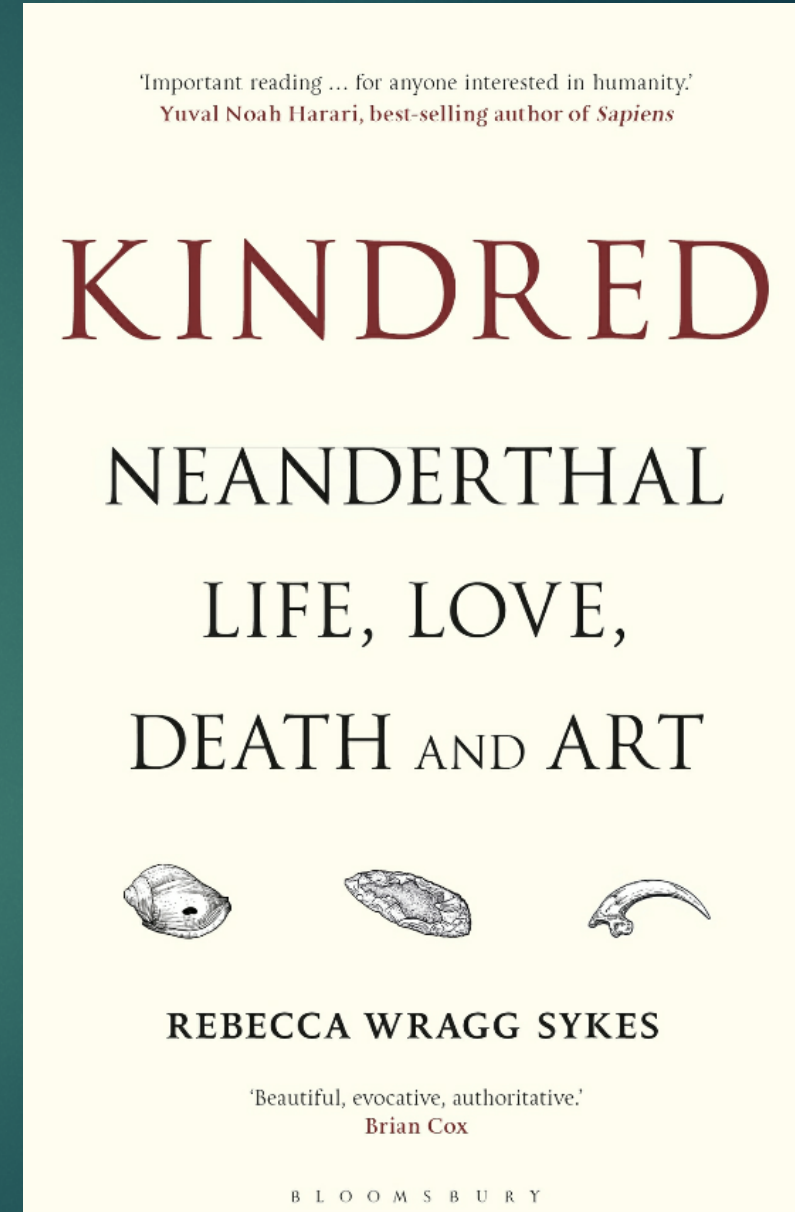
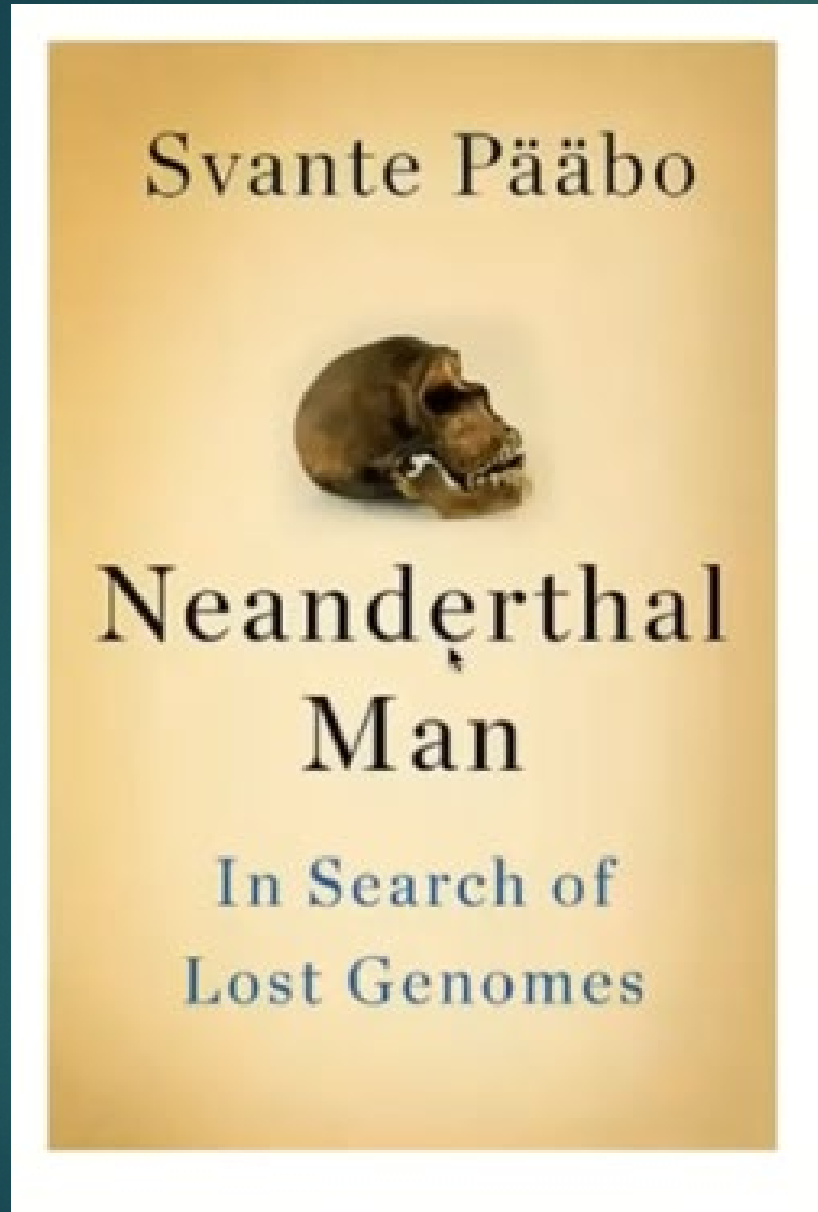
The most famous and best understood of all fossil humans.  
But were they an evolutionary dead end or not.

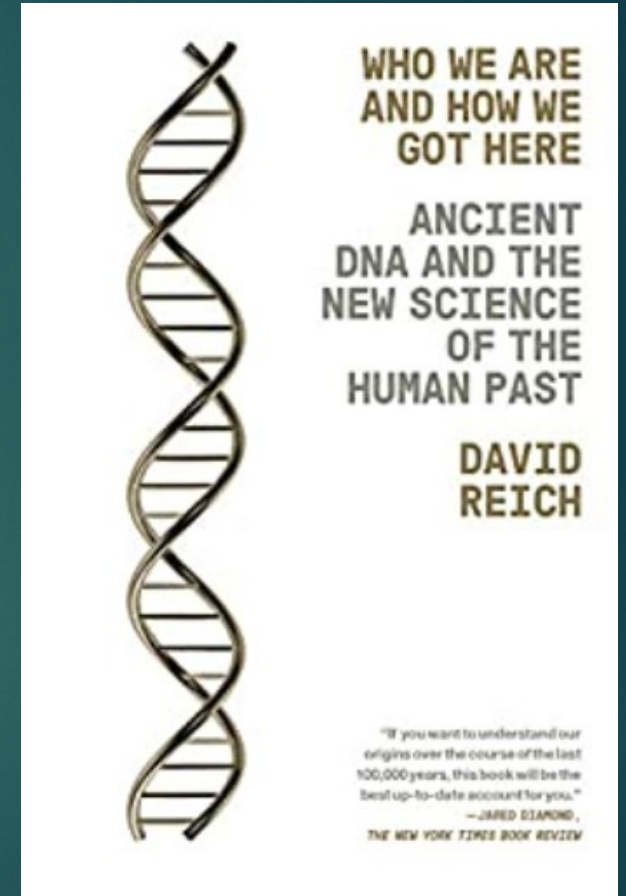
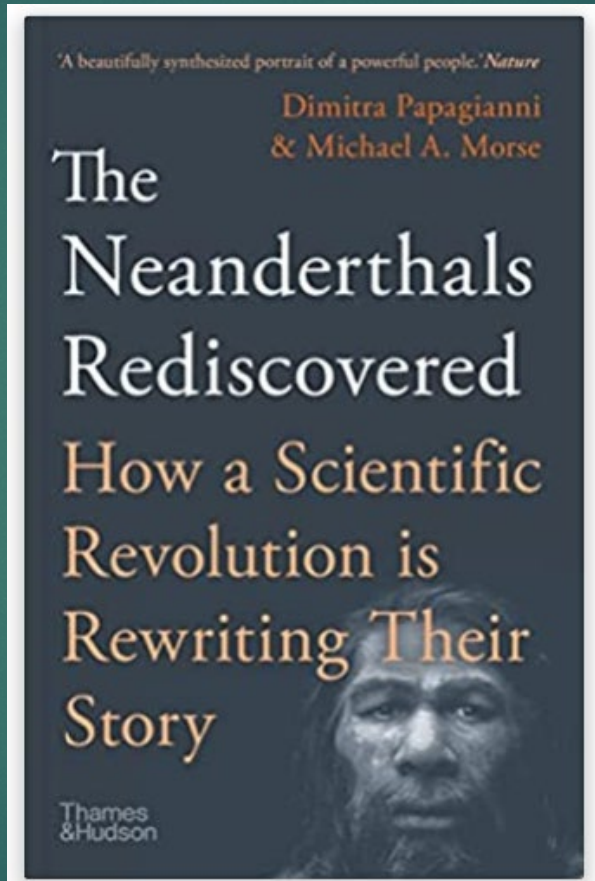
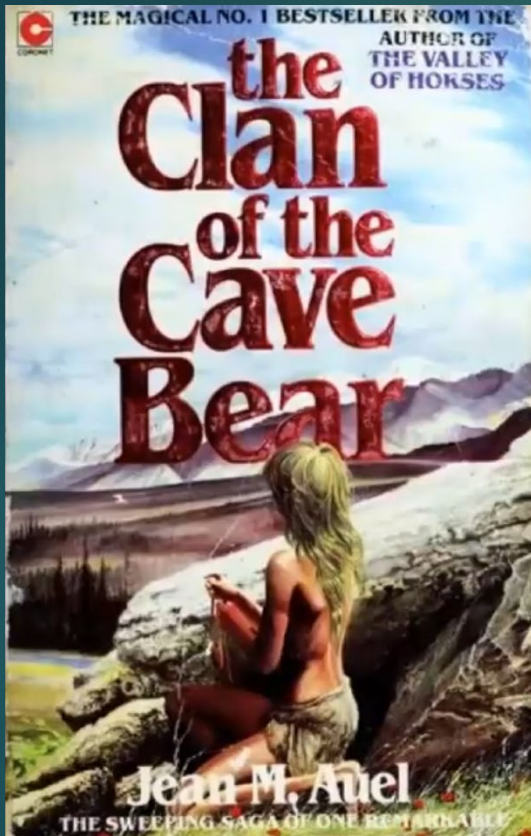


Neandertals = the James Deans of human evolution—they grew up fast, died young, and became legends.

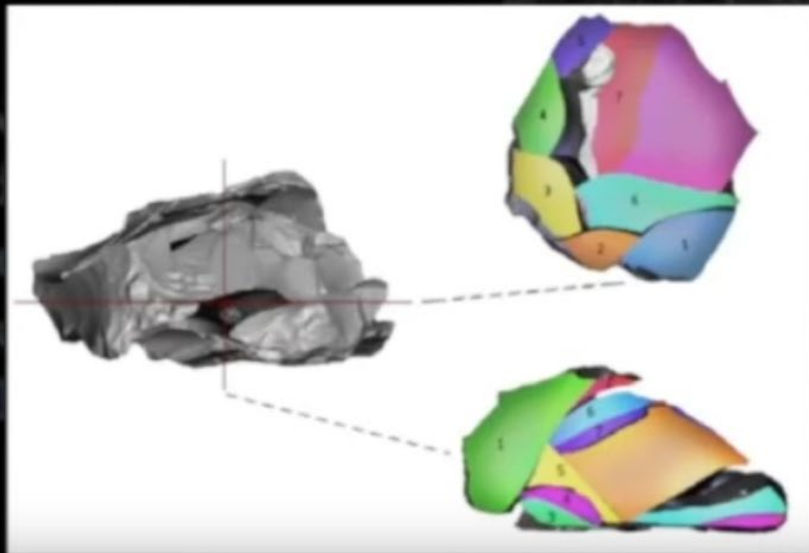
Oct. 2008

(Ann Gibbons)





# Advances in archaeology



## Advances:

3D CT scanning

Total Station surveying – projection of every layer

Barcode every miniscule item

Micro stratigraphy

Refitting cores of stone tools

Micro excavation of layers at cm range

Microscopic hearth analysis

aDNA - DNA from sediments

Archeological teams are now massively multidisciplinary



# Archeology has changed: tools today's archeologists use

- ▶ **Older archeological technology:** bulldozer, shovel, trowel, pointing trowel, sieve, toothbrush, brush, bucket, flag, camera, clipboard, pen, tape measure, grid system, C<sup>14</sup> dating
- ▶ **Newer technology:** electronic compass, GPS device, resistivity meter, magnetometer, ESL, U-thor dating; discarded waste analysis/debitage
- ▶ **Total Solution Theodolite:** This is an electronic tool used during a survey that measures distance, slope, angles, and the elevation of a feature at an archaeological site.
- ▶ GIS (geographic information systems); ground penetrating radar
- ▶ DNA/protein analysis, microwear teeth analysis, eDNA analysis, geologic isotopes
- ▶ Computers, statistics

# Stone Tool Refitting

- ▶ **Refitting** – basically, putting all stone flakes from which a stone tool was made back together, looking at the sequences they used for knapping, the process of flaking stone blocks to make tools.
- ▶ It's "**slow archaeology**": you excavate meticulously and collect even the tiniest objects. Then you try, piece by piece, to fit those 3-D fragments back together. It takes hundreds of hours, but if you don't do that you're missing so much about how things were made and used.
- ▶ **Refits have been used to evaluate:**
  - ▶ the non-human and post-depositional processes that have caused the stratigraphic displacement of archaeological items;
  - ▶ reconstructing site formation and taphonomic processes;
  - ▶ analysis of stone technology (use-wear analysis)
  - ▶ intra-site spatial distribution (spatial functions, number of occupants)
- ▶ .

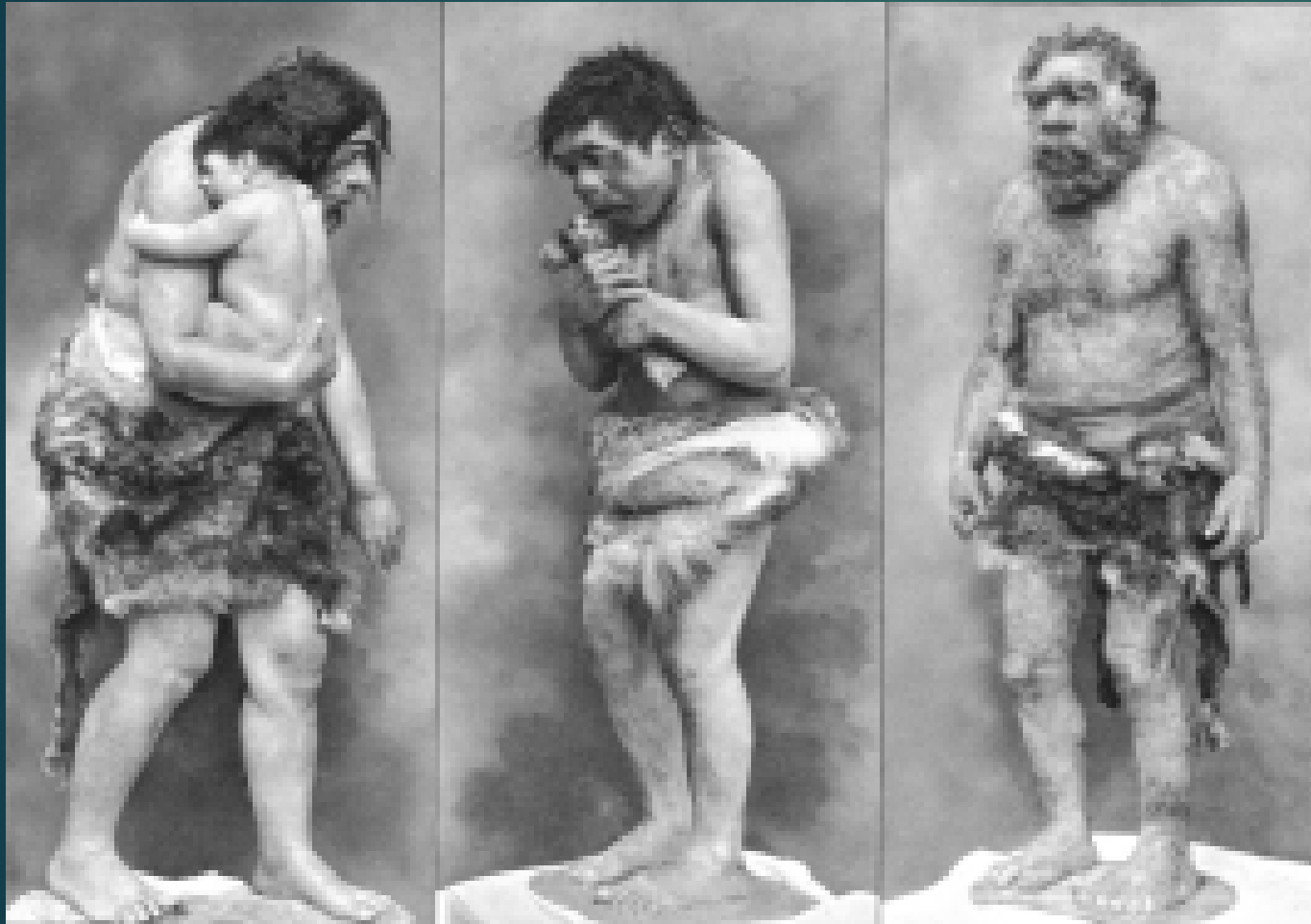
# Site reconstruction

- ▶ To study these archeological places, modern technology as well as infinite patience is vital. Lasers record object positions in 3D, providing data to digitally reconstruct the vertical or horizontal spreads of artefacts.
- ▶ Details such as lithic clusters around hearths or micro-layers invisible during digging emerge on screen.
- ▶ A key approach is to **look for 'special' things**: unusual stones or rare animal species that stand out against masses of other fragments.
- ▶ Combined with **refitting and microscopic sediment analysis**, today we are as close as we may ever get to being able to 'watch' Neanderthals going about their daily lives.

# Beliefs about Neandertals

- ▶ There is still a widespread, persistent belief that Neanderthals were less capable, and less intelligent than modern *Homo sapiens* despite a plethora of recent finds that demonstrate their technological, cultural and social sophistication.
- ▶ We now have even more proof that they were as intelligent as we were when they disappeared

# Neanderthals: Earlier Views = Not history's Intellectuals

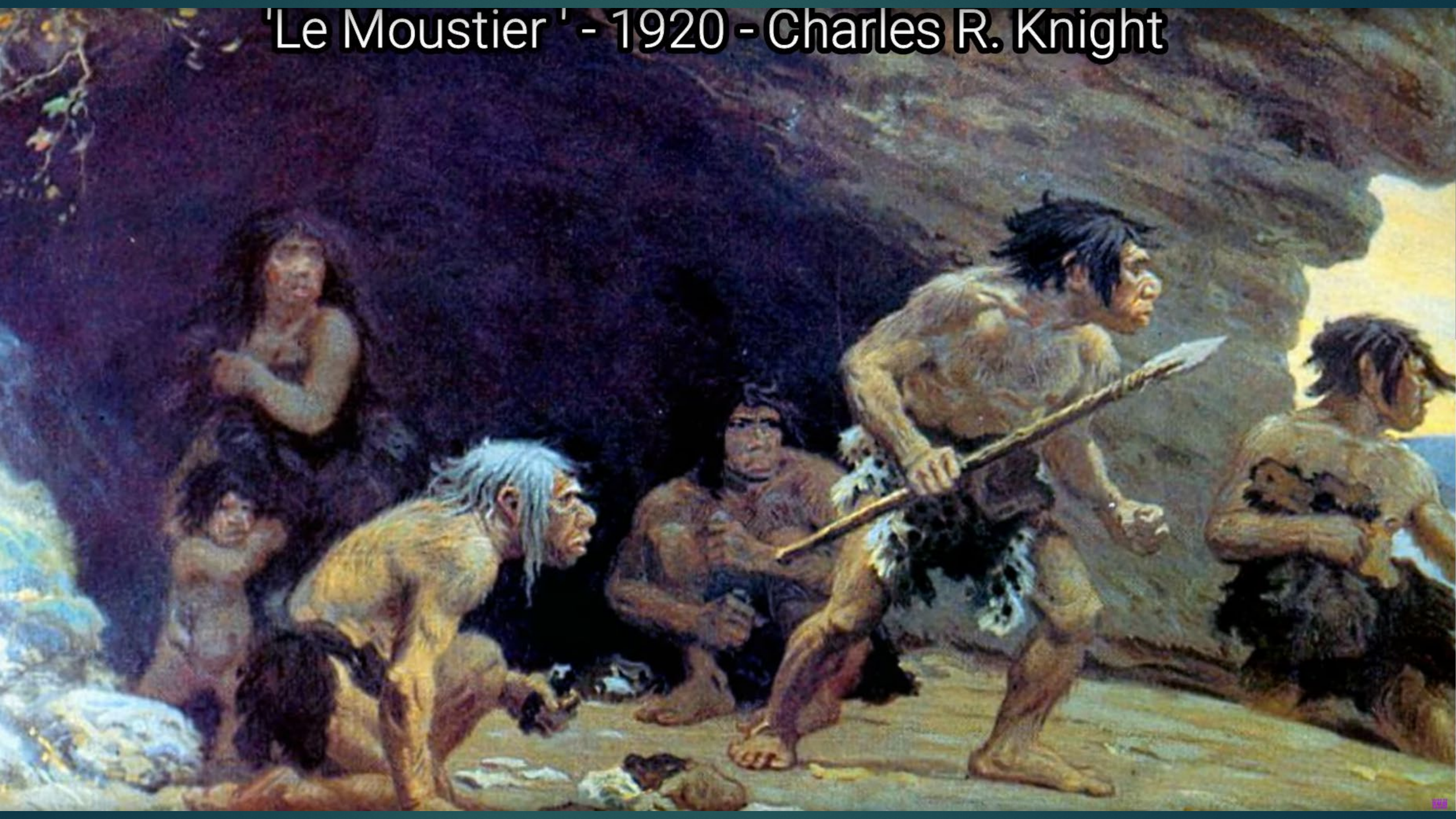


Until very recently, Neanderthals were most often depicted as brutish, dimwitted, “half man . . . half beast.”



Field Museum, 1915:  
Based on La Chapelle

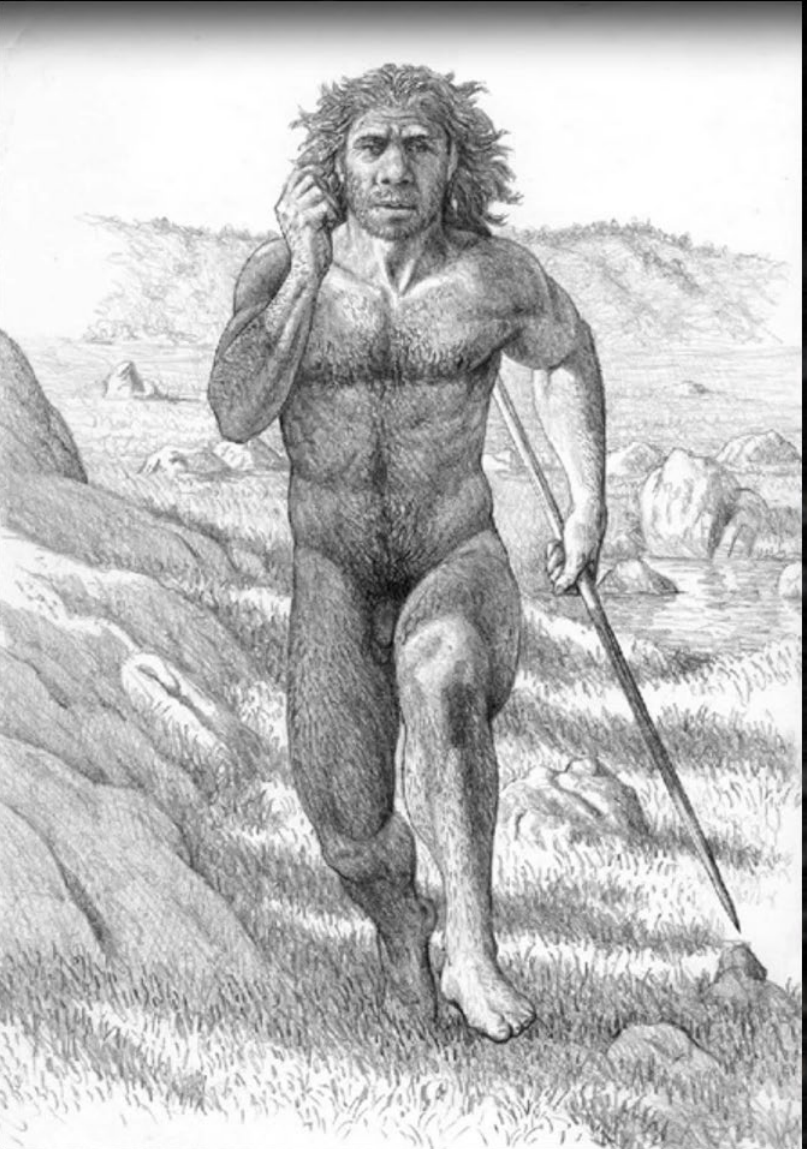
'Le Moustier' - 1920 - Charles R. Knight



# Which image of N?



Field Museum, 1930s  
Blaschke



Contemporary  
M. Antón

# We assumed Ns were dumb: because they are gone

## **News flash: negative evidence convicts Neanderthals of gross mental incompetence**

John D. Speth

There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact.

(Mark Twain)

As this is an issue of *World Archaeology* whose overall aim is to promote lively discussion, I hope with this rather smallish contribution to do likewise. In the process, I will stick my neck out far enough that some of my readers will no doubt be delighted to perform the obvious surgery. And, although my tone may seem rather heavy-handed at times, this is done not with the conviction that my ideas are right and those I question are wrong, but

In a 50,000 years, after the eventual effects of climate change, what will the bright rats say about us?

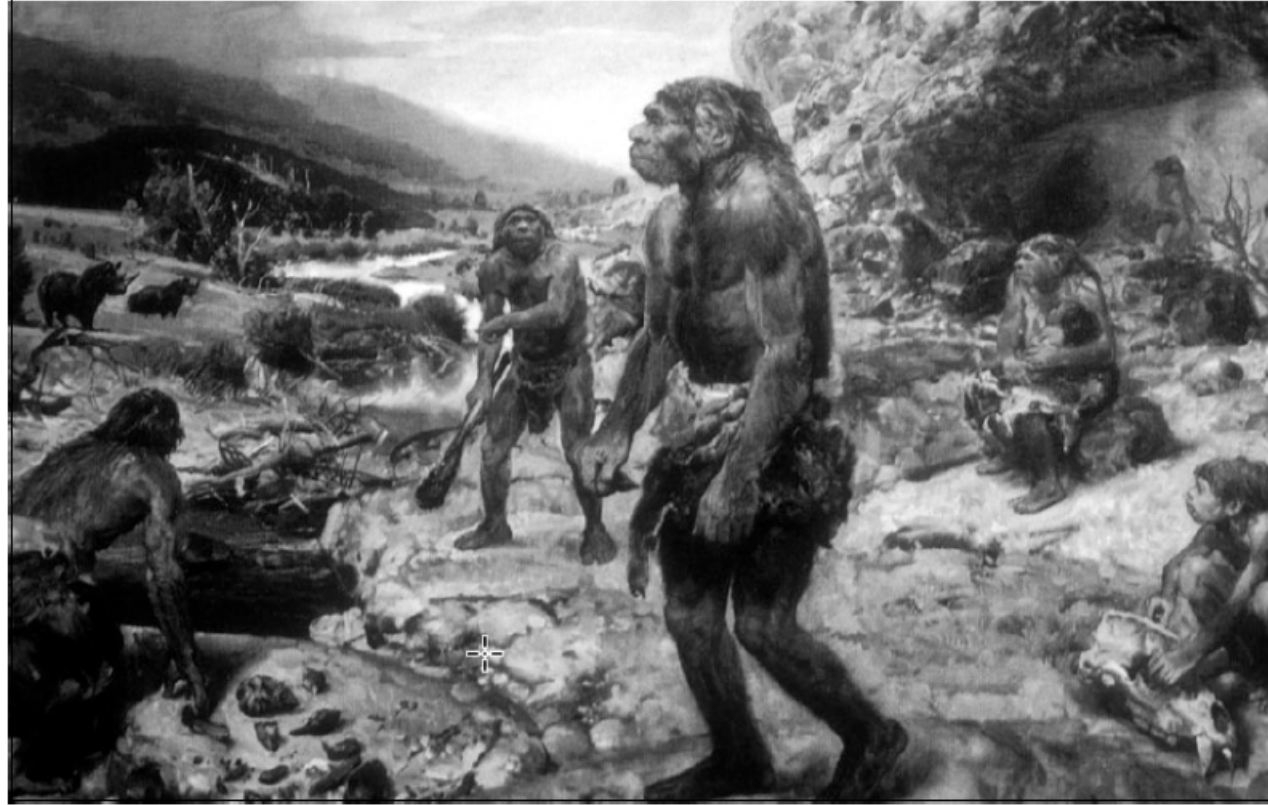




EXTINCT?!  
I'VE BEEN  
MARRIED TO ONE  
FOR 30 YEARS!

News  
SCIENTISTS  
MAY CLONE  
EXTINCT  
NEANDERTHALS

## “cave men”



We once pictured Ns as a brutish, stocky group of primitive humans who could only grunt to communicate and violently wield their clubs before anyone got too close.

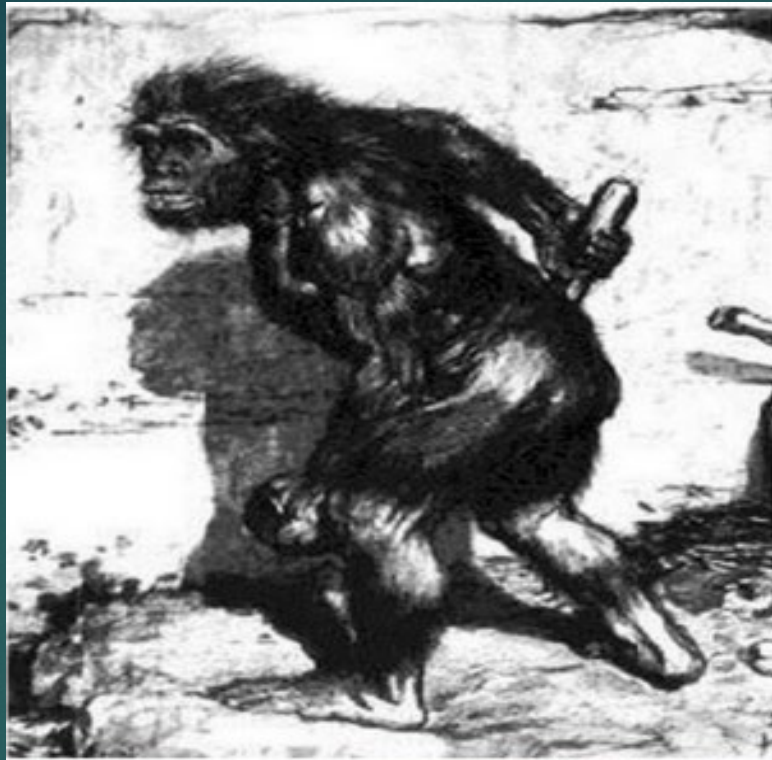
**Neandertal: our only fossil curse word:** only hominin species that is used as a paleontological insult – “You are a Neandertal”; **a name synonymous for primitiveness**



# N as brute

- ▶ In an 1864 study of the Neander 1 skull, “The Reputed Fossil Man of the Neanderthal,” geologist William King (who named this species) speculated the Neanderthal’s “thoughts and desires... never soared beyond those of the brute.”
- ▶ The view persists today from GEICO ads to the Oxford English Dictionary (N = “(disapproving) a person who is unpleasant and rude, or whose behavior or ideas are old-fashioned and not acceptable”)

# Negative depictions of Ns





# THE NEANDERTHAL MAN

He held them  
all in the grip of  
deadly terror  
nothing could  
keep him from  
this woman he  
claimed as  
his own!

CLASSIFIED BY  
ONTARIO BOARD OF CENSORS  
AS  
**ADULT ENTERTAINMENT**

STARRING  
ROBERT SHAYNE  
RICHARD CRANE  
DORIS MERRICK  
JOYCE TERRY  
Directed by E. A. DUPONT  
Written and Produced by  
AUBREY WISBERG and  
JACK POLLEXFEN  
A WARNER BROS. PRESENTATION  
DISTRIBUTED BY WARNER BROS. PICTURES  
RELEASED FROM WARNER ARTISTS

**HALF MAN... HALF BEAST...**

1953 Film: Anthropologist devolves into a murderous Neanderthal.



Svante Pääbo: 'It's maybe  
time to rethink our idea of  
Neanderthals'



# Rethinking Neandertals

- ▶ Many current researchers accept that Neandertals were:
  - ▶ intelligent
  - ▶ capable of developing highly functional tools to help them adapt to a wide variety of ecological zones
  - ▶ buried their dead,
  - ▶ cared for the sick,
  - ▶ had language
  - ▶ had art
  - ▶ mated with us
- ▶ But the question has always remained: **Why did they go extinct?**



# N mtDNA - 1997

- ▶ Mitochondrial (mt) DNA sequences began to be recovered from Neandertal bones in 1997.
- ▶ Neandertal haplotypes were described as falling outside of the modern human range, and were accordingly interpreted as proving that Neandertals are a different species from H. sapiens and did not contribute to the gene pools of the early modern populations that replaced them.
- ▶ However, the DNA evidence took a U-turn in 2010. Analysis of the first high-coverage Neandertal draft genome demonstrated that 1-2% of recent modern human nuclear DNA was Neandertal (N)

# Effects of aDNA studies of N on their image

- ▶ The impact of the new aDNA studies on views of Neandertals and their place in human evolution cannot be overestimated.
- ▶ For example, almost immediately after that draft genome was published, studies began to appear that attributed more complex, human-like behaviors to the Neandertals.
- ▶ Once the issue of whether some modern people are part Neandertal was solved, it was easier to accept that Neandertals' abilities mirrored our own. They were part of us.

# History of Inferring Neandertal Inferiority: Mother of all image problems

- ▶ No hominin group has been more maligned in the history of paleoanthropology than the Neandertals (N).
- ▶ Only hominin now known mainly for use of their name as a pejorative.
- ▶ Historical perception that *H. sapiens* was superior has blighted the perception and interpretation of Neandertal capabilities

# Comparative N and MH abilities

- ▶ For decades, most of the scientific community believed the arrival of MHs in Europe was the causation of N's demise
- ▶ It was assumed that humans replaced Neanderthals without interbreeding – the implication being that Neanderthals could not compete with our 'superior' capacities.
- ▶ Influential theories typecast them as creatures who were intrinsically antisocial, even to their own kind.

# Assumptions about Ns

- ▶ Paleoanthropologists believed that Neanderthals' social networks resembled chimpanzees', in which members tend to treat 'out-group' counterparts as enemies to be driven away or eliminated.
- ▶ This inference stemmed from the belief that Neanderthals generally moved their tools short distances from the source of the stone to the home sites where they were discovered – brushing aside the rare but widespread presence of artefact transfers over 100 km.

# Comparative N and MH abilities

- ▶ However, it's now clear that Neanderthals weren't any *less* 'evolved' than us.
- ▶ They were capable hunters and knowledgeable gatherers; artisan crafters across a range of materials.
- ▶ They weathered multiple glacial cycles over 400 K years, they survived extreme climate change as rapid and severe as the worst predictions for the coming centuries.

## *Kindred: R. Wragg Sykes*

- ▶ All the new evidence calls into question the way we have theorized Neanderthal lives, often involving lists of standards they must meet to be considered genuinely human.
- ▶ **'Modern' behavior** has always been a very particular version of how we like to think of ourselves.
- ▶ **A classic example** – still being played out in arguments over re-excavation of the La Chapelle site – is **at what point are we prepared to grant Neanderthals a conception of death?**

# Kindred

- ▶ Too often, clear evidence for special treatment of the deceased is not enough; only a perfectly cut grave, the perfect example of 'proper' Christian burial, is considered proof of meaningful social practices.
- ▶ Yet their relatedness to us is hardly the most interesting thing about them. Instead of a cautionary tale of a disreputable cousin, they are a uniquely precious mirror that refracts, rather than reflects. **Far from some primitive offshoot, Neanderthals should be more accurately understood as another of nature's experiments in humanity. They are Kindred.**



# Neandertals

- ▶ **First hominin ever discovered** in 1856 (= 1<sup>st</sup> recognized N; 2 prior N skulls at Engis and Gibraltar)
- ▶ Archeology grew up at same time.
- ▶ The first Other.

Unknown Neandertals: 1 = **Engis**, Belgium N skull, **1829**: not identified till 20<sup>th</sup> C; 2 = The **Forbes** female skull from **Gibraltar** as it was when it came to George Busk in **1864**, still covered with concretions.



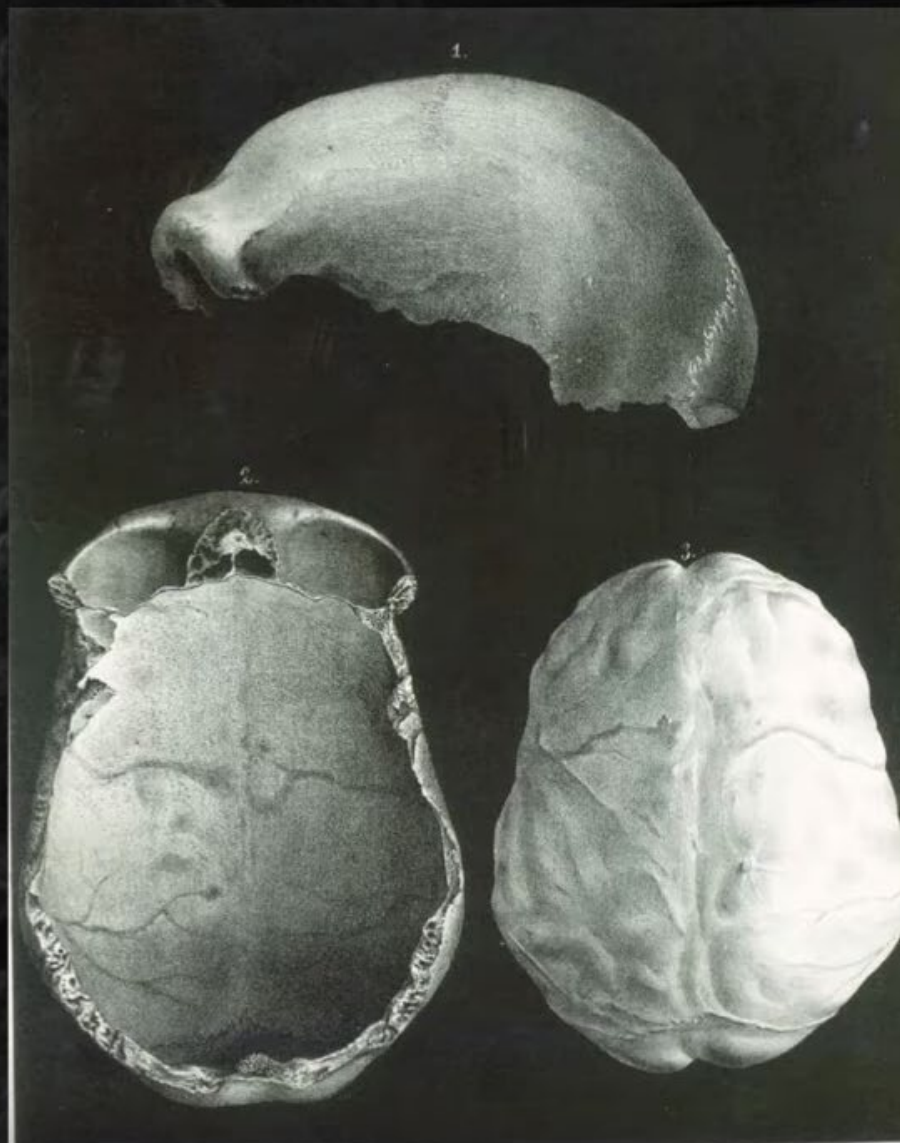
Engis

Forbes, Gibraltar

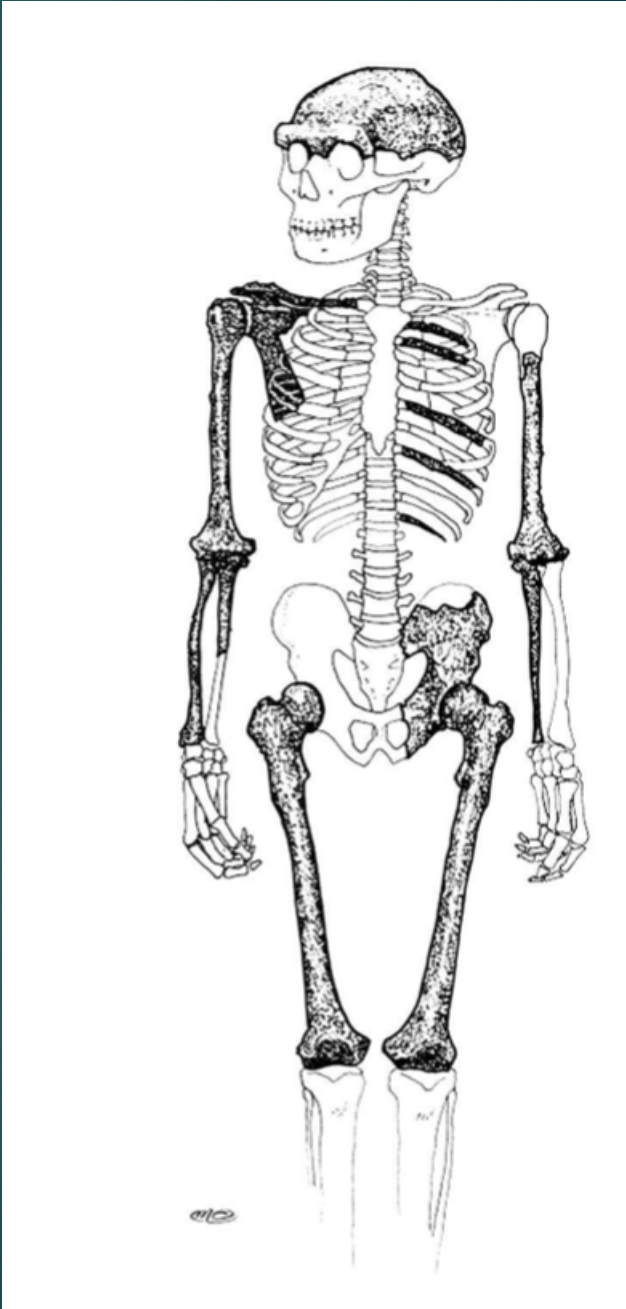
# Rendezvous: 1856



DIE WANDERHÖHLE IM GEBIRGE



# Limestone quarrying

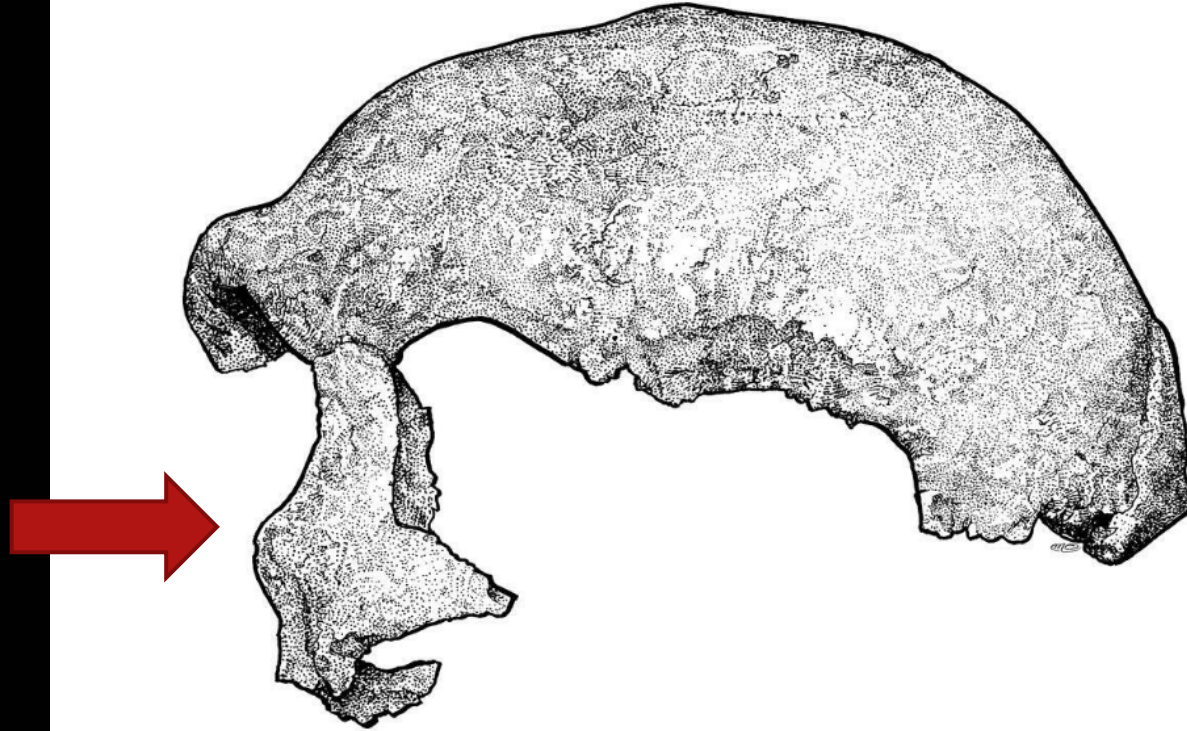


# 1856: Neandertal 1 skeleton



Dear Charles Vella.

144 years  
later: Missing  
left zygomatic  
bone  
discovered in  
2000

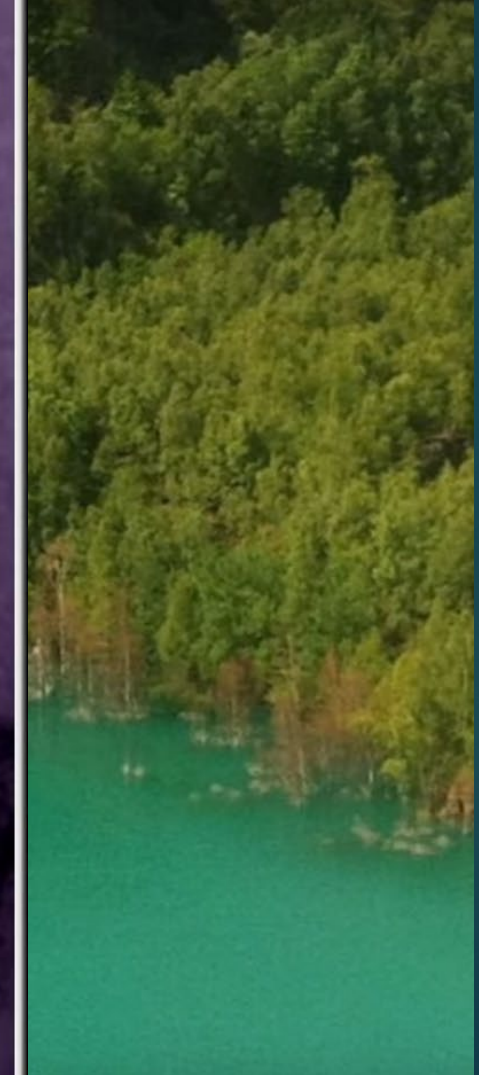


~1525 cc

When Western science first encountered the Neanderthals in 1856, they were a jumble of bones – one of which was a broken skull dome. The remains had lain 2ft deep in undisturbed clays before being blasted out of the rock by a pair of Italian miners in the Kleine Feldhofer cave in Germany's Neander Valley ('Neandertal'), enough remained of the weirdly flat skull with colossal brow ridges to hint at something alien yet human-like.

Neander Valley, n  
Quarry

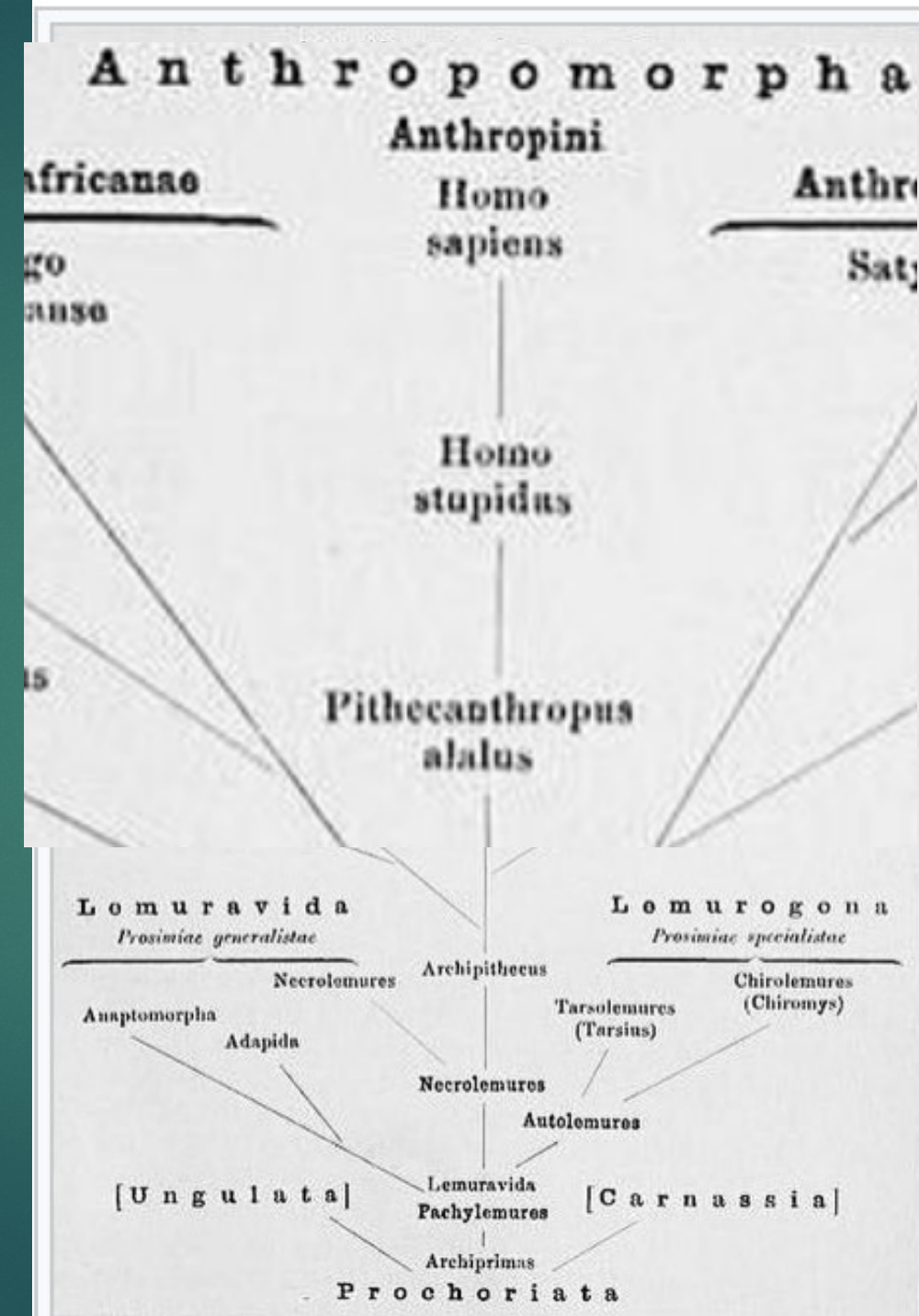
ble/Limestone



Johann Carl Fuhlrott

# Ernest Haeckel 1866 Tree

Neanderthals =  
Homo stupidus





# Backlash to the name “*Homo*” *neanderthalensis*

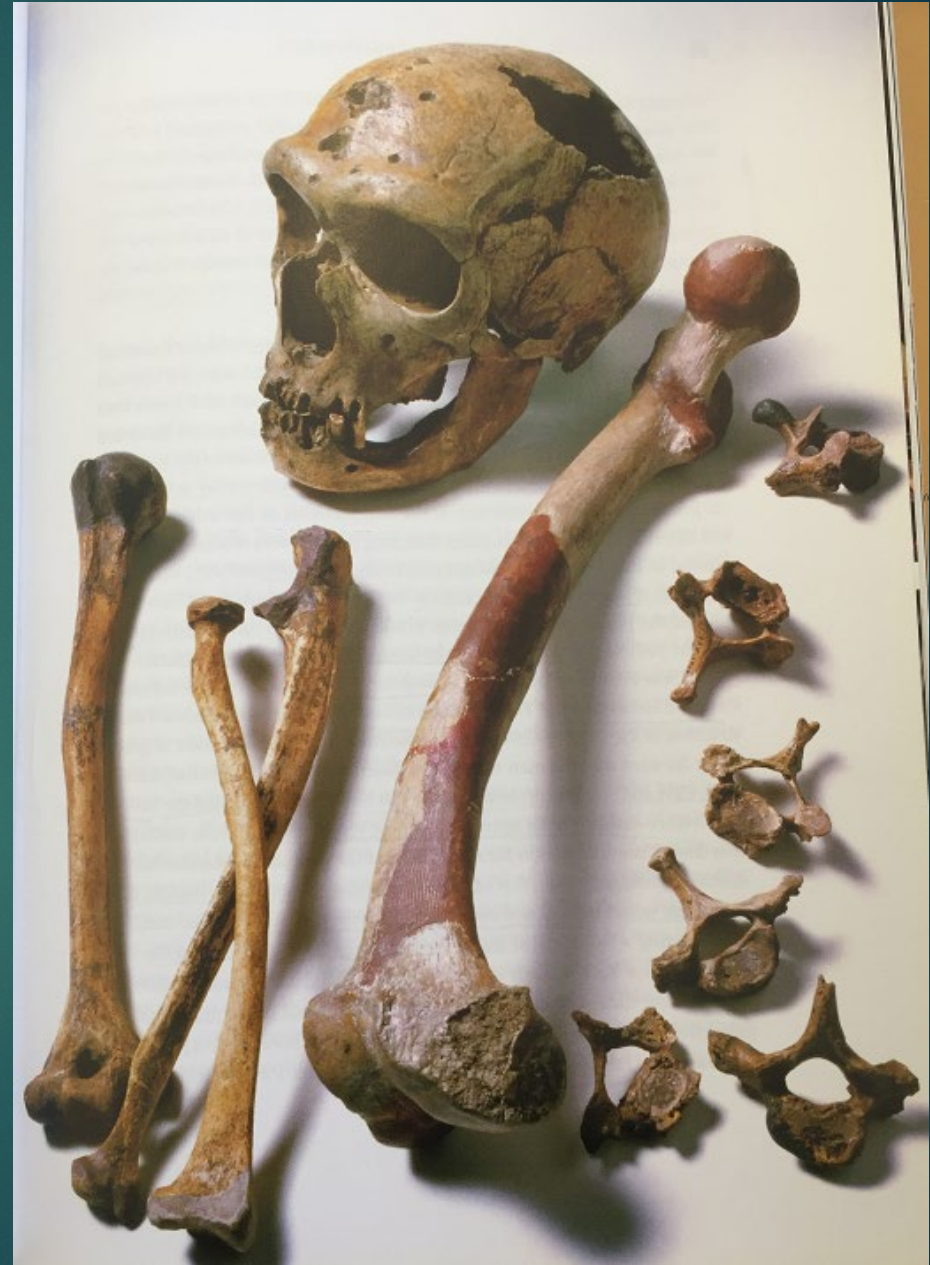
- ▶ Somewhat later in 1872 the eminent biologist Rudolf Virchow examined the Feldhofer bones and agreed that their anatomical peculiarities could be explained if a lost Russian Cossack with arthritis, rickets, a broken leg and bowed limbs from his cavalry career had secreted himself in the cave and died.
- ▶ Suggested the formidable brows resulted from excessive frowning due to chronic pain.

# 1908: Neandertal, La Chapelle-Aux-Saints, “Old Man”



*Homo neanderthalensis*  
(La Chapelle-Aux-Saints)  
Discoverer: Fathers Bouyssonie  
& Josef Bonneval  
Locality: Bouffia Bonneval, La  
Chapelle-Aux-Saints, France  
Age: 350K  
Date: 1908

Aged, pathological skeleton  
formed basis of pervasive negative  
view of Neandertal



# La Chapelle-aux-Saints



La Chapelle aux Saints, 1909

Bouyssonie, Bouyssonie, and Bardon. 1908. "Découverte d'un squelette humain moustérien à la bouffia de La Chapelle-aux-Saints (Corrèze)." *L'Anthropologie* 19:513-518.

# La Chapelle-aux-Saints

- ▶ In 1908, a nearly complete skeleton of an adult N male was found at the La Chapelle-aux-Saints cave in France.
- ▶ The scientific publication of the find by M. Boule included illustrations made with cutting-edge Edwardian technology, in the form of 3D 'stereo' photographs.
- ▶ In his publications on La Chapelle aux Saints N between 1911 and 1913, M. Boule accepted the view that Neandertals were a separate species, but he denied their position as modern human ancestors.
- ▶ Ever since Boule, the Neandertal problem has centered around four issues: **Were Neandertals members of our species? Are any living people descended from them? How smart were they? And why did they go extinct.**

ANNALES DE PALÉONTOLOGIE. 1911

**L'HOMME FOSSILE**  
DE  
**LA CHAPELLE-AUX-SAINTS**

PAR

**MARCELLIN BOULE**

PROFESSEUR DE PALÉONTOLOGIE AU MUSÉUM

DIRECTEUR DE L'INSTITUT DE PALÉONTOLOGIE HUMAINE



## M. Boule's misinterpretation of Ns - 1911

- ▶ **Marcellin Boule's interpretation of Ns was highly biased.** Rather than seeing this N as an old arthritic man, Boule insisted Ns were a highly primitive, ape-like, stooped, not fully erect creature.
- ▶ He pointed to the low cranial vault, receding forehead, projecting face, prominent supraorbital torus, and absence of a chin as distinctly primitive characteristics. Despite its 1625 cc brain size, N was obviously an idiot.
- ▶ **All of Boule's postcranial description were erroneous,** misreading the results of degenerative joint disease and other pathologies as primitive traits.
- ▶ **For the next 60 years, Ns had a major image problem.** The only hominin species used as a curse word implying intellectual deficiency.
- ▶ **Later research totally discredited Boule's analysis of Ns.**

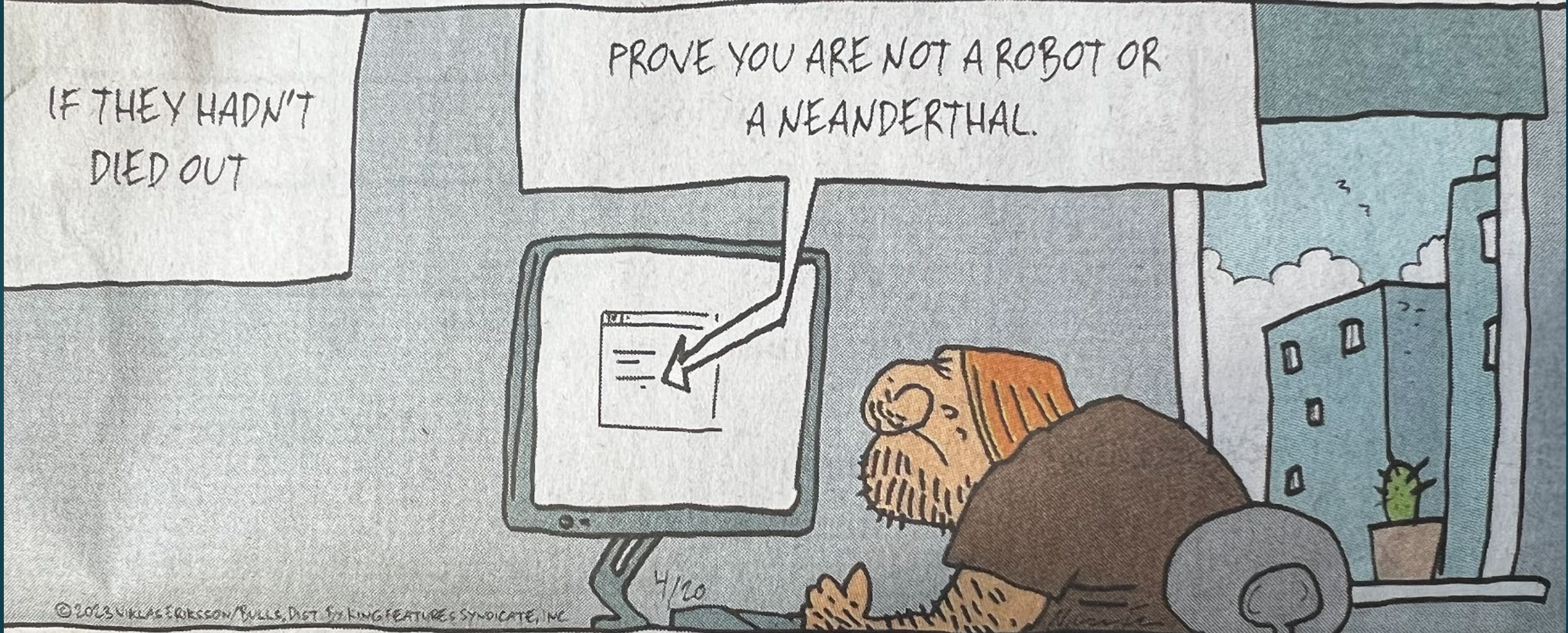
1909 by  
Frantisek  
Kupka



**19<sup>th</sup> Century Neanderthal Portrayal** = Scientifically endorsed reconstruction of Neandertal, London Times, 1909, based on French anthropologist, Marcellin Boule: scientific origin of club wielding, knuckle dragging caveman stereotype of stupid brute

# SF Chronicle, April 2023: 114 years later

## CARPE DIEM Niklas Eriksson





## N inferiority

- ▶ For 150 years, Ns were thought of as genetically incapable of language, symbolic behavior, foresight, tool creation, art, hunting, & blade & bone tool production; all characteristics granted only to the “superior” MHs of Upper Paleolithic
- ▶ Neandertals were not technologically and cognitively “disadvantaged”
- ▶ Neandertal Wars: There is a growing body of archeological evidence showing that Ns were not significantly different from MHs in their capacity for cultural and symbolic behavior. But it’s a continuing debate.

# Modern Understanding of Neandertals

- ▶ Another form of Human
- ▶ *Homo sapiens neanderthalensis*
- ▶ N are an endemic Eurasian population – originated in Western Eurasia
- ▶ LCA for MHs and Ns at 760-550 – no one knows where
- ▶ Ns existed for 500 K+ years; distinct morphology from 400 Ka
- ▶ Despite interbreeding, they remained anatomically distinct

# Neandertals

- ▶ While discovered in 1856, it was not until the 1890s that their stone tools, the Mousterian, were attributed to their culture
- ▶ Static image of Ns from 400 to 40 Ka: no attribution of innovations
- ▶ Ns were sophisticated nomadic hunter gathers; prime predators; environmental specialists; but not stuck in big game mode
- ▶ They lived occasionally in steppe tundra with mammoth & woolly rhinos, but more frequently in warm forests with red deer and boar

# The evidence: N fossils

- ▶ Today, several thousand Neanderthal bones are known from more than 300 individual sites. Klein: Total N sample includes 500 individuals;
- ▶ Every part of skeleton is represented; ranging from relatively complete skeletons to fragments of a single bone; entire age range; newborns, toddlers, children, adults, elders
- ▶ There are also more than 21 partial skeletons from individuals of both sexes and different ages.

# Species: *Homo neanderthalensis*: Basic Facts

- ▶ **Lived:** from about 750,000 to 40,000 years ago
- ▶ **Brain size:** at least 1,200 cc to 1,750 cc;
  - ▶ Average cranial capacity: 1520 cc; contested
- ▶ **Tool use:** Mousterian, Lavallois, Quina, Discoid techniques; Châtelperronian?
- ▶ **Species named:** 1864
- ▶ **Name meaning:** 'human from the Neander Valley'

- ▶ People who occupied **western half of Eurasia** (central Asia and Europe)
- ▶ **Survived wildly fluctuating climate** (hot to glacial conditions)
- ▶ **Masters of regional food resources**
- ▶ Their **skeletons are morphologically different from MHs**
- ▶ **Genetically 99.7% identical to MHs**
- ▶ **1.6-2.1 % N DNA in MHs** (from .3% different N genes)
- ▶ **Capable of speech**: MH-like hyoid bone, FOXP2 language gene
- ▶ **Geographic morphological variability and a huge territorial range**
- ▶ **Always a small population**

# *Homo neanderthalensis*

- ▶ *Homo neanderthalensis* (alternatively, *H. sapiens neanderthalensis*) was a late hominin form:
  - ▶ N and MHs diverged from common ancestor ~ 550 to 765 Ka
  - ▶ Commonly given span: 430 to 30 Ka
    - ▶ gradual development and establishment of typical N form in Europe
    - ▶ disappeared from Europe and Asia by ~39 to 40 Ka,
- ▶ Interacted with modern humans both:
  - ▶ ~100 K in Levant
  - ▶ 40 K in Europe (for estimated 5600-2600 yrs); Ns & MHs overlapped for about 1600 years in France.

# Who were the Ns

- ▶ Genetics tells us they **emerged as a lineage around 700 ka**. While it's impossible to pinpoint the 'first' of their kind, they became **a distinct morphological population at 450 to 400 Ka**.
- ▶ The **Sima de los Huesos fossils** have been dated **to 430 ka** and anatomy that make them prime suspects for being **true proto-Neanderthals, confirmed in 2016 by DNA analysis**.
- ▶ The **Neanderthals endured for an astonishing 450,000+ years**.



# Neanderthals = nomads

- ▶ **More Eurasian than European**, Their **range**: Wales to Spain to Germany to Israel to Denisova Cave in Siberia (and maybe China)
- ▶ **Neanderthals** survived in tundra habitats, but also more often in warm forests, coasts and mountains. They sheltered in caves, but mostly lived in open campsites. They were **nomadic at the core**.
- ▶ They were **ecological and faunal experts**, knowing their terrain, the properties of rocks and trees, and the life habits of the animals they hunted.

# Neandertals

- ▶ The extreme cold of the European Ice Ages is considered at least partly responsible for the evolution of some of the distinctive Neanderthal anatomy, although other factors (gene flow, small population size, effects of chance in small populations) were probably equivalently important.
- ▶ The causes for the Neanderthal extinction are still debated.
- ▶ But there has been a continuing debate surrounding the relationship of Neanderthals with modern humans.

# Neandertals: Ancestors, Dead Ends, or Interbreeding?

- ▶ The “Neandertal Question” is probably paleoanthropology’s longest running headache:
- ▶ “What is their relationship to the succeeding modern European populations.”



## Equivalency of N capabilities

A growing body of evidence creates a more dynamic image of Neandertal cultures and **challenges the idea that they were essentially static, closed to innovation and without symbolic ability.**

**CJV: Neandertal studies appear to be moving toward a position of Neanderthal cognitive equivalency to MHs at 45 Ka**

# Older vs newer views of Neanderthals

- ▶ Older view of Ns emphasizes the relative inflexibility of Neanderthals from a cognitive, behavioral and technological perspective. This line of argument often generally speaks of “Neanderthal” capabilities or behaviors as if this group of hominins always did the same things no matter the temporal or ecological circumstances.
- ▶ The newer view emphasizes an increasing recognition of the variability of Neanderthal behavior and the elucidation of previously unrecognized behaviors including personal ornamentation, a wide and varied diet, and even maritime navigation. This recognition of behavioral variability through space and time argues for superb adaptation of Neanderthal groups to local conditions.

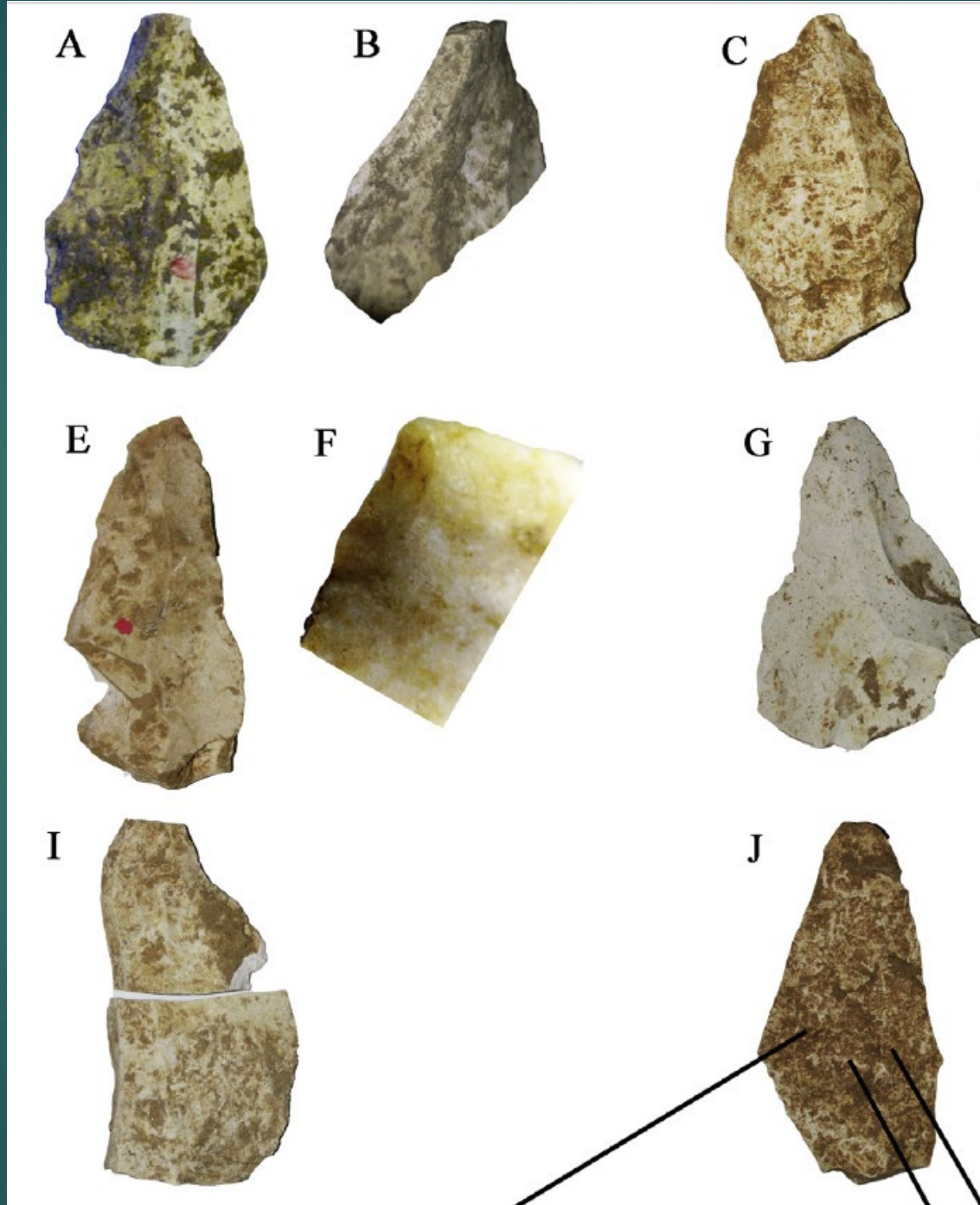
## N flexibility, 71 Ka

- ▶ Evidence that at the Abri du Maras, Ardèche, France, Neanderthals were behaviorally flexible at the beginning of MIS 4 (71 Ka).
- ▶ Here, Neanderthals exploited a wide range of food resources including large mammals, fish, ducks, raptors, rabbits, mushrooms, plants, and wood.
- ▶ Twisted fibers on stone tools provide evidence of making string or cordage. Snares, nets, and traps of various kinds all become possible with the production of string
- ▶ Presence of stone projectile tips, possibly used in complex projectile technology.
- ▶ This evidence shows a level of behavioral variability that is often denied to Neanderthals.

Projectile  
points

Abri du Maras

Hafted points?  
Dart points?



2-3  
inches

# Neandertal demise

- ▶ As Carl Sagan said, 'Extinction is the rule, survival is the exception.'
- ▶ Neandertals disappeared in Eurasia at about 39-40 Ka, shortly after the European appearance of African MHs in Europe about 45 Ka.
- ▶ Remember that correlation is not causation.



# Neandertal demise: MH Superiority Complex

- ▶ **Required reading:** Villa, P, & Roebroeks, W. (2014), *Neandertal Demise: An Archaeological Analysis of the Modern Human Superiority Complex*. PLoS ONE 9 (4)
- ▶ Modern humans were usually seen as superior in a wide range of domains, including weaponry and subsistence strategies, which would have led to the demise of Neandertals.
- ▶ This systematic review of the archeological records of Neandertals and their modern human contemporaries finds no support for such interpretations, as the Neandertal archaeological record is not different enough to explain the demise in terms of inferiority in archaeologically visible domains.

# Presumed Causes of Neandertal Demise

## Neandertals:

1. did not have "complex symbolic communication systems" and "fully syntactic language"
2. limited capacity for innovations.
3. less efficient hunting capacities
4. weaponry was inferior to AMH projectile technology.

# Presumed Causes of Neandertal Demise

- ▶ 5. narrower diet. No exploitation of wide range of plant and marine resources,
- ▶ 6. Did not use of traps and snares to capture animals
- ▶ 7. Small social networks - - as shown by transport distances of raw materials
- ▶ CJV note: did AMHs in Europe at 45 Ka have any of above capacities?

# Presumed Causes of Neandertal Demise

- ▶ 8. AMH populations entering Europe were significantly larger than regional Neandertal populations.
- ▶ 9. AMH hafting required complex procedures indicative of modern cognition, while Neandertals hafting was a simple procedure using naturally available glues.
- ▶ 10. Cold climate around 40 ka.
- ▶ 11. Eruption of Mount Toba volcano at 75 ka played an indirect role in N extinction.

## N Demise: Superiority of MHS caused N demise

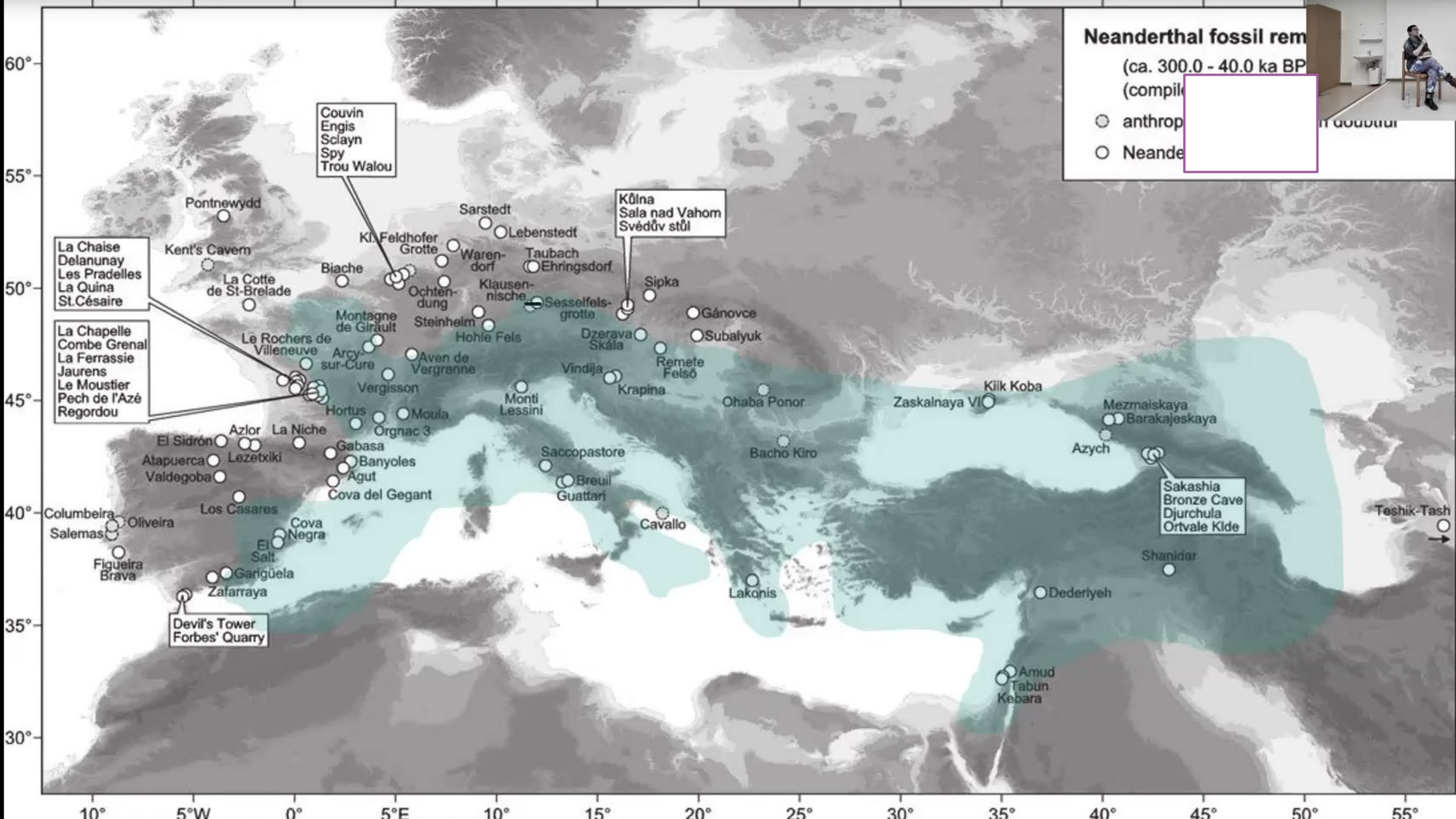
- ▶ Virtually all explanations for the disappearance of the Neandertals from the Eurasian record point in one way or another to the arrival of *Homo sapiens*, anatomically modern humans (AMH), in Europe and western Asia
- ▶ The disappearance of the Neandertals is routinely explained
  - ▶ in terms of the “superiority” of modern humans,
  - ▶ who had developed in Africa more complex cultural traditions
  - ▶ Due to superior cognitive capacities which allowed them to expand globally and replace all other hominins

## N Demise: Villa & Roebroeks Conclusions

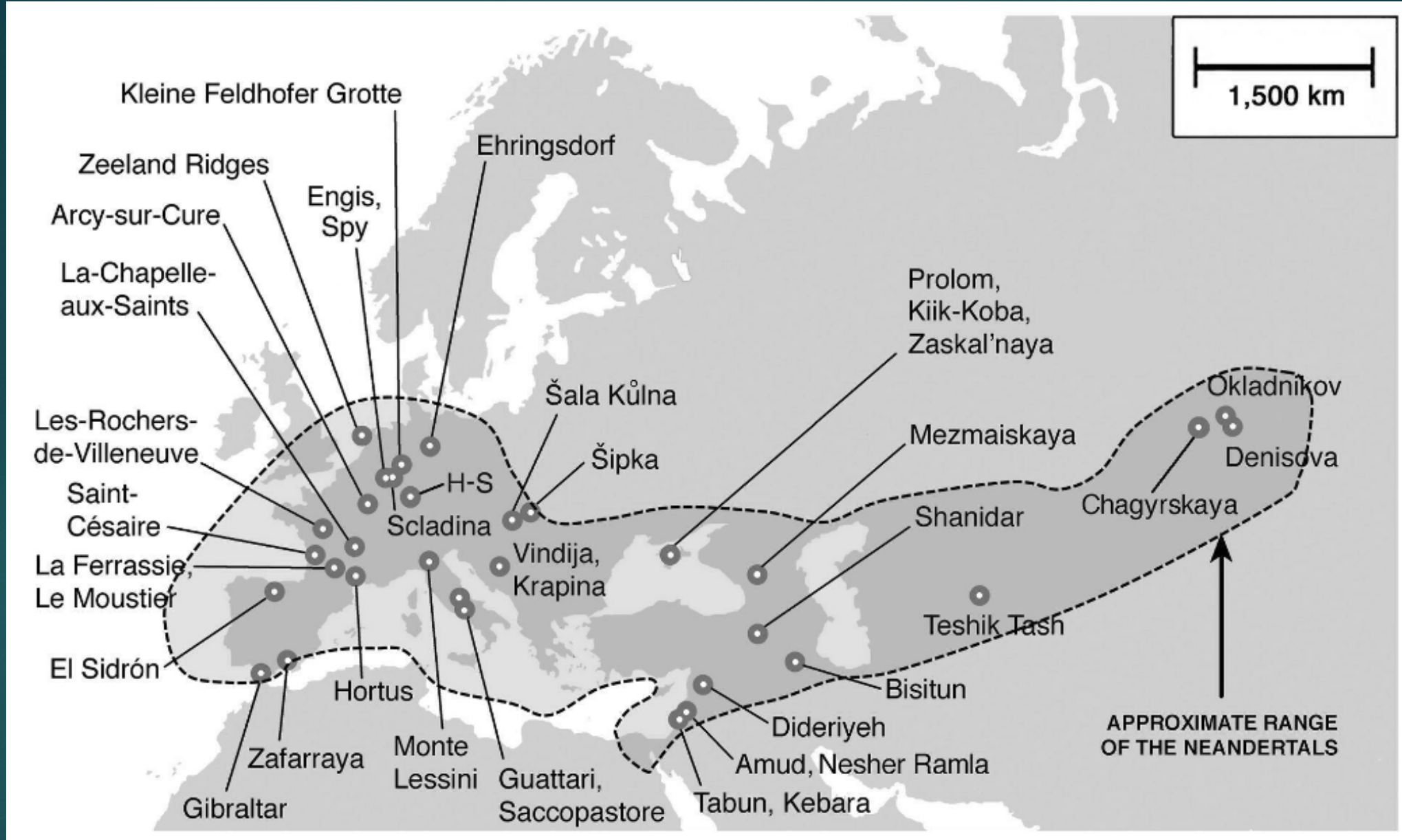
- ▶ All the 11 “archaeology-based” explanations for the demise of the Neandertals listed above were found to be flawed.
- ▶ They were based on much less data than we have available today and were at least in part the result of a long tradition of thinking in terms of Neandertals-AMH dichotomies; equating UP capacities as MH, and assuming the MHs had superior cognitive ability.

# N Demise: Villa & Roebroeks Conclusions

- ▶ Use of ocher, of personal ornaments, production of specialized bone tools and complex hafting techniques were clearly part of the Neandertal repertoire already before the arrival of AMH in western Eurasia.
- ▶ Production of bladelets has been securely identified in French Mousterian assemblages.
- ▶ Neandertals, like late MSA humans, mastered the technology of bladelet production by 60 Ka. It is their frequency, not cognition or technical competence, that distinguishes AMH bladelet production from that of Neandertals







N Range: Geographic morphological variability and a huge territorial range: 10 M Km<sup>2</sup> = size of Africa; 9000 miles from West to East

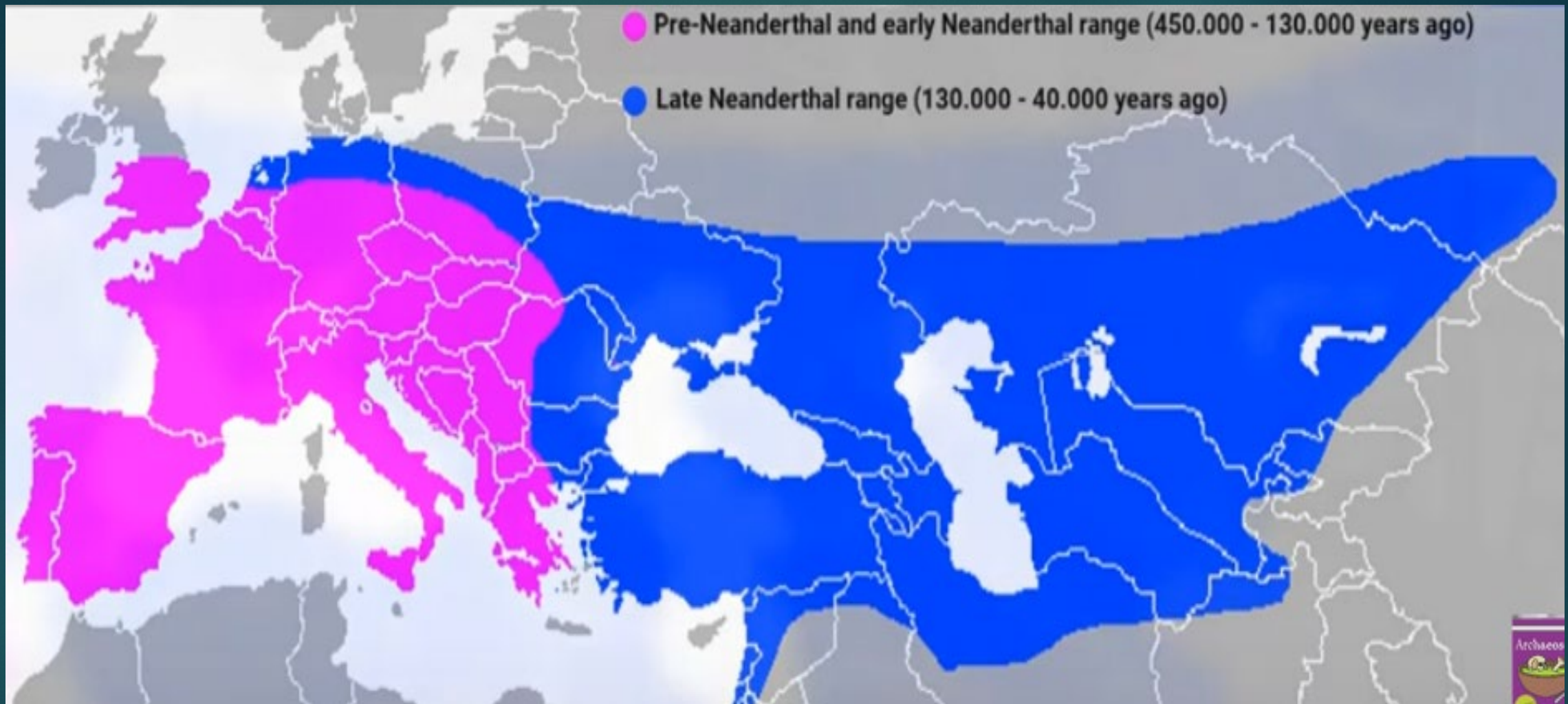
# MAP OF SITES

1 Feldhofer	18 Les Bonas	35 Bruniquet	52 Maltravieso	69 Compiello	85 Kiiou
2 Schwabingren	19 Arcy-sur-Cure	36 U'hoama	53 Las Callesetas	70 Puggetti Vecchi	86 Zaskalskaya
3 Salzgitter-Lebenstedt	20 La Folie	37 Muela Garcia	54 Cova Negra	Fossilbone and	87 Mezmaiskaya
4 Königsaue	21 Saint-Cesaire	38 Payne	55 Bolomor	71 Sant'Agostino	88 Uv'-Idim
5 Neumark Nord	22 Jonzac	39 Abri du Maras	56 Abri del Pastor	72 Moscerini	89 Denisova
6 Hildesheim-Stadel	23 Les Pradelles	40 Mandrin	57 El Salt	73 Roccamonfina	90 Okladnikov
7 Taubach	24 La Roche Cotard	41 Mazarin	58 Sima de la Palomas	74 Lurahanga (Altamura)	91 Chagyrskaya
8 Engis (Avin)	25 La Quina	42 Noisetier	59 Cueva de los Aviones	75 Cavallo	92 Teshik-Tash
9 Spy	26 La Chapelle-aux-Saies	43 El Sidrón	60 Bajondillo	76 Maastricht-Bevélère	93 Wenzsch
10 Schladis	27 Le Moustier	44 La Piesga	61 Arlès	77 Zealand Ridges	94 Shanidar
11 Lynford	28 Roc de Marol	45 El Coco	62 Gibraltar sites	78 Zaskmotor	95 Umm el Tiel
12 Pommewydd	29 La Ferrassie	46 Aramburta III	63 Figueira Brava	79 Likoski	96 Dederiyeh
13 La Cotte de Saint-Brelade	30 Combe Grenal	47 Afdor	64 Oliveira	80 Theopetra	97 Kibara
14 Caouis	31 Cosnal	48 Atapuerca sites	65 Barma Grande	81 Ciocari-Borosteni	98 Tabari
15 Tourville-La Rivière	32 Pech de l'Aze I and II	49 La Roca dels Dons	66 Fumane	82 Peytera cu Oase	99 Amud
16 Le Bonel	33 Burgasko	50 Teixoneres	67 Rio Secco	83 Gura Chioi-Băjicor	
17 Roche-Saint-Vincent	34 Les Caselles	51 Abri Rotund	68 De Nulde	84 Krapiina	



A Eurasian species:  
 Massive landscape:  
 Wales, Gibraltar,  
 Israel, Crete to  
 Denisova, Siberia

Asia: mostly  
 unresearched



From 400 to 130 kya, Ns only in Europe;  
after 130 kya, advance into Asia



# Last 4 Neanderthal Strongholds per C. Finlayson



- ▶ Last populations of Neanderthals were concentrated in four strongholds
- ▶ (1-4 in order of importance). The south of Iberia stands out as the largest stronghold and it is within this area that the last Neanderthals survived.

## N Range: 9000 miles across

- ▶ N had a massive range. 9000 miles west to east. A Neandertal range estimated from archaeology would be considerably larger. Mousterian sites extend into more areas in Europe (for example, into the Alps) as well as into Siberia and North Africa. And China.
- ▶ However, Mousterian tools are not always a reliable indicator of the presence of Neandertals. Outside of Europe, such tools are often associated with the bones of more modern-looking people – at Skhūl and Qafzeh in Israel and at Jebel Irhoud and Haua Fteah in North Africa

## The easternmost Middle Paleolithic (Mousterian) from Jinsitai Cave, North China

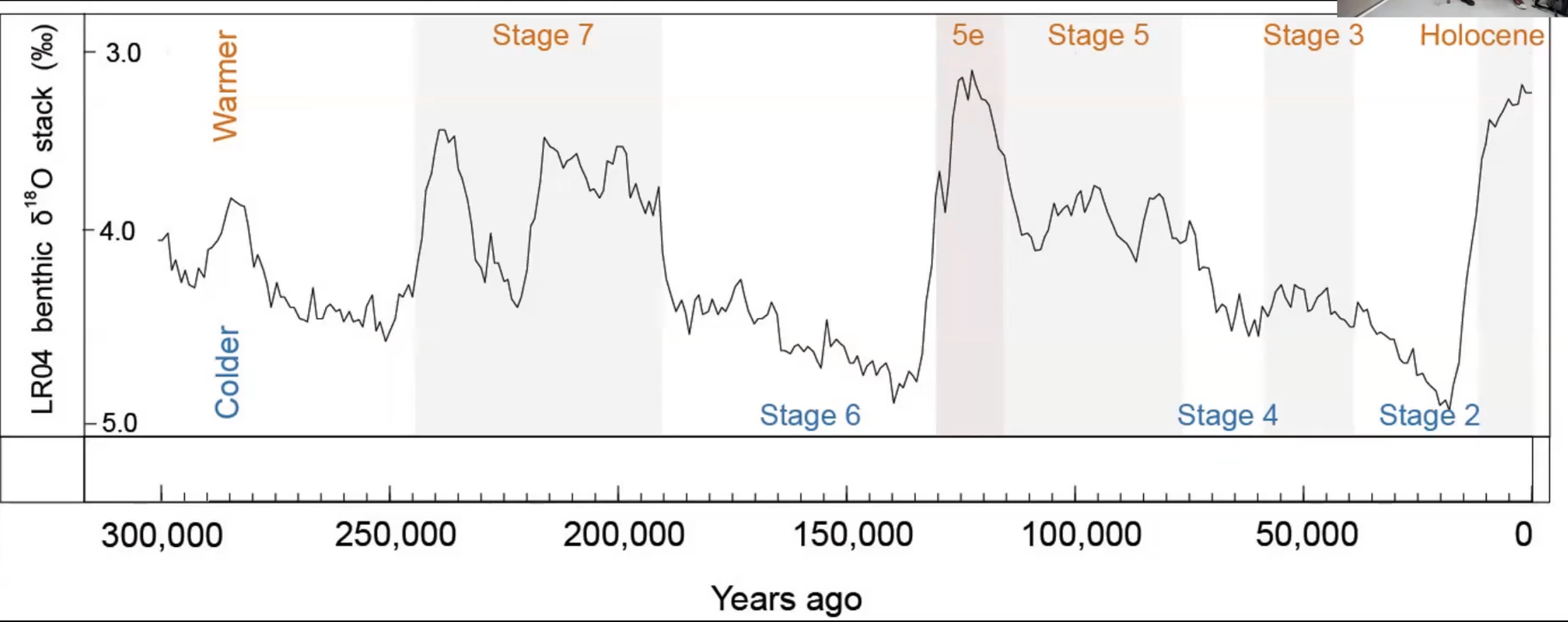
- ▶ Neither Neanderthal fossils nor typical Mousterian assemblages have been reported in East Asia to date.
- ▶ Report on artifact assemblages comparable to western Eurasian Middle Paleolithic (Mousterian) at Jinsitai, a cave site in North China. They more closely resemble the Mousterian assemblages from central and western Eurasia than the contemporaneous artifact material from central and northern China.
- ▶ The lithic industry at Jinsitai appeared at least 47–42 ka and persisted until around 40–37 ka. These findings expand the geographic range of the Mousterian-like industries at least 2000 km further to the east than what has been previously recognized.

Myth of Ns  
as creatures  
of the ice





300,000 years of climate change: alternating periods of cold and warmth; not just cold; Ns headed south during cold periods



# Habitat

- ▶ The majority of evidence suggests that Neandertals evolved in Europe from *H. heidelbergensis* that had spent hundreds of thousands of years adapting to the harsh Pleistocene glacial climate.
- ▶ During the extensive colder periods, Europe north of the “mountain belt” (Pyrenees to the Carpathians) would have been primarily Alpine tundra, largely uninhabitable for the Neandertals and their ancestors.
- ▶ Across much of southern Europe, the mixed deciduous/coniferous forests common today were replaced by boreal forests of the sort found currently in only in northern Eurasia.
- ▶ These conditions would have played a major role in the adaptation and evolution of the Neandertals and in the migrations of Neandertal populations further south during the colder periods.

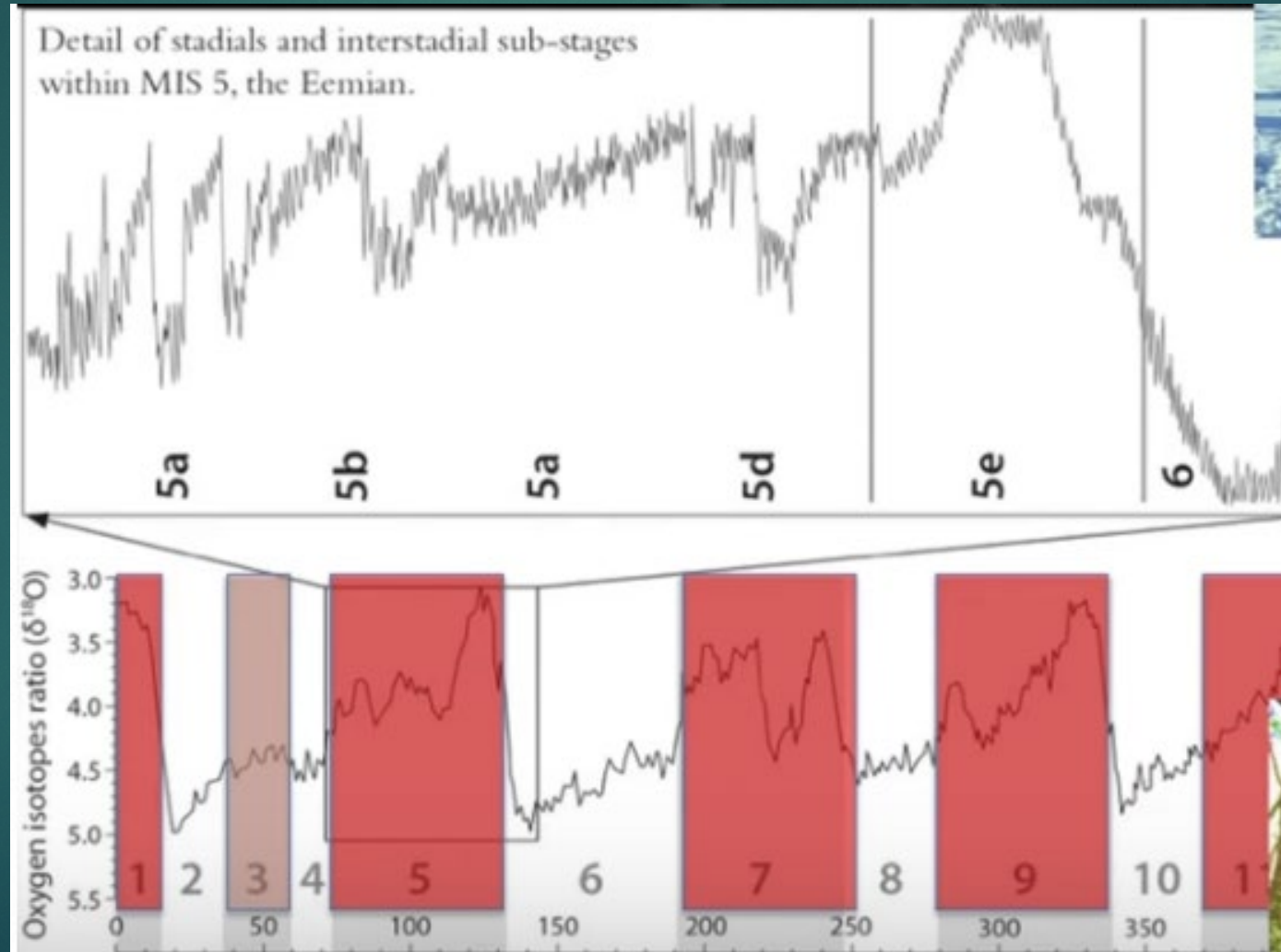
# Neandertals

- ▶ Archaic Europeans rarely managed to inhabit far northern Europe during Pleistocene cold cycles.
- ▶ Ns were both cold and warmth adapted: could not have survived without mastering fire & making and wearing clothes; survived numerous episodes of extreme climate change, including heat waves

# Climate

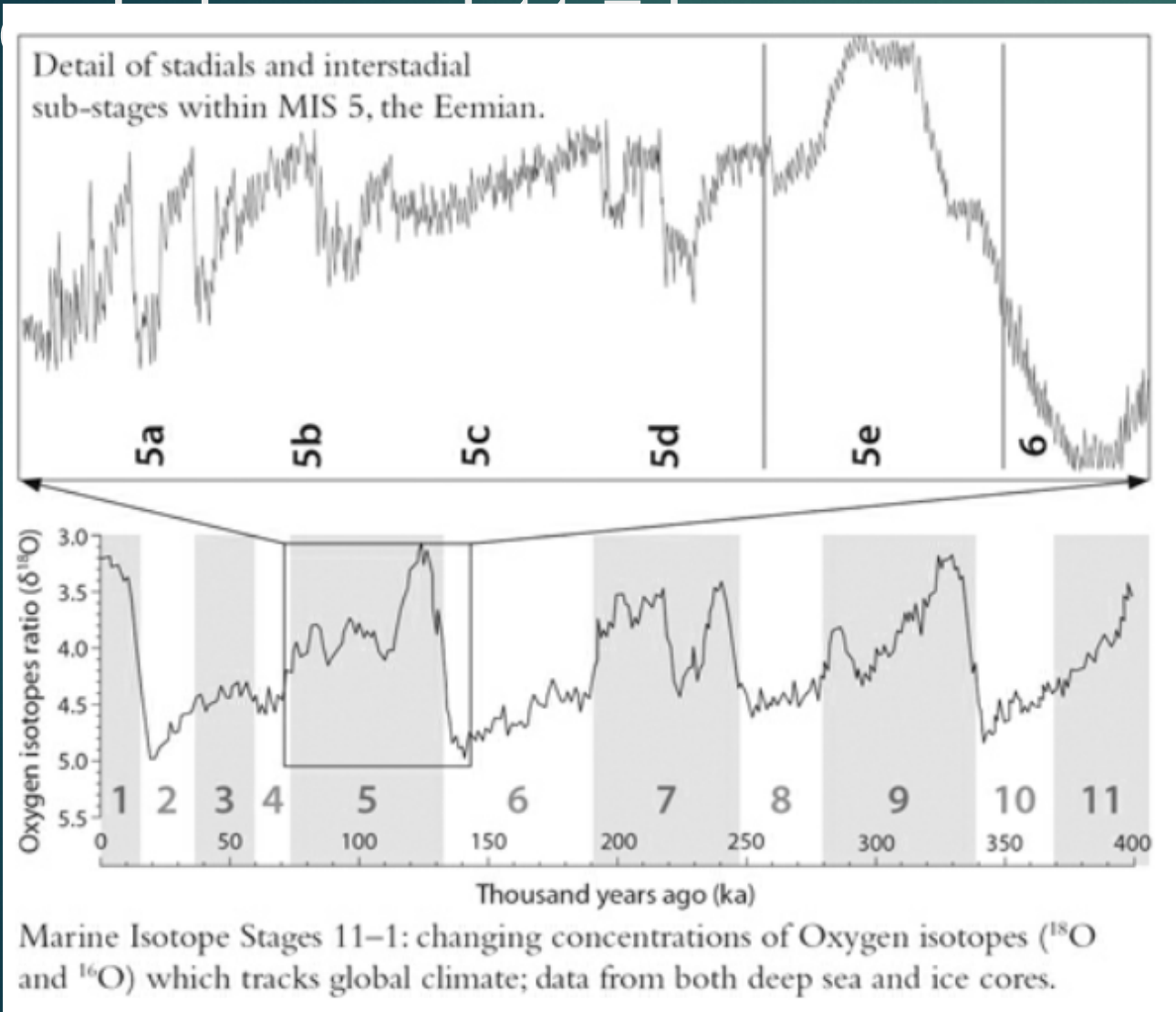
- ▶ Ns survived 3 major climate periods, including a warming period (Eemian) that we are going to face (2-4° C)
- ▶ Disappearance: 40 Ka as colder period, but with greater fluctuations; but N had lived thru these kinds of climate changes many times before
- ▶ Did not like super cold (muskox): went extinct or moved
- ▶ 100-70 Ka, then very cold

**Adapted to many landscapes:** Original view of N as arctic, cold adapted is far too narrow; Ns flexibly adapted to multiple landscapes and multiple climatic variations; but were never truly arctic



Red = warm periods  
MIS 5 = 120 Ka, warmer than now

We're living in Stage 1, a warm – or interglacial – period following Stage 2, the last cold phase, which



- Paleoclimate during the time of the Neanderthals, including glacial periods and the Eemian (a world 2–4°C warmer than today).
- Today = 13.9 °C (57 °F)

# Harsh environments? Erroneous anthropological

## conclusions

- ▶ Because many more sites were preserved from glacial periods than warm climates, scientists concluded that Neanderthals must have lived predominantly in harsh colder environments, where they barely clung on.
- ▶ By the 1960s, it was widely believed that Neanderthals were primarily carnivores who dwelt in frigid surroundings with very little vegetation. This was in part based on ignorance of Indigenous plant use in comparable habitats, but also because anthropology was male-dominated, and particularly focused on the lives of big-game hunters.
- ▶ The nadir came during the 1980s, when scholars proposed that the vast amounts of bones and teeth in Neanderthal sites weren't even from hunting, but scavenging. This left Neanderthals skulking around the fringes of hyena or lion kills, grabbing scant scraps.

# Ns and Climate

- ▶ Even if elements were appearing earlier, distinctively Neanderthal morphology and culture became clearly expressed not during a glacial period, but the clement MIS 9 interglacial after 350 ka.
- ▶ Moreover, looked at over the full span of time between around 400 to 45 ka, contrary to the clichés, Neanderthals actually lived through more warmer interglacials than glacials.
- ▶ Later Eurasian MIS 3 (55-35 Ka) interstadial environments were not glacial wastelands. Instead, what makes this climate cycle distinctive is its instability, temperatures see-sawing rapidly up and down.



# Warmth

- ▶ The most recent proper interglacial, MIS 5, was even warmer than today. As the preceding MIS 6 glacial ended, temperatures rose rapidly, peaking around 123 Ka as the sub-stage MIS 5e, known as the Eemian. This remains the warmest period hominins experienced across Eurasia. It lasted roughly 10,000 years, equivalent to some 500 generations.
- ▶ The Eemian's other fauna also subverts traditional ideas about Neanderthals being only cold adapted. Alongside aurochs and horse were wild boar, roe deer and their spotted fallow relatives. Beavers feasted on saplings, flooding valleys and creating rich new habitat where turtles swam. Other big beasts arrived with the warmth: water buffalo, straight-tusked elephant and hippopotamus.

# Cold-adapted?

- ▶ Neanderthals mostly avoided truly arctic conditions.
- ▶ Woolly rhinoceros and mammoth also left the harshest tundra to arctic specialists like reindeer or Arctic fox. The most hardcore are musk oxen, adapted for bitter cold and deep snow, and which only expanded southwards during extreme glacials.
- ▶ Occasional sites where lithics are found along with musk ox bones do exist. They testify that Neanderthals were resilient enough to cope, at least temporarily, with the ultimate in challenging ice age environments.

# Adapted to multiple habitats

- ▶ But Neanderthals were much happier in steppe-tundra exemplified by MIS 3, populated by herds nearly as rich as those in the great African grasslands today.
- ▶ Current understanding of Pleistocene climate and environment certainly casts the 'hyper-arctic' explanations for Neanderthals' anatomy in an even less acceptable light.

Cro-Magnon



La Ferrassie N



# N Skull

- ▶ Early modern humans from Europe and West Asia (European Early Upper Paleolithic and Skhūl/Qafzeh) have equally long skulls.
- ▶ In MHs, cranial breadth is greatest high up on the parietals; in Neandertals, maximum cranial breadth lies lower on the parietals.
- ▶ The **N braincase**: a distinctive oval silhouette in rear view. This vault shape, conventionally described as “**en bombe**” (French, “bomb-like”), is regarded by some as a uniquely Neandertal apomorphy.
- ▶ Neandertal frontals, like those of Erectines and Heidelbergers, are persistently ancient in having big supraorbital tori and a relatively flat frontal bone (forehead) that slopes sharply backward

Long, flat, low braincase

Receding forehead

Occipital bun

Supraorbital torus

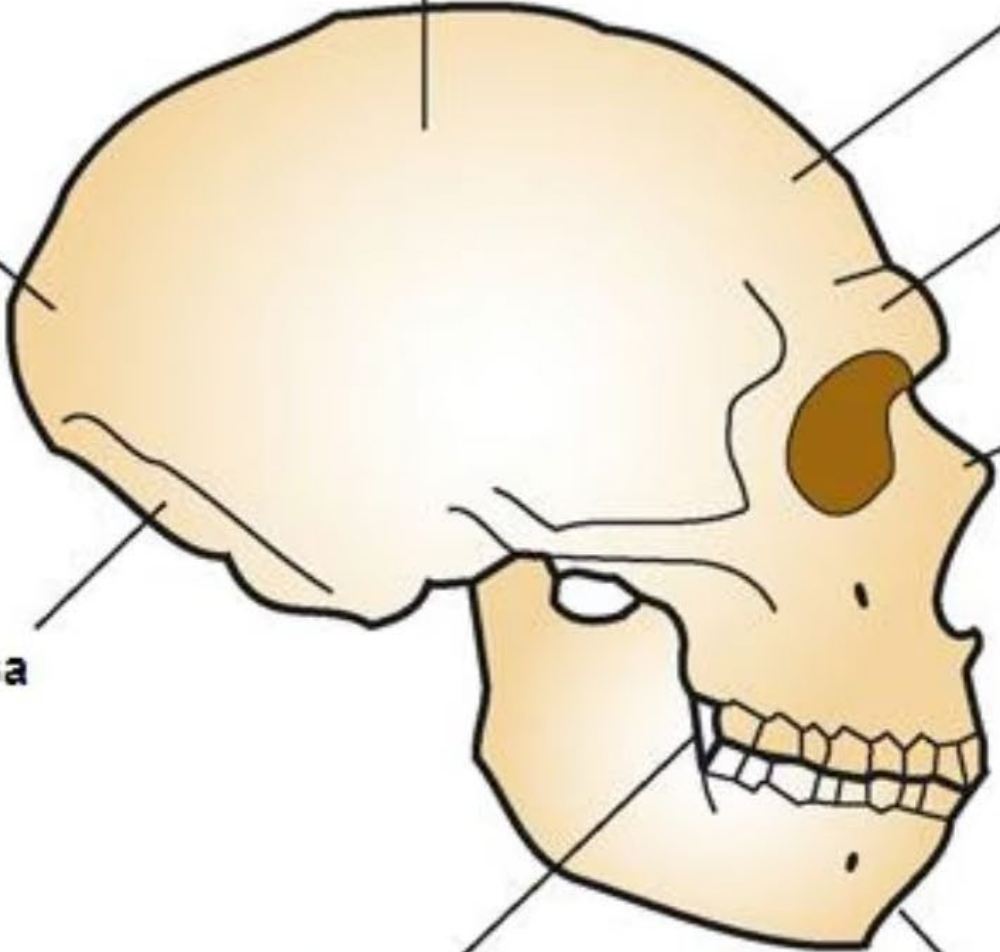
Large nasal cavity

Suprainiac fossa

Projecting midface

Large gap behind third molar

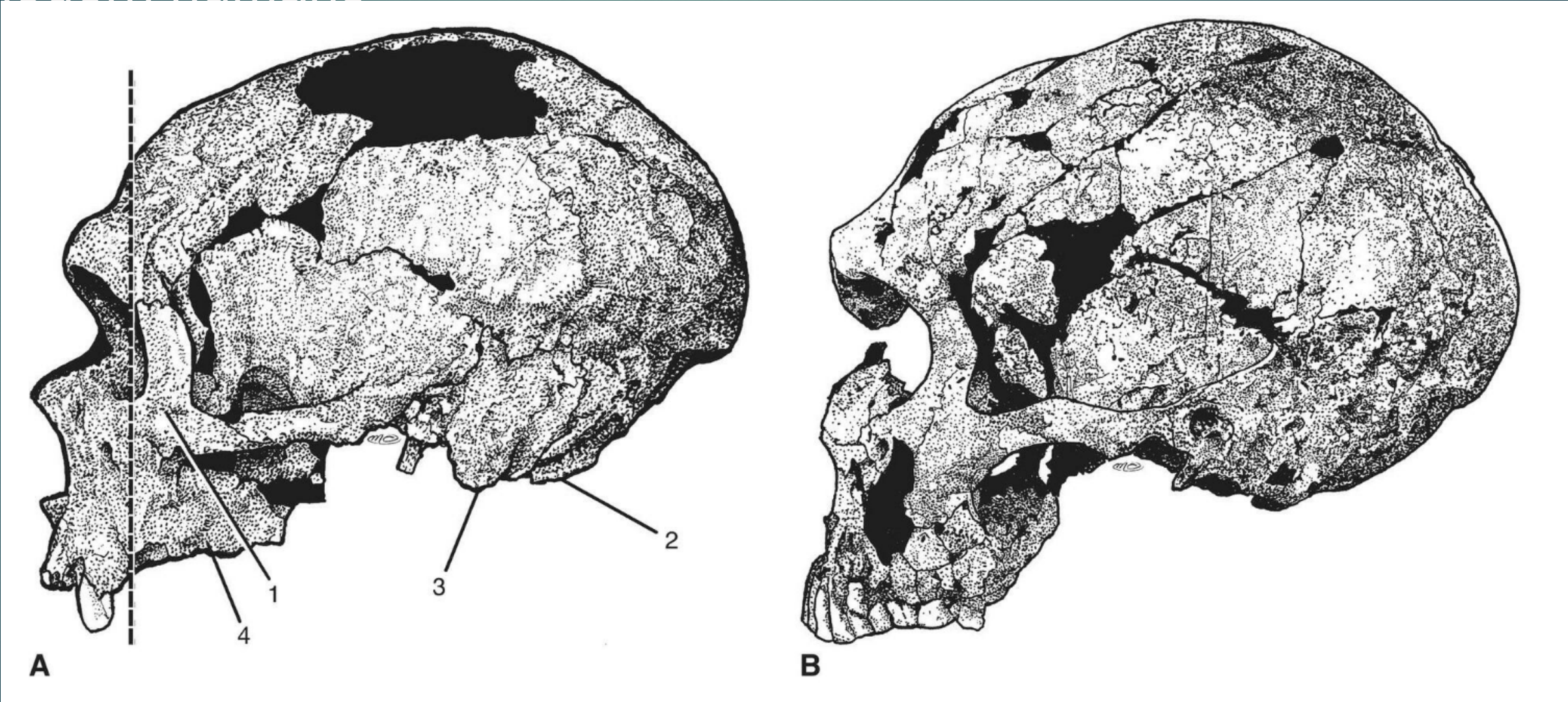
Little or no chin (mental eminence)



# Spy 1 and 2

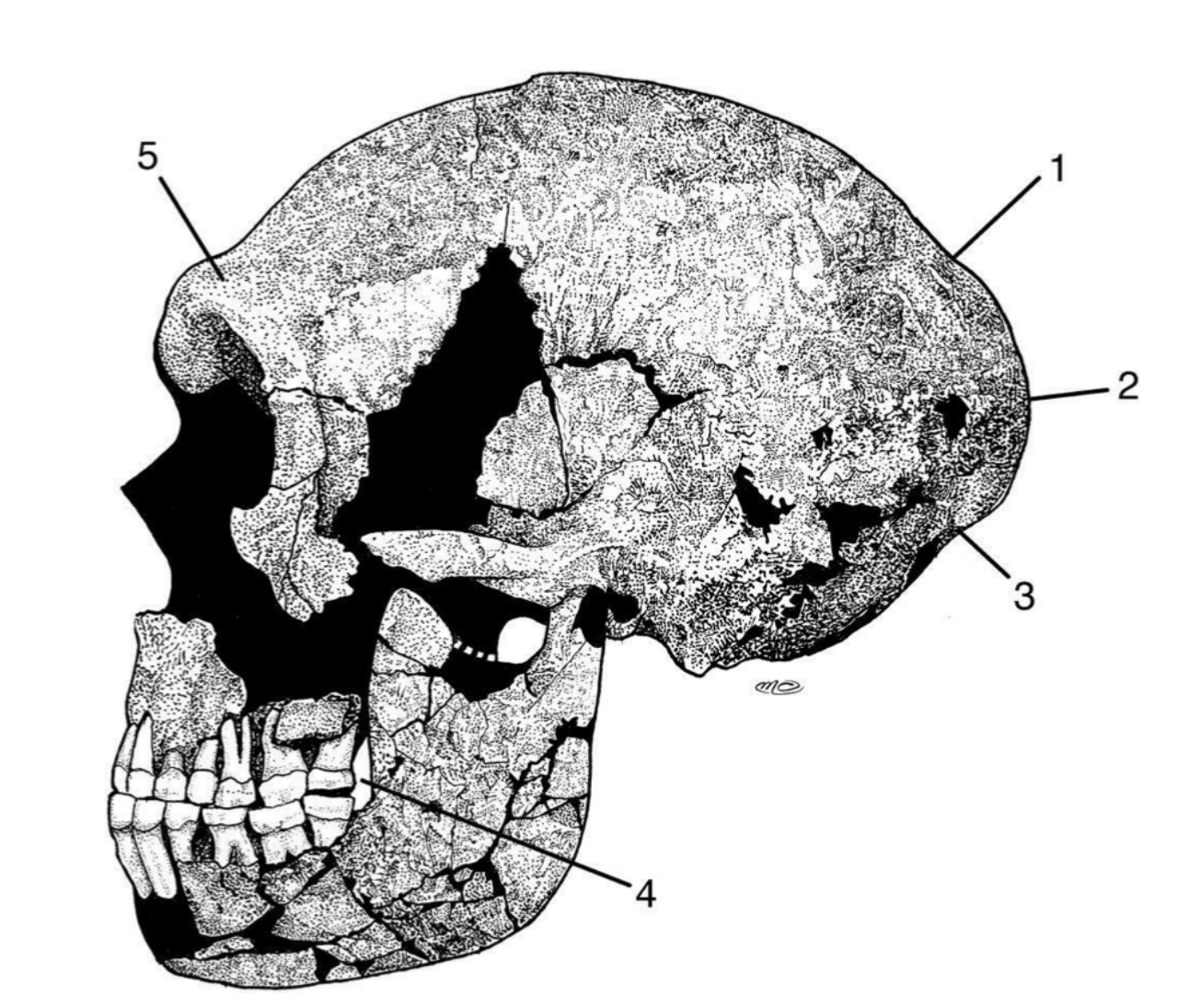


La Chapelle and La Ferrassie: Neandertal cranial vaults are longer, wider, and lower than those of modern humans



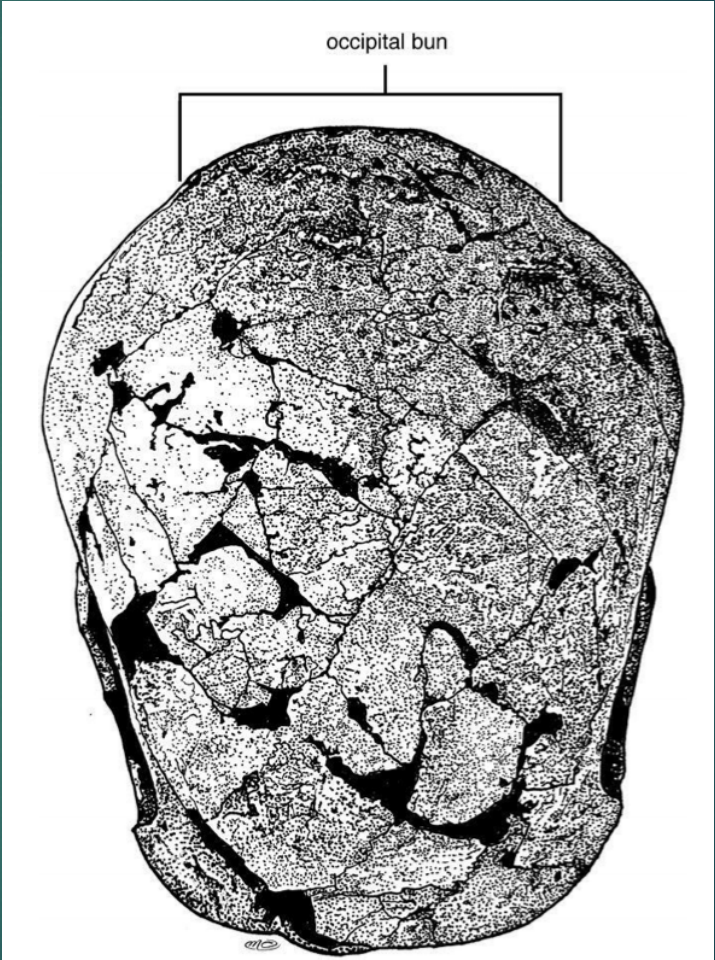
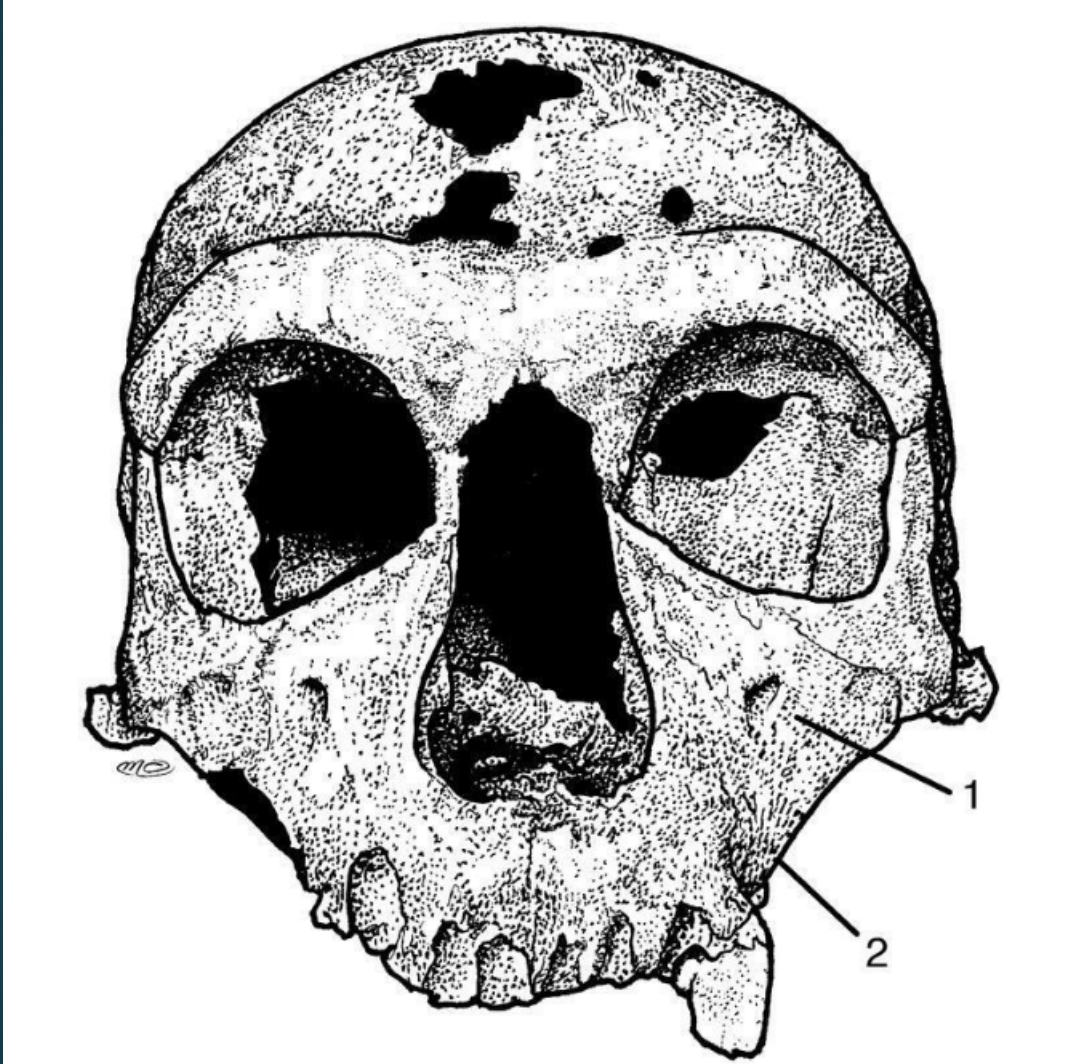


**N Morphology: La Quina** – Supraorbital torus (dip in middle), occipital bun, retromolar gap



La Ferrassie - rear

**La Chapelle** - Supraorbital torus (dip in middle);  
midface prognathism; large nasal opening

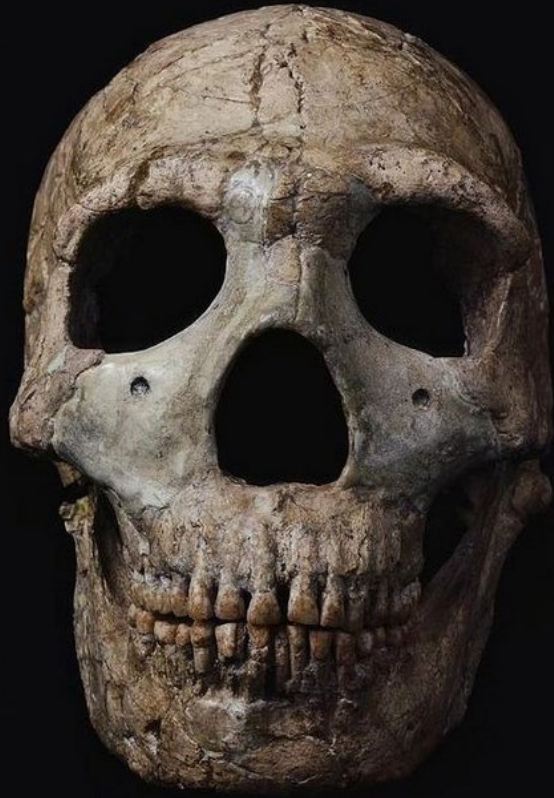


La Ferrassie –  
occipital bun

Amud 1, Israel = higher vaulting; no occipital bun



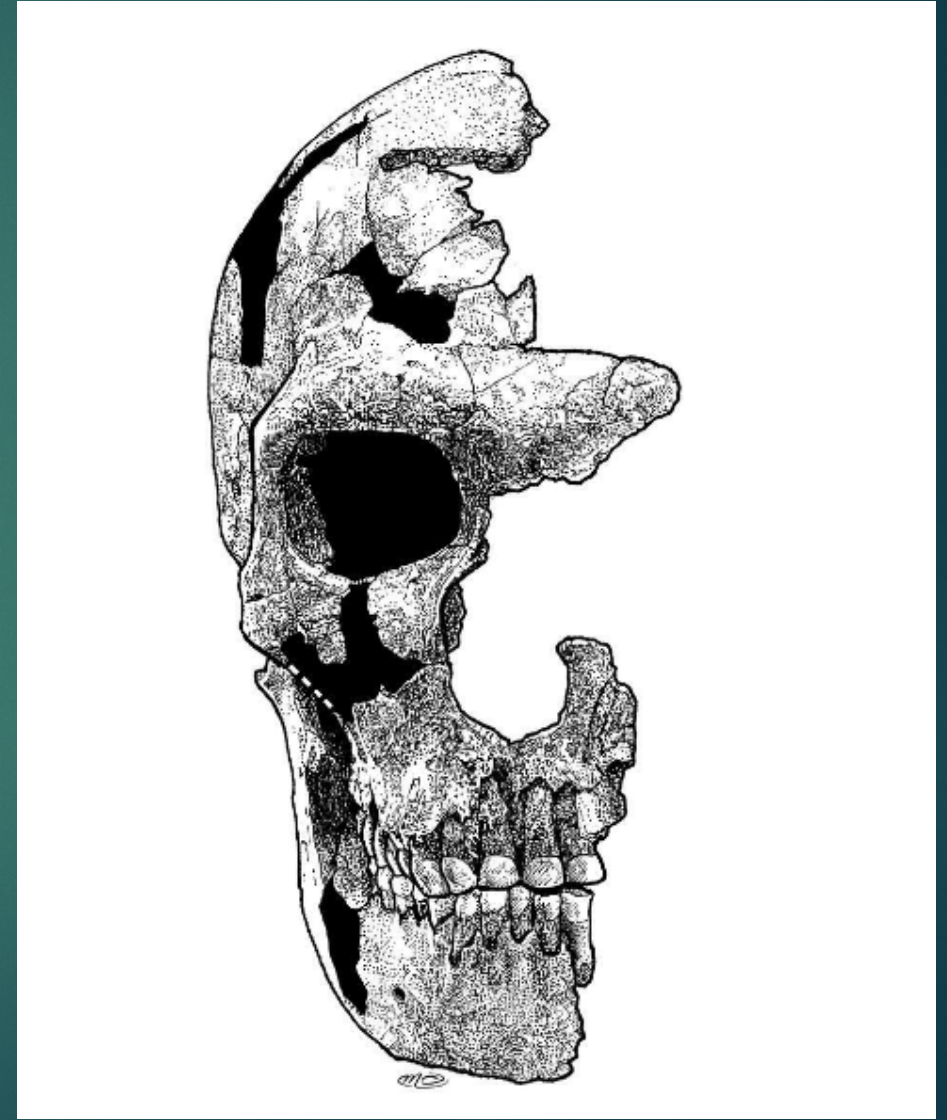
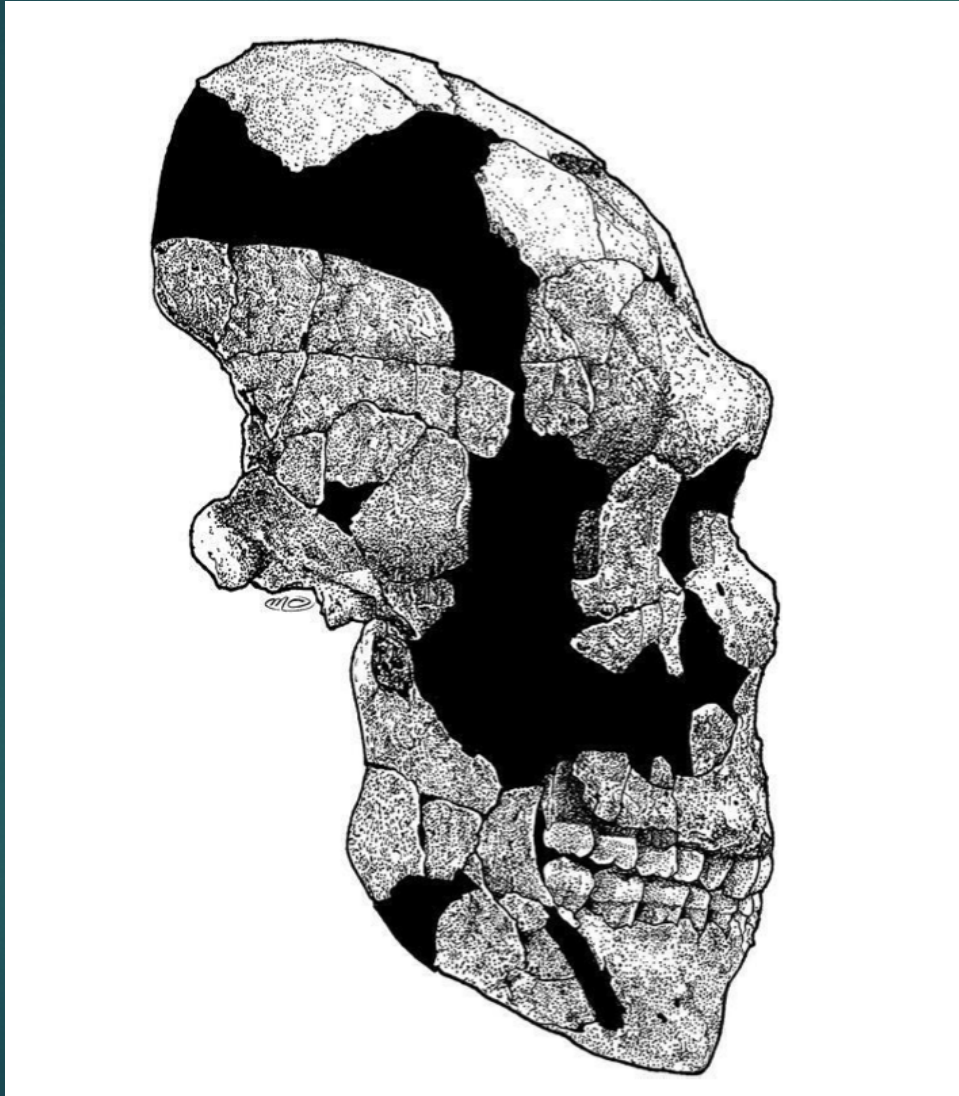
# Amud 1 Skull - largest Neanderthal brain volume at 1736 cc+



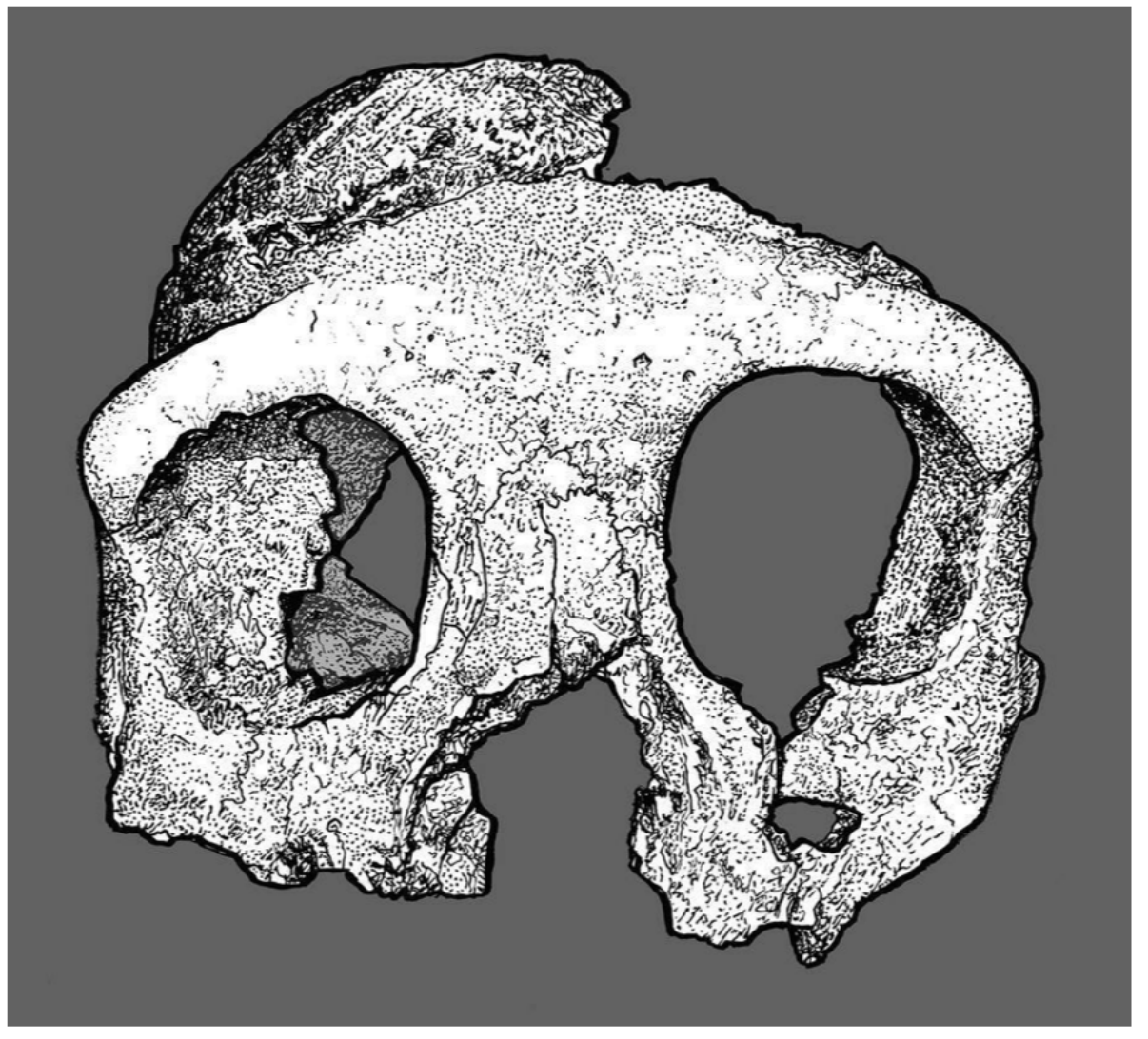
Amud



The late female Neandertal cranium and mandible  
from **Saint-Césaire, France.**



# Skull C of Krapina, Croatia



# Altamira Neandertal: 130-172 Ka



# 1993: *Homo neanderthalensis*, Altamura, Italy

200

Altamura Man, 130-172 Ka: fell down a hole



Date Discovered: 1993

Most complete skeleton of a single nonmodern human ever found;  
DNA, 2016: 130,000+ years old;  
Oldest classical Neanderthal DNA



N = oval Foramen magnum

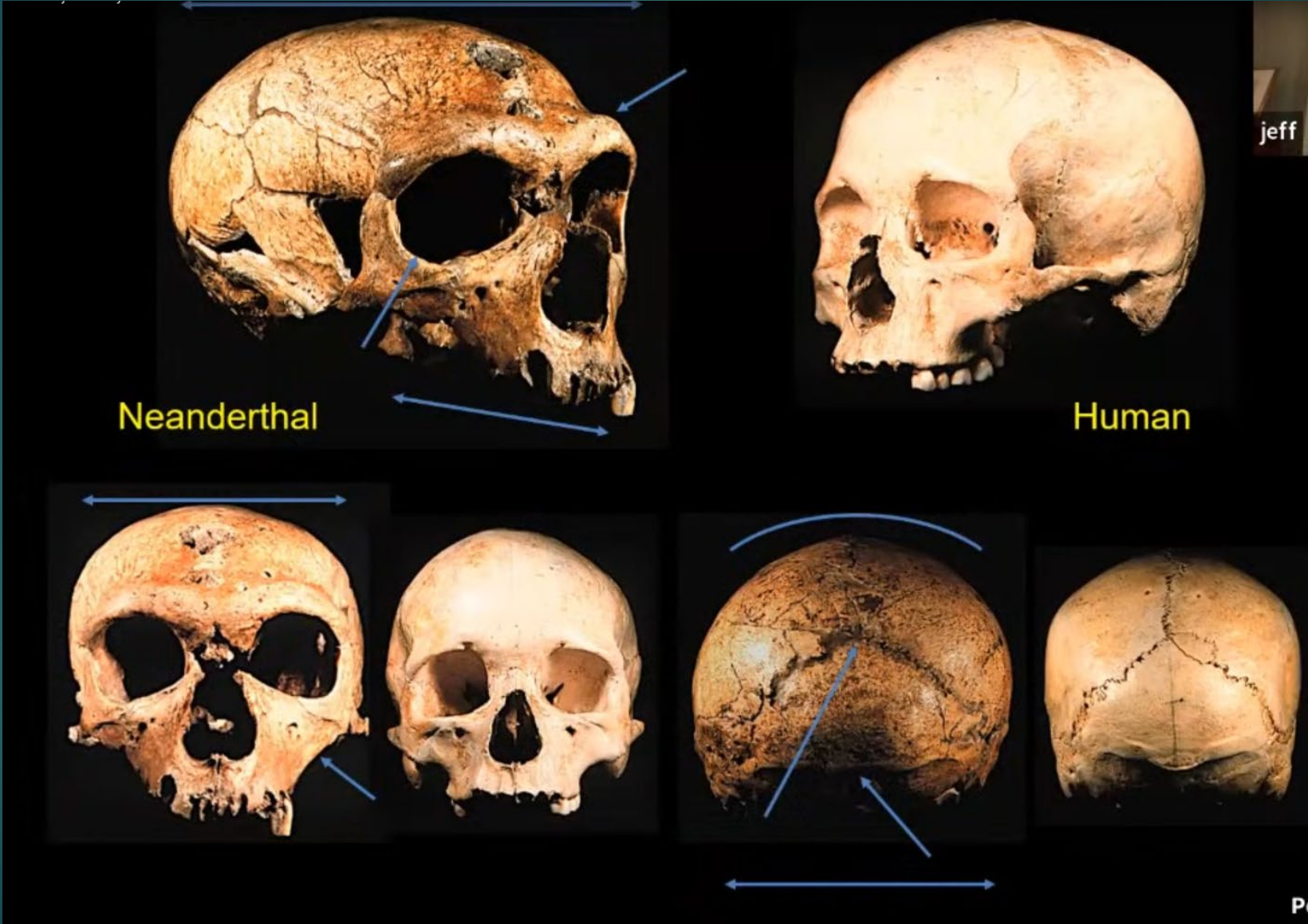




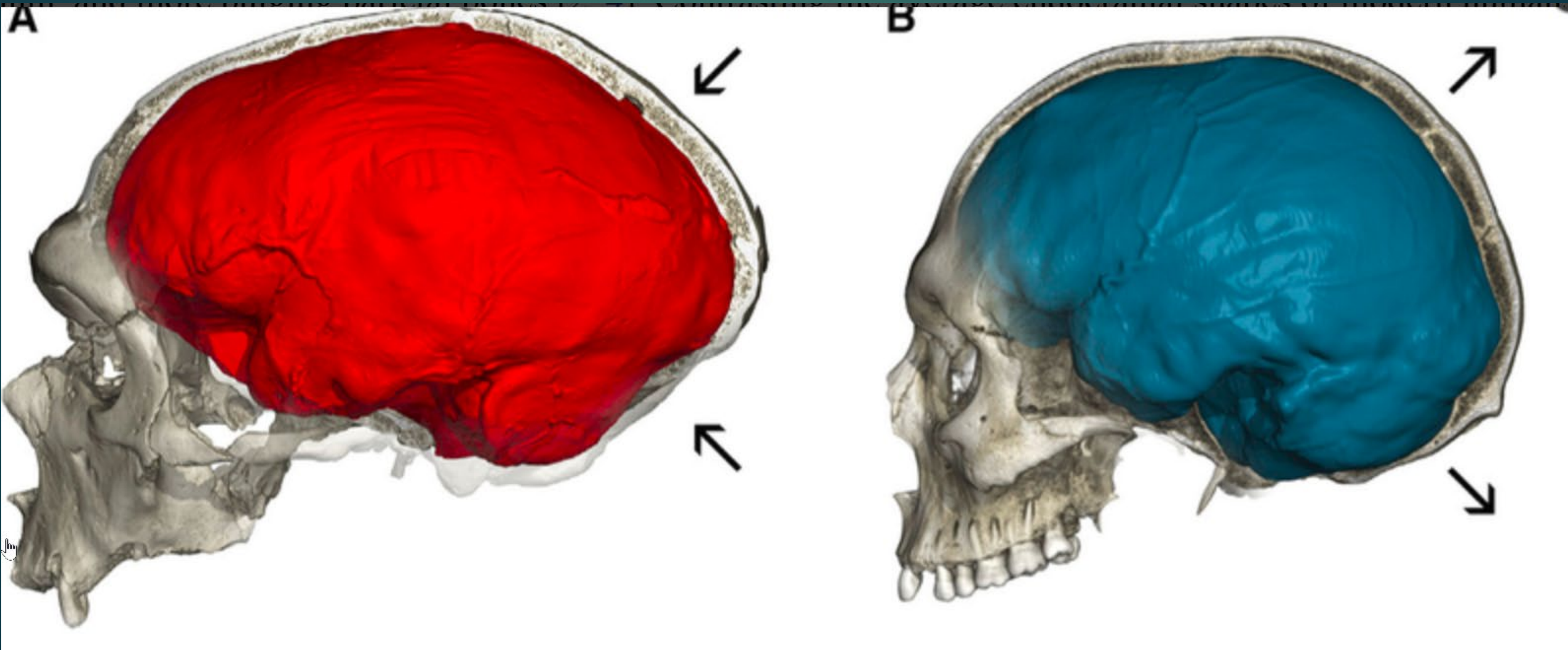
# Krapina, 250 Ka

- ▶ Krapina, Croatia: the largest sample of early Neandertal fossils, which has yielded large collections of Mousterian tools and over 1200 fragmentary pieces of Neandertal skeletons; many appear to have been intentionally smashed.
- ▶ D. Gorjanović-Kramberger, the excavator and initial interpreter of Krapina, described the fragmentation and burning of the skeletal remains as an “act of cannibalism”. Because he recognized two different Neandertal varieties at Krapina, the implication is that perhaps one group perpetrated the act on the other.
- ▶ The Krapina Neandertals exhibit morphological traits that are more like what we see in Heidelbergers than any other Neandertals

# Neandertals and Modern Humans



Unique late N and MH brain morphologies:  
elongated vs globular, 1450 cc vs 1350 cc



# African *H. sapiens*: Not Globular until 100 Ka



Jebel Irhoud – 315 Ka

Omo 2 – 233 Ka



1983: *Homo neanderthalensis*, at Kebara, Israel, 60 Ka  
Most complete extracted Neandertal specimen & hyoid bone



*Homo neanderthalensis*  
(Kebara 2)  
Discoverer: Lynne  
Schepartz  
Locality: Kebara Cave, Israel



Pelvis

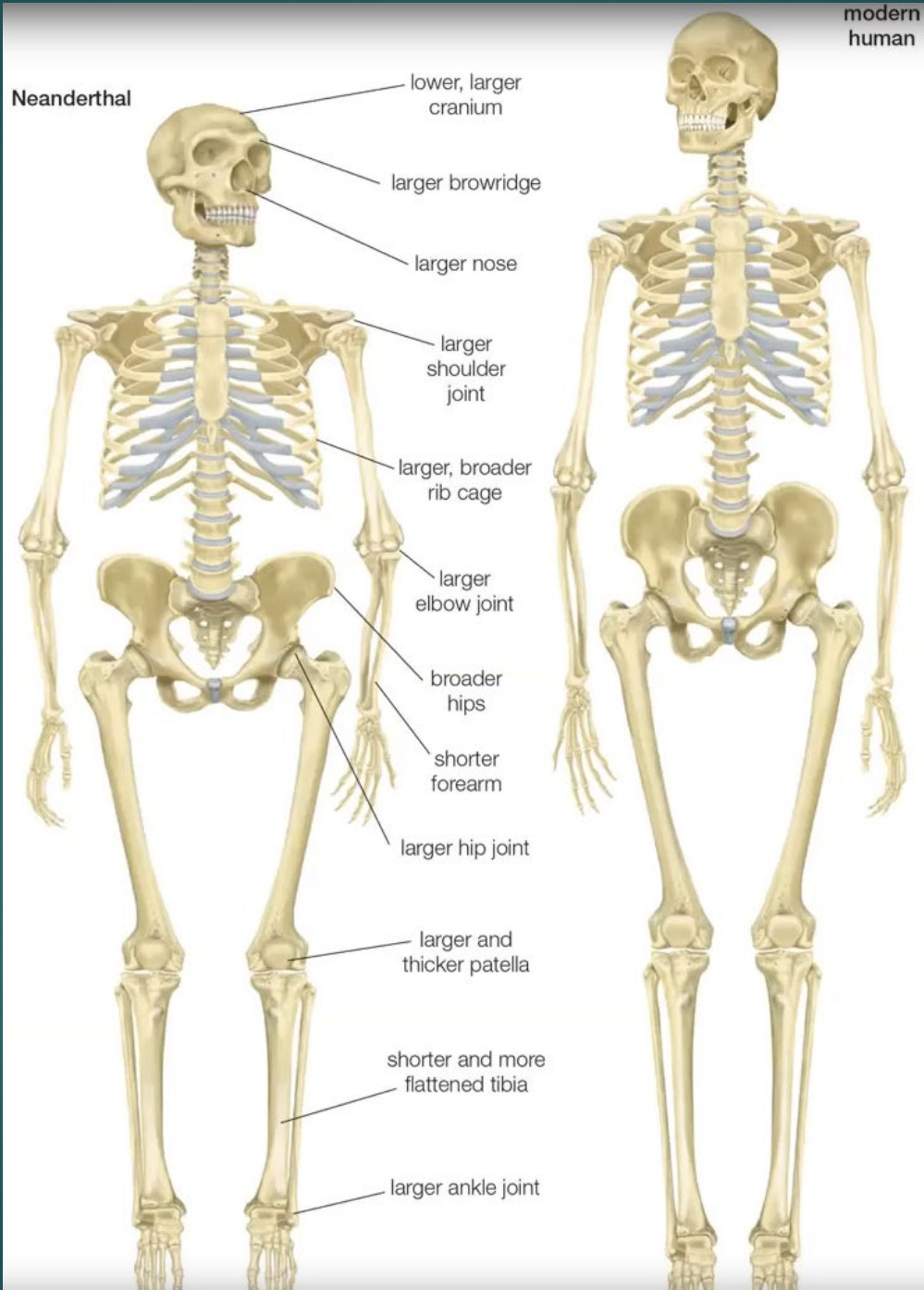


Hyoid bone

# Kebara N skeleton, 60 Ka







1600 cc  
Average 1478 cc



**Neanderthal**

160-168 cm, 80kg



158-184 cm, 80kg



1300~1600 cc



**Sapiens**

Low

Large

Long

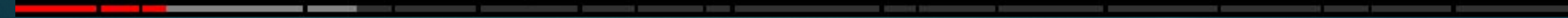
Brain Case

Nasal aperture

Collarbone

High

Narrow



**Allen's Rule:**  
body form or shape is linear in warm climates and more rounded and compact in cold climates

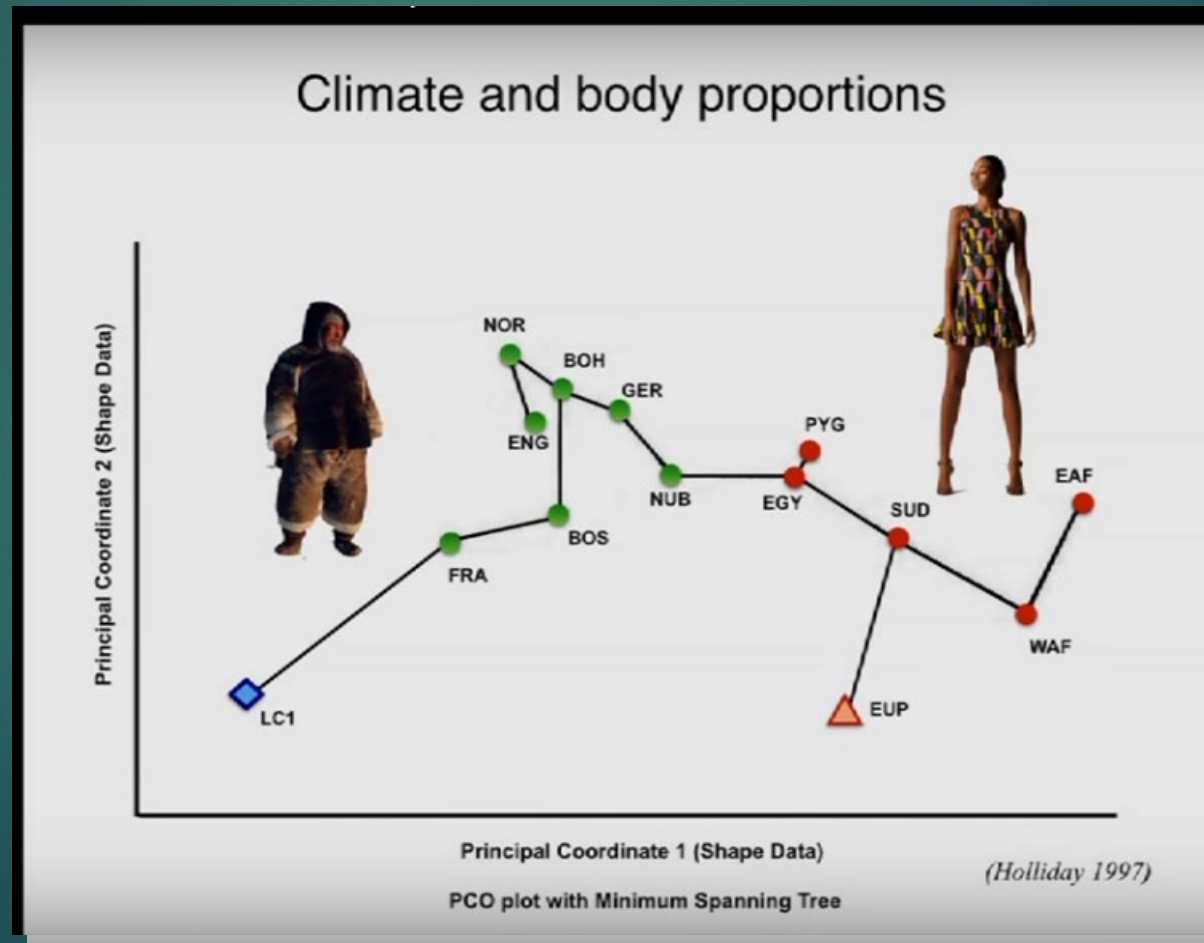


**Bergmann's Rule:** body size is large in cold climates and small in warm climates. Large bodies have a smaller surface area to volume ratios.

In warm climates where you need to expel heat, so bodies are smaller and more linear

**Climate and body shape:** proportion of limbs, shape of trunk; in hot areas, need to cool, have thinner bodies, narrow trunks, longer arms, taller; in colder, stockier bodies, shorter limbs, wider trunks

Don't find N  
In arctic regions



If you plot Russian N, far stockier than modern Inuits; if plot MH from 50 Ka, look like modern Sudanese

# Neandertal morphology circa 100 - 40 Ka

- ▶ The classic Ns are morphologically unique, best displayed in western European group.
- ▶ Full-blown N with all distinctive morphology:
  - ▶ thick, double-arched brow ridges over each eye
  - ▶ large nasal opening/broad nose
  - ▶ face that projects forward in midline
  - ▶ very large rounded eye orbits
  - ▶ laterally projecting and rounded parietal bones;
  - ▶ braincase widest lower down;
  - ▶ rounded top and back of cranium;
  - ▶ rounded, posteriorly projecting occipital bone (i.e. an occipital 'bun').

# Classic Ns

- ▶ **Endocranial volume?**: Cranial cavity is on average larger (1450 cc) than that of modern humans (1350 cc) – now challenged
- ▶ **No chin**
- ▶ **Distinctive limb bones with thick shafts and large joint surfaces**
  
- ▶ **Essentially a European and Near East taxon** (none in Africa or Scandinavia); but Eastern region has been less researched

# N body

- ▶ **Ns = short stature: exceptionally stocky and robustly built.**
- ▶ **N bones:**
  - ▶ tibia and fibula are unusually short compared to the femur,
  - ▶ radius and ulna are short compared to the humerus;
  - ▶ evolved these limb proportions as an **adaptation to either cold climates or hunting sprinting style or both**
- ▶ Neandertal pelves were also very broad.

# N body morphology

- ▶ Shorter than us, they weighed about 15 per cent more, were bulkier and had thicker, heavier bones.
- ▶ They were strongly muscled. Since the nineteenth century, biologists have known that cold-adapted species – often in higher latitudes – tend to have larger bodies, but shorter limbs; mean less surface area and better heat retention.
- ▶ Being bigger means creatures can have more fat stores for times when food is scarce. Living humans appear to roughly follow these geographic and seasonal bodily patterns, with Europeans tending to be stockier and have thicker bone shafts than those of African backgrounds.
- ▶ Neanderthals fit the trend, and since initially their bones were mostly found in clearly glacial contexts, this idea was hugely influential.



# Bone density



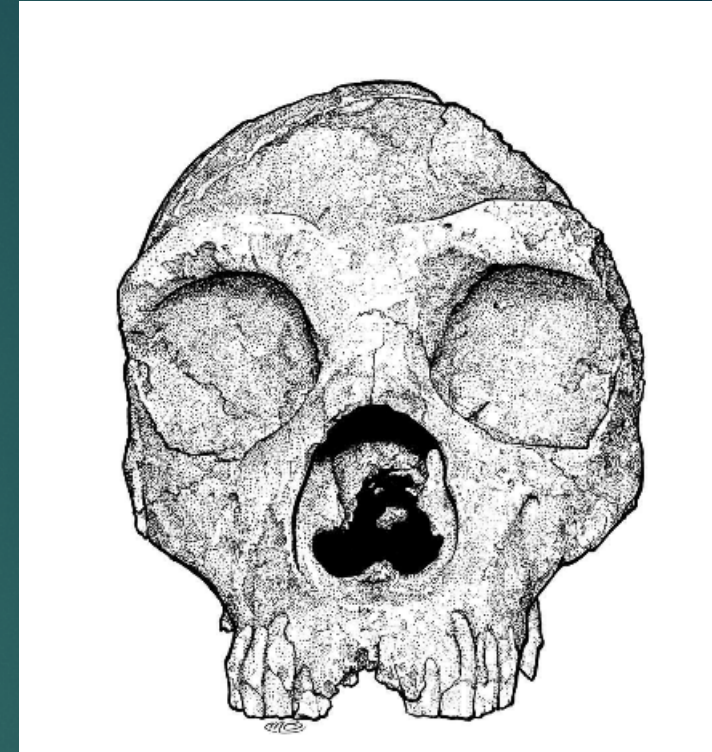
Current MH weight lifter

Neandertal

*N: increased thigh bone robusticity* (comparable to modern weightlifter); but with **greater mass & shorter limbs**, have **increased energetic cost of transport**; spent 215 kilocalories per day more than MHs in foraging

# N's face

- ▶ Neandertal faces:
- ▶ Big in all three dimensions: height, breadth, and length; broader and longer faces than early MHs
- ▶ Orbits are correspondingly wider, higher, and more voluminous
- ▶ Large, prognathic face; a face that was pulled forward at the middle



Gibraltar Forbes  
Quarry N

## N face

- ▶ Exceptionally large nasal opening. Related to face size, not for warming air (Arctic MHs do not have broad noses; Africans do).
- ▶ Neandertals had elevated metabolic needs and therefore elevated levels of oxygen consumption, demanding increased volumes of airflow; but also warming.
- ▶ The anterior teeth of Neandertals are quite large

# Diagnostic traits of *Homo neanderthalensis*: Cranium

- ▶ Long and low (platycephalic) skull: in profile, with retreating forehead and relatively flat cranial base
- ▶ Large but flatter cranium (N = football shape vs MH = soccer ball); globular when seen from behind (*en bombe* = subspheroid or oval)
- ▶ Browridges are large and double-arched (semicircular in shape (not continuous bar or shelf-like); characterized by extensive pneumatization

# Neandertal anatomical specializations

- ▶ The specializations include
  - ▶ the extraordinary forward projection of the face along the midline.
  - ▶ the tendency for the braincase to bulge outwards at the sides.
  - ▶ a depressed elliptical area of roughened bone on the back of the skull (suprainiac fossa)
  - ▶ singular configuration of the bony labyrinth of the inner ear.

**Computer simulations** show that Neanderthal facial morphology represents adaptation to cold and high energy demands, but not heavy biting

- The distinctive Neanderthal face, adapted to “**facilitate greater ventilatory demands**” —**inhaled up to twice that of modern humans**.
- Neanderthal facial morphology evolved to reflect **improved capacities to better condition cold, dry air, and, to move greater air volumes in responses to N’s higher energetic requirements**
- **Neanderthal’s nasal passage = 29 % larger than MHs**
- **But the internal structures in Neanderthals appear to be worse at air conditioning than MHs.**
- Computer simulations show that Neanderthal facial morphology represents adaptation to cold and high energy demands, but not heavy biting

N bodies may have been moulded in large part by how and where they lived.

- ▶ Large eye sockets: Their sockets were larger than any *H. sapiens* past or present, and bigger eyes mean more photo-absorbing retina and greater light sensitivity.
- ▶ Ns lived at higher latitudes, dealing with less light and especially dim winters. Northerly animals tend to have bigger eyes, and on average, even people from higher latitudes have eyeballs up to 20 per cent bigger than those from near the equator.
- ▶ Expanded eyes would require a larger visual system, and this area, housed in the distinctive occipital bun, is clearly bigger in Neanderthals.

# N diversity in pigmentation

- ▶ N's likely had lighter skin in Europe. The combination of red hair and freckles is possible in some Neanderthal individuals, but we can't be totally sure those genes were expressed exactly the same as in us.
- ▶ Their population was also diverse: the ginger-freckle marker is found in some Spanish and Italian Neanderthals, whereas other analysis indicates that individuals from Croatia had darker skin, eyes and hair.
- ▶ Various skin tones; but subset were brown eyed, tawny skinned, brunette hair



## N body needed more energy; more oxygen

- ▶ Older hominins, and even very early *H. sapiens*, were sturdier and had thicker bones than living people.
- ▶ Neanderthals' more compact size and shape would have bought barely 1°C of extra cold resistance, and their large brain size doesn't fit a **thermal trend either**. To be fair, some nineteenth-century scholars like biologist Thomas Huxley saw Neanderthal brawn not as a mirror of brutality, but resulting from highly mobile lifestyles.
- ▶ More massive bodies coped better with their intensive lifestyles, but needed a lot of fuel. And extra calories require more oxygen to convert into energy.

# N respiratory efficiency

- ▶ Respiratory efficiency became crucial, exemplified by huge noses siphoning in air and larger chests to accommodate larger lungs.
- ▶ Experiments show that increased exercise makes not just the limbs of young animals more robust, but their whole bodies. Skulls get heavier, browridges larger, muscle attachments bigger.
- ▶ That all sounds very familiar to what we see in Neanderthals. From finger to toe, their skeletons show clear evidence for thicker bones and larger muscles, making them at least 10 per cent beefier than even similarly stocky *H. sapiens* populations.
- ▶ This was definitely genetic, since it's visible in babies, but even youngsters also had physically tough lives.

# N size

- ▶ Average **Neanderthal leg-to-arm strength ratios** were even greater than cross-country competitors running 100 mi. per week. But it's not necessarily only about distance.
- ▶ **Neanderthal relative limb bone thickness more closely resembles prehistoric and recent *H. sapiens* populations who habitually travelled over extremely rugged landscapes.**
- ▶ **Had a gait that wasn't identical to ours and being shorter means they likely covered ground around 4 to 7 per cent more slowly.**

# N bodies

- ▶ While an image of them as tireless striders fits the skeletal evidence, running doesn't seem to have been a Neanderthal forte.
- ▶ With reinforced foot arches to cope with their greater bulk, sprinting and especially endurance running would have been less efficient. Perhaps Neanderthals might have lost to any *H. sapiens* in a 5,000m track race, but on the other hand their Achilles tendons made them much more sure-footed on uneven ground.
- ▶ But most of the strength was in the upper arms, a pattern unlike any recent *H. sapiens* populations.
- ▶ Neanderthals were right-handers like us,

## Right arm musculature asymmetry: throwing or scraping

- ▶ The dominant arm of Ns was between 25 to 60 per cent more developed; implies strenuous, habitual activity, often assumed to be spear hunting.
- ▶ Fossils including a 200,000-year-old isolated arm from Tourville-la-Rivière, France: some Neanderthals were making upwards and rotating movements similar to throwing; Ns used actual javelin-like spears.
- ▶ But overall, their shoulder mechanics aren't as well suited to overarm movement as ours, and the asymmetric patterns in arm muscle development also don't match this.
- ▶ Another possibility exists: one-handed scraping -- wood, working of animal skins
- ▶ Each animal skin can require more than 10 hours of scraping in multiple phases; perhaps 100 hours annually. Huron used 30 skins per year for a family.

# N sexual muscular differences

- ▶ N males have right arm asymmetry - more muscular right arms
- ▶ Right arm muscles were stronger,
  - ▶ Unlike us, right arms were very much stronger than left
  - ▶ for clothes-making through hide scraping
- ▶ Women were equally muscular in both arms
- ▶ Men's legs are more powerful than women's
- ▶ Both sexes were using mouths as third hand – leather processing?

# N legs and arms

- ▶ European N males bulked out between 170 and 190 lb, females 140 and 150 lb
- ▶ Legs overall were equally strong but women showed some asymmetry, with more buff thighs than lower legs. Differences in the amount of walking versus running might explain this, connected to the sort of terrain covered, but it's hard to model specifics.
- ▶ There's also sex dissimilarity between upper and lower arm bones. Neanderthal women don't display asymmetry between right and left arms like the men. Whatever they were doing with their lower arms, it mostly involved both hands. Double-handed hide working is a distinct possibility,

N teeth





# Teeth

- ▶ Teeth scratches tend to be more numerous and longer in Neanderthal women. N had right oblique angled scratches on incisors indicating they were right-handed
- ▶ It's long been obvious that Neanderthals' front teeth are extremely worn, even exposing dentine. In particular they seem to resemble hunter-gatherer societies that used their mouths for hide working: clenching the teeth like a vice through which to drag the hide and soften it up, or process sinews.
- ▶ There are also sex differences here: some women seem to have much more intensively worn front teeth. The closest match is historic Arctic hunter-gatherer societies, where women spent much of their time working hides.

# Teeth

- ▶ But not identical: Neanderthal women were using their upper front teeth far more, and lacked heavily worn back teeth from chewing skins. Either they had a very particular method, or there was another task happening that is as yet unidentifiable.
- ▶ To add to the impression that some tasks tended to be done by one sex more than another, Neanderthal women have a higher frequency of chipping damage on their lower front teeth, while in men it's on the upper set.
- ▶ These patterns are roughly similar across Western European sites, we might be looking at widespread commonalities in activity organization. But the sample size for female skeletons is limited.

# Mandible differences

Modern Human

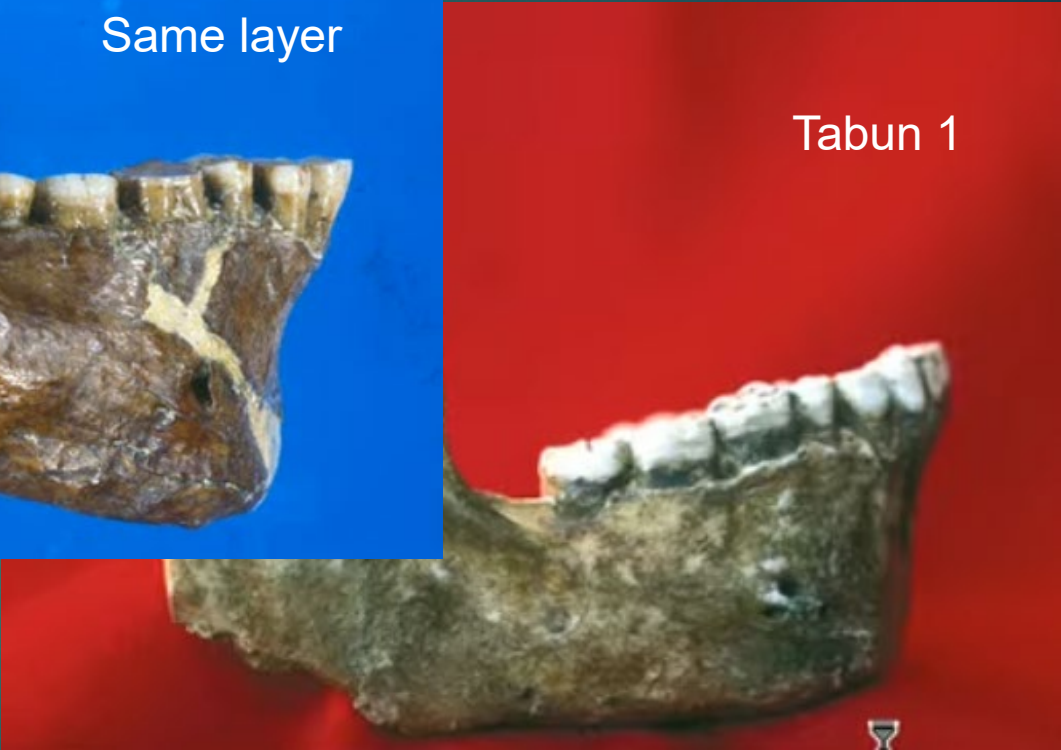


Neandertal

Tabun 2  
Same layer

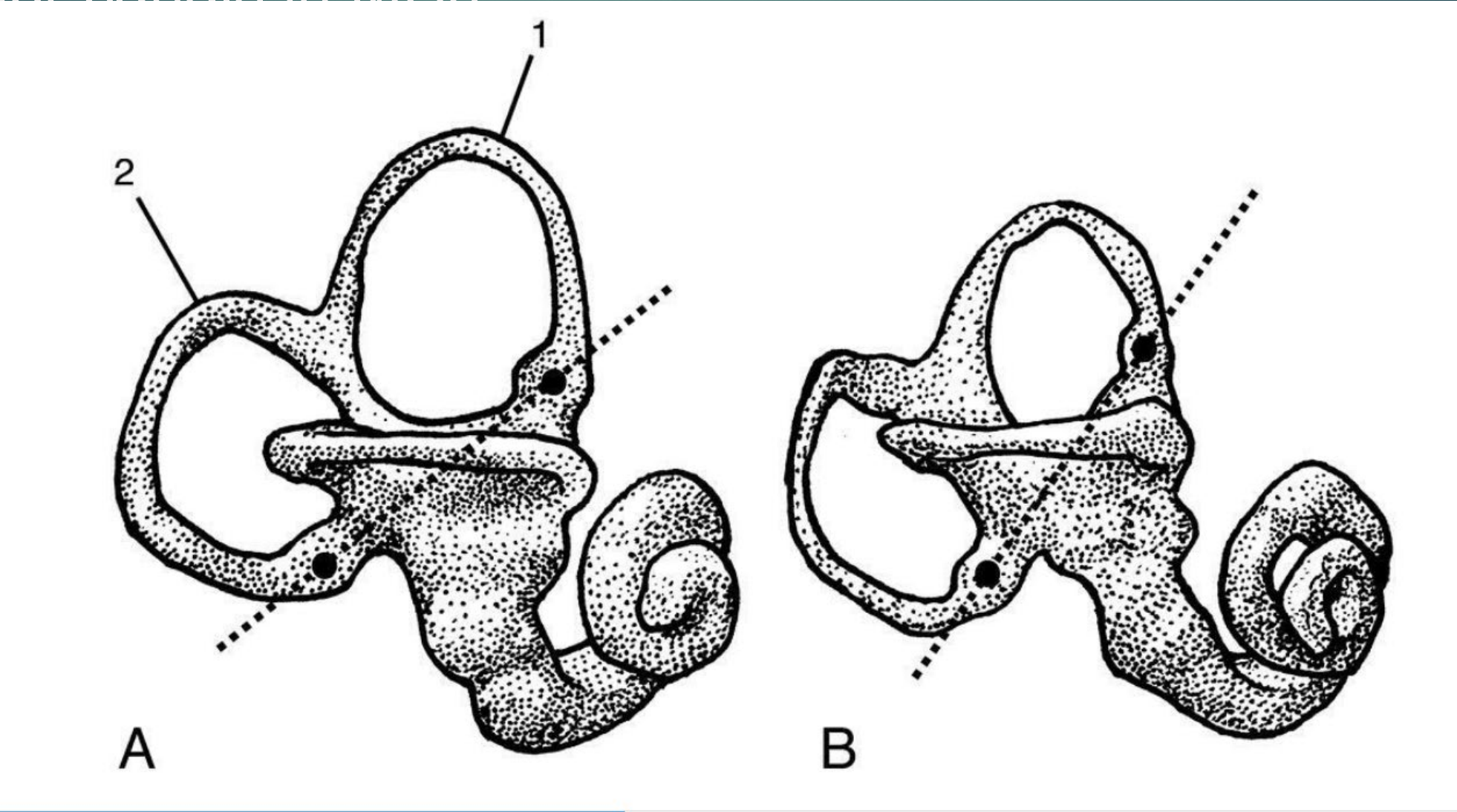


Tabun 1

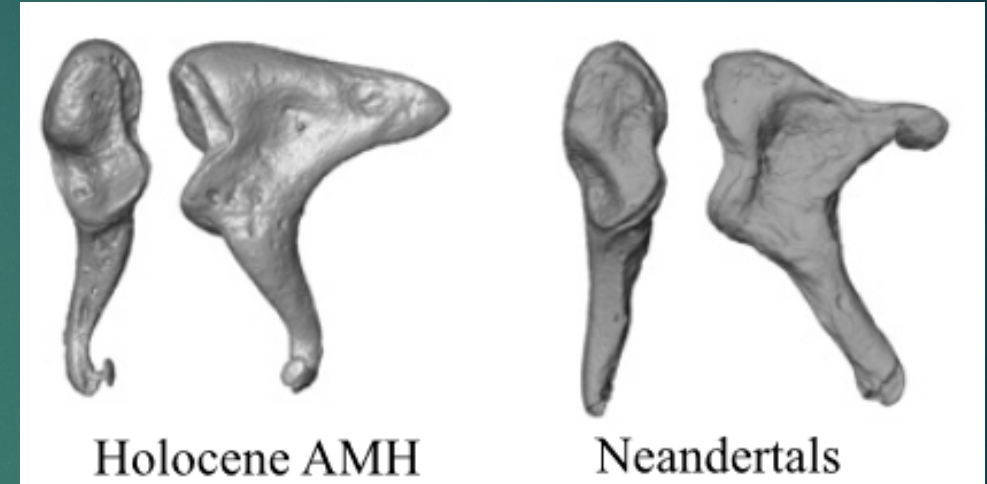
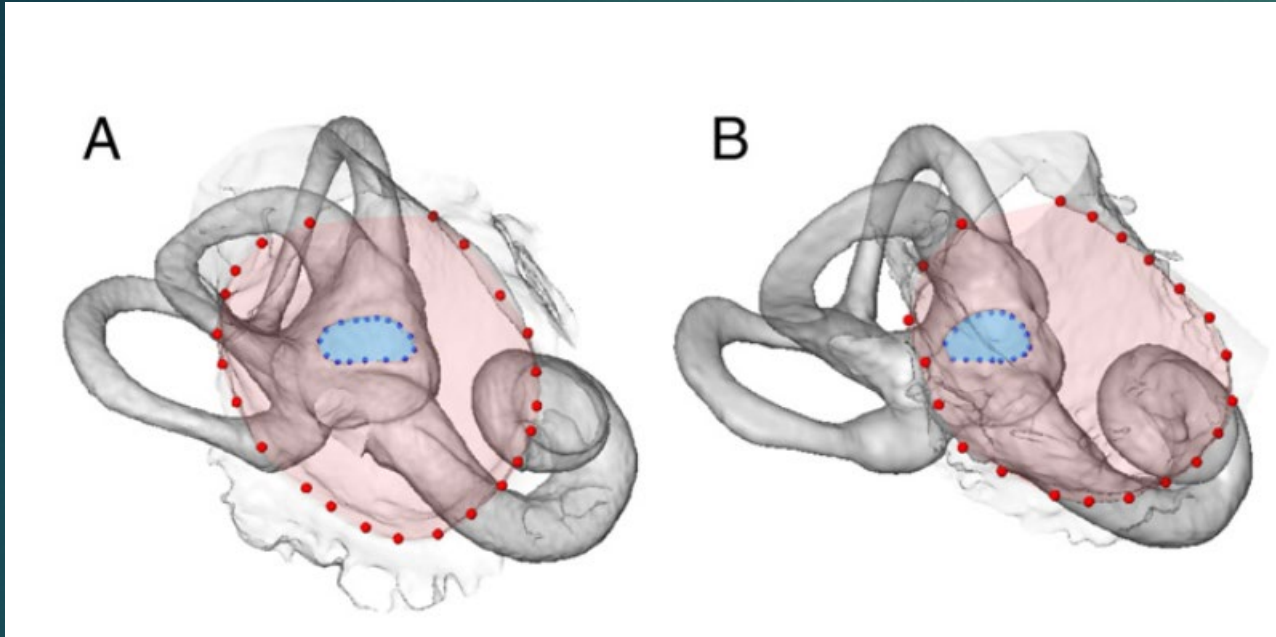


Lower posterior condyle, wider open mouth

Virtual (CT) endocasts of the bony labyrinth of the inner ear in modern humans (A) and Neandertals (B): larger canals in MHs



# N ear ossicles: differed from MHs, but equally sensitive for sound



Known ossicles of Neandertals are distinctly different from those of anatomically modern humans (AMHs);

But the functional properties of the middle ear of AMHs and Neandertals are largely similar. The relevance of these functionally equivalent solutions is likely to conserve a similar auditory sensitivity level inherited from their last common ancestor

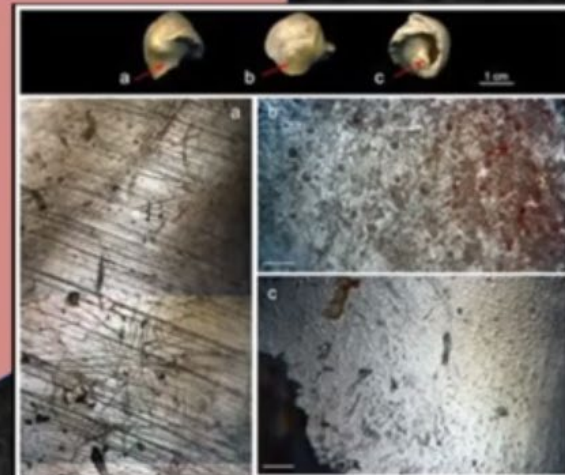
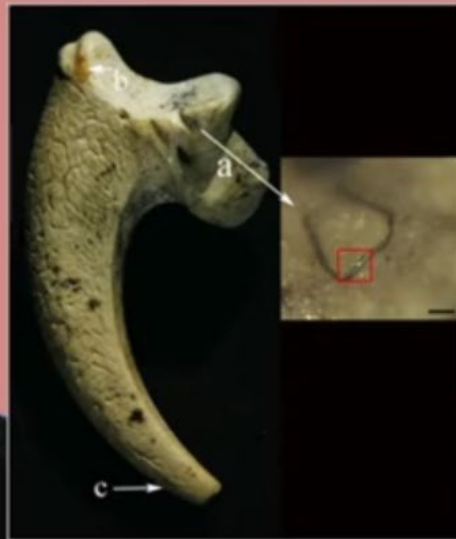
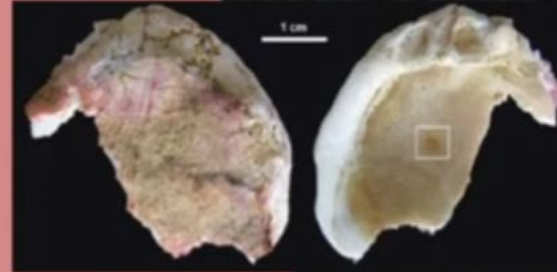
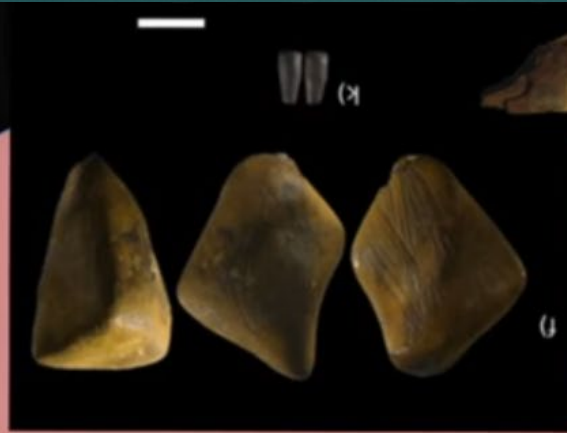
# N hearing ability at Sima de los Huesos imply they spoke

- ▶ Sima de los Huesos fossils: primitive morphology, indicating that Homo sapiens and Neanderthal cochleae evolved separately, from originally different anatomies, to similar morphology. This evidence indicates that the hearing of our species and that of Neanderthals evolved separately to end up hearing in the same way.
- ▶ Still transferred and amplified soundwaves exactly as in your own ears. And there's a fair amount of evidence that for humans, to a **large extent** this means sounds we make using vocal communication.

# Hearing range = speaking range

- ▶ Again, the evidence shows us a parallel evolution between the hearing of the Neanderthals and ours.
- ▶ The result of this evolution is that Neanderthals and we have great acoustic sensitivity to the same sounds. All available evidence indicates that these sounds were the same sounds we use today to communicate verbally: vowels and consonants.
- ▶ The consequence is immediate: Neanderthals used the same sounds as us to communicate; that is, they spoke.

# Neandertal Aesthetic Entanglements





# The late discovery of N “advanced” behaviors

- ▶ It is striking that almost all these discoveries of advanced human behaviors and capacities in Neandertals occur after the discovery that current MHs have Neandertals DNA.
- ▶ Suspect that this is not a coincidence – that these behaviors were discovered because people started looking for them, and that they started looking for them because it suddenly became important to situate Neandertals on the human side of the boundary between humans and animals.
- ▶ This connection is nowhere more evident than in the literature bearing on the existence of so-called “symbolic behavior” in Neandertals.

# N capabilities

- **N used feathers frequently**; feathers found at majority of Neandertal sites; clearly capable of hunting/trapping birds
- **N understood animal behavior and migration patterns; used topographic traps in hunting** (chased herds over cliffs; into narrow, dead-end canyons)
- Evidence of **intentional burial** at Chappelle-aux-Saints, France, 50 Ka ; Shanidar, Iraq
- **Specialized bone tools (lissoirs**, smoothers for leather tx), from Abri Peyrony (France), 47 Ka
- **Bruniquel Cave**, SW France: Neandertal structure of stalagmites, 176 Ka;

# N capacities

- Oldest handmade fiber/string
- Complex hafting (with glue) technology
- Use of manganese dioxide as fire starter;
- 300 Ka throwing sticks, and javelin type spears, at Schöningen, Germany; digging sticks
- Spatial organization in home sites - used different areas for different functions; understood fireplace placement in caves to avoid smoke inhalation

# N had equivalent cognitive & symbolic capability as early MHs

- ▶ This growing body of evidence challenges the idea that they were essentially static, closed to innovation and without symbolic imaging:
- ▶ Burials & grave goods in the form of faunal remains, stone and bone tools, engraved bone, and rock slab engraved with cupules
- ▶ Pech de l'Azé manganese use as pigment & to rekindle or maintain a fire
- ▶ Use of pigment (ocher), since 250 Ka, becomes widespread after 60 Ka and is associated with the discovery of pigment processing tools and pigment containers

# N Symbolism

- ▶ Perforated shells in Slovenia, 50 kya
- ▶ Mollusks as food, with klg of seasonal availability
- ▶ Transport and coloring of exotic objects and their possible use as pendants
- ▶ Increased distance that they transported stone to make tools
- ▶ Extraction of large feathers from raptors, corvids and pigeons, esp. black feathers in Gibraltar and elsewhere

# N Symbolism

- ▶ Self medication with aspirin and penicillin containing plants
- ▶ Eagle talons & mollusk shell pendants
- ▶ Bladelet production occurs in Acheulean and later Mousterian; Levallois spear points
- ▶ Use of birch-bark pitch as adhesive
- ▶ Châtelperronian tools & jewelry ?
- ▶ All above well before the arrival of MHs circa 45 Ka

# No representational art

250

- ▶ What Neanderthals do have in common with early *H. sapiens* prior to 45 Ka is an absence of any unequivocal representational art.
- ▶ The oldest known image of an animal was painted before 44 Ka in Sulawesi, Indonesia; there are also handprints around the same age from Lubang Jeriji Saléh, Borneo, and Venus of Hohle Fels figurine around 35 Ka.
- ▶ The specific motivations behind Neanderthal aesthetics are probably unknowable.

# Wherefore Art Thou, Neanderthal?

- Neanderthals were probably on an independent trajectory to symbolically complex behaviors: growing body of evidence from Europe that this was the case ranging from pigment on shells, stalagmite constructions at Bruniquel, France, and collections of raptor feathers and talons in many regions.
- N hand prints at Maltravieso: All of the rich symbolic meanings ascribed to later MH handprints and negatives hand impressions in Upper Palaeolithic caves must also be considered for Neanderthals: a sense of self and the marking of places and more.



## Wherefore Art Thou, Neanderthal?

- They might not have been drawing images of animals (that we know of!), but they were using paint to create a representation of the body, whatever the meaning was.
- Lines and handprints are incredibly common features in European caves, but when they are found as part of panels made at several points through time, N's appear to have been done first.
- This raises the possibility that there's a hidden layer of Neanderthal art in many more sites, underneath later Upper Palaeolithic additions.
- The first *Homo sapiens* entering Europe did not find 'empty' caves, but walked into the dark to discover red markings and even handprints of others before them. And were then moved to add to this record themselves.

## N aesthetics:

- Use of mineral pigments: yellow, orange, black – intentional choice of purity
- Mixes of charcoal and crushed iron pyrite for new sparkly visual effect; at 200-250 Ka
- Fossil shells with pigments – shell from 100 miles away, pigment from 40 miles away
- Incisions on material
- Black feather use

## N aesthetics:

- ▶ Shells with pre-existent holes
- ▶ Making marks on material – regularized even markings/notations:  
Hyena bone with sequential markings unrelated to butchering
- ▶ Hash markings from Gibraltar
- ▶ End aesthetic object may not have been the goal; the performance of creation may have been what was important

## Pigment use by Ns

- ▶ Soressi M, & D'Errico F. 2007: three different kinds of evidence for Neandertal “symbolic behavior”:
  - ▶ engravings (mainly on bone, but also stone),
  - ▶ ornaments,
  - ▶ pigments.
- ▶ Pigment use by Ns: In Europe, 70 sites, 250 to 40 Ka, have yielded blocks of pigments or objects that served to grind pigments; mostly black pigment, manganese dioxide, and more rarely ocher attributed to the Mousterian. Perhaps to paint their faces or bodies: body ornamentation

# Ornaments

- ▶ N use as ornaments/jewelry:
  - ▶ perforated shells in Slovenia, 50 Ka
  - ▶ bird feathers (Finlayson et al., 2012)
  - ▶ eagle talons ( Radovic et al., 2015 )
  - ▶ perforated animal teeth of different species;
- ▶ Zilhão & d'Errico: shows that Neanderthals adorned themselves with symbolic artefacts and, since these date before modern humans arrived in the area, they also represent independent Neanderthal innovations
- ▶ Many of these objects, if found in MH site, would be unquestionably interpreted as symbolic

## Ns and bright, shiny things:

- ▶ Did Neanderthals also have a magpie lust for shine and glitter?
- ▶ Collection of non-utilitarian objects
- ▶ When things with those qualities but no obvious practical function are found, it's hard not to instinctively assume an aesthetic motivation for their presence.
- ▶ The simplest cases are manuports, meaning 'carried in by hand'. They're always rare. Examples include a quartz crystal at Abri des Pechêurs, south-east France, or a fossil shell at Pech de l'Azé I.

Ns had an eye for beauty: An elegant Acheulean handaxe was carefully shaped so as to display a fossil shell of *Spondylus spinosus* at its center. It was made around 200 Ka by a N.



A **limestone rock** that stood out among other items at the Krapina site, 130 Ka

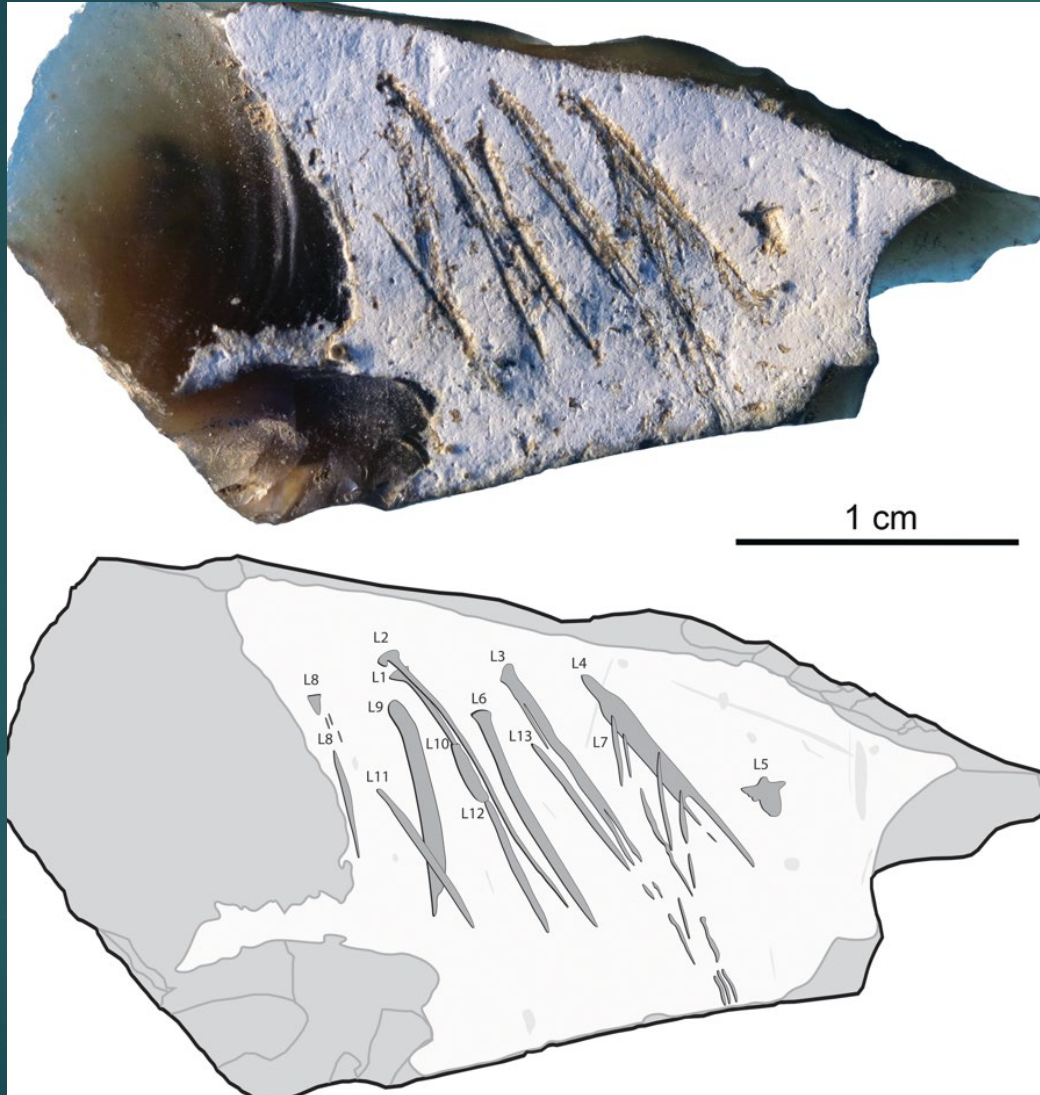




## Bright, shiny things

- ▶ Shiny things snag the gaze, so we must assume Neanderthals' curiosity was piqued. They also picked up things with unusual tactile qualities, such as pumice stones found at some Italian sites.
- ▶ And **these curiosities were sometimes also moved long distances**: the Pech de l'Azé I fossil was carried at least 20 mi. and given everything carried with them must have been thought important, this was no thoughtless choice.
- ▶ **Ns were attracted to odd things**: geodes, fossils – often brought to site from great distances away

# Small engraving on stone cortex from Kiik-Koba: 13 parallel lines



From layer IV, the same layer in which a Neanderthal child burial was unearthed

## Engraved Elephant bone from Bilzingsleben, Germany



More commonly incised than minerals or stones are animal remains.. The most ancient is an elephant bone from Bilzingsleben, Germany, engraved with two sets of parallel lines at different angles. At around 350 ka, it's not much older than Schöningen and was likely made by early Neanderthals, but following this there are few other objects for the next 150,000 years..

Recent study of the **disputed Neandertal “flute” from Divje Babe I in Slovenia** (Turk 2014, Turk et al. 2018) presents a strong case that this specimen is **Neandertal-produced and not the result of carnivore activity.**

Massive amount of research.



Divje Babe flute



# Mask of La Roche-Cotard; 75 Ka

Fig. 2: Langeais. La Roche-Cotard II. The "mask". Height: 93 mm, width: 105 mm, thickness: 40mm, weight: 299 gm.



The artifact, in clear Mousterian context, created by Neanderthal, is a piece of flat flint that has been shaped in a way that seems to resemble the upper part of a face.

A piece of bone pushed through a hole in the stone has been interpreted as a representation of eyes.

# 2014: Neandertal Art

- Gibraltar Cave, 2012:
- 39K, crosshatched pattern of 13 grooves in the bedrock;
- Took between 188 and 317 strokes with a flint tool to create the entire figure.
- Clan Marking?



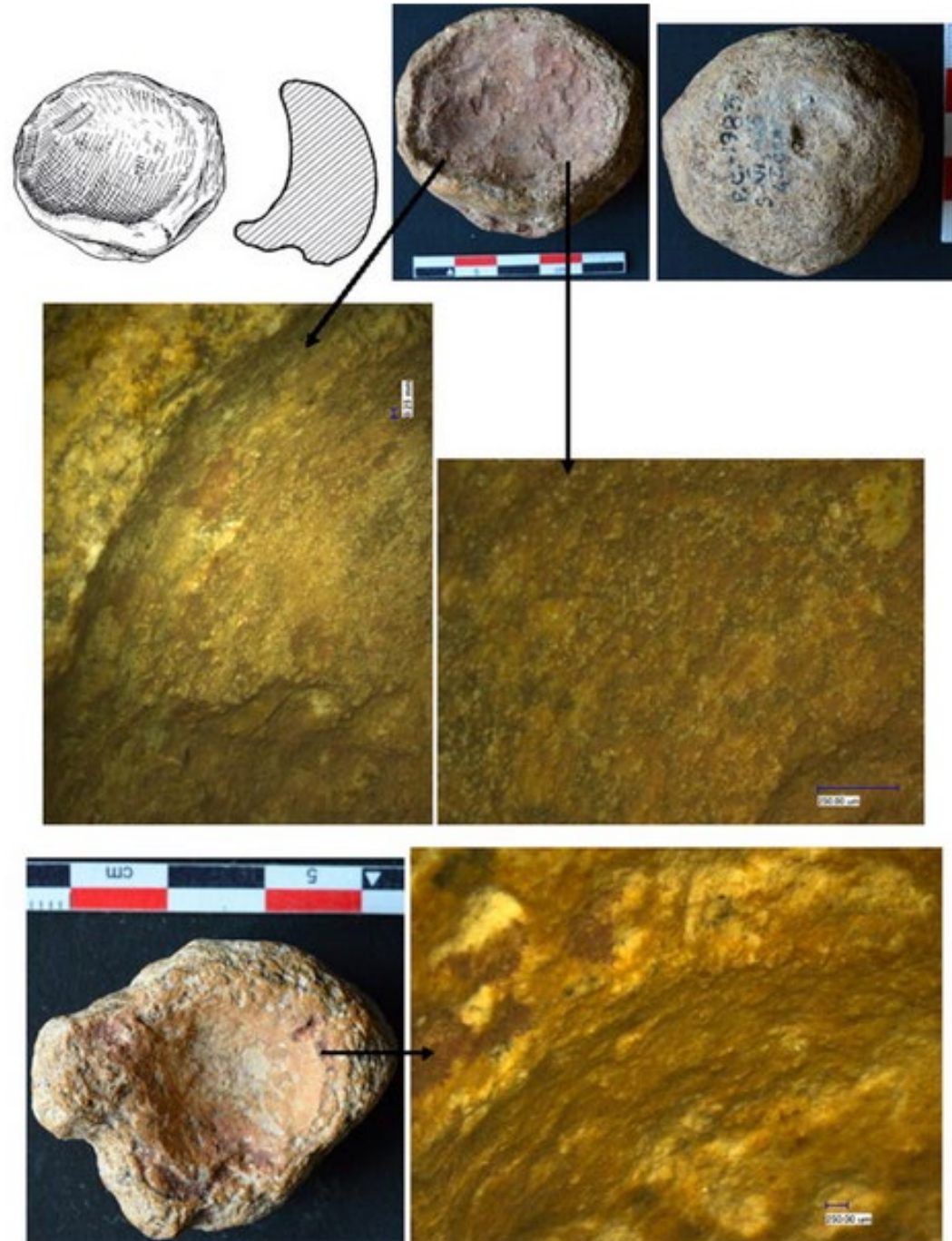
Gibraltar Cave, 2014

# The Hashtag

- ▶ Within Gorham's Cave, Gibraltar, 13 intersecting lines were deeply etched sometime well before 40 ka onto a raised section of the stone floor. They form a rough grid pattern, dubbed by the media as 'the hashtag'. Experiments suggest that somewhere between 200 and 300 gouging's were needed.
- ▶ They were produced in a particular sequence
- ▶ The weight of evidence from more and more cases of pigment use and mark making is increasingly leading even sceptics to accept that Neanderthals had an aesthetic, symbolic capacity.

2002 article reporting pigment inside natural stalagmite 'cups' from a Middle Palaeolithic context in Romania.

Mousterian layer: Two of the eight ochre preparation containers found in Cioarei-Boroteni Cave, Romania, and traces of ochre observed by means of the digital microscope ( $\times 200$ ), inside the ochre preparation containers.



Same object at Blombos, S. Africa made by African MHs at 70 Ka was Immediately called symbolic



# N capacity for symbolism

- ▶ What's needed to infer symbolism is special treatment, or repeated associations and patterns in behaviour.
- ▶ Cioarei-Borosteni Cave in Carpathians: a hard ball-like object, just large enough to fill your hand, yet remarkably dense. Scanning revealed it to be mineral geode, possibly opal. Sprinkled with red ocher.
- ▶ Neanderthals, over considerable periods of time, were interested in applying color to unusual things. That, fundamentally, is a definition of art.

# N use of color

- ▶ Evidence for Neanderthal symbolism has seen a pigment boom in the past decade
- ▶ Pigments have been identified at more than 70 sites, just in Europe. As well as red and yellow minerals, Neanderthals were collecting and using various black substances. But what for?
- ▶ Color is central to visual displays for social communication.
- ▶ Minerals can be used for sunscreen, insect repellent, hair management or even antiseptics; ochers in particular can be used in hide working or as hafting glue additives, black manganese may be useful in fire-lighting.

# Pigment use

- ▶ There's certainly plenty of evidence pigments were used: many nodules have wear traces, sometimes from being rubbed on soft things, or due to scraping in a way that produced richly colored powder.
- ▶ **Between 250 and 200 Ka Neanderthals were making liquid red ochre.** Minute analysis of red-stained sediments from the open-air locale of Maastricht-Belvédère, Netherlands
- ▶ **Maastricht-Belvédère is the oldest known use of pigment.** For Neanderthals, as time goes by pigment gets much more common in the archaeological record. Most impressive, in levels around 60 Ka at Pech de l'Azé I, there are some 500 pieces of black manganese,

- ▶ Combe Grenal is also remarkable for long-term pigment use, with around 70 blocks through 16 layers. But here the colors and uses shift, and they appear linked to different stone technologies.
- ▶ Quina layers mostly have grey-black minerals. After this, mineral use becomes rarer, but unworn red pieces appear. Then during a phase of Discoid assemblages, more reds, browns and yellows turn up but they're different chemically, and must have come from other sources.
- ▶ In some south-west French sites it's possible to make out that, once again, Neanderthals were focusing on quality. They must either have been systematically searching large areas for the richest manganese minerals, or selecting the best pieces from individual sources.

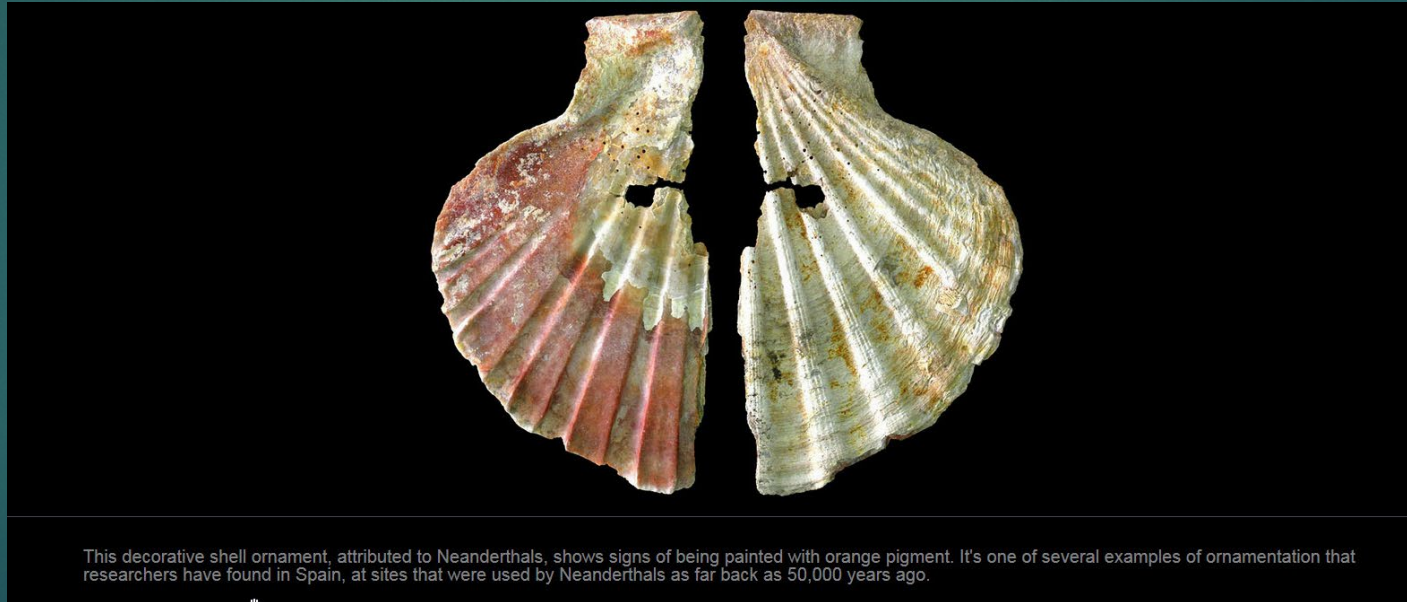
# Shells with pigments

- ▶ Some sites indicate connections between pigment and shells.
- ▶ **Cueva de los Aviones, Spain**. Contained hundreds of shells, probably collected for food, but beneath cemented sediment on two dog cockles, red ochre was visible, with small holes near the tips of both shells. A horse bone and three other shells - thorny oysters - also bear pigment,
- ▶ Neanderthals were color mixing. Analysis showed that the 'recipe' contained hematite, goethite, black carbon (probably charcoal or burned bone), limestone and sparkly pyrite.

# Neandertal Symbolic Behavior? Now dated to 115

Ka

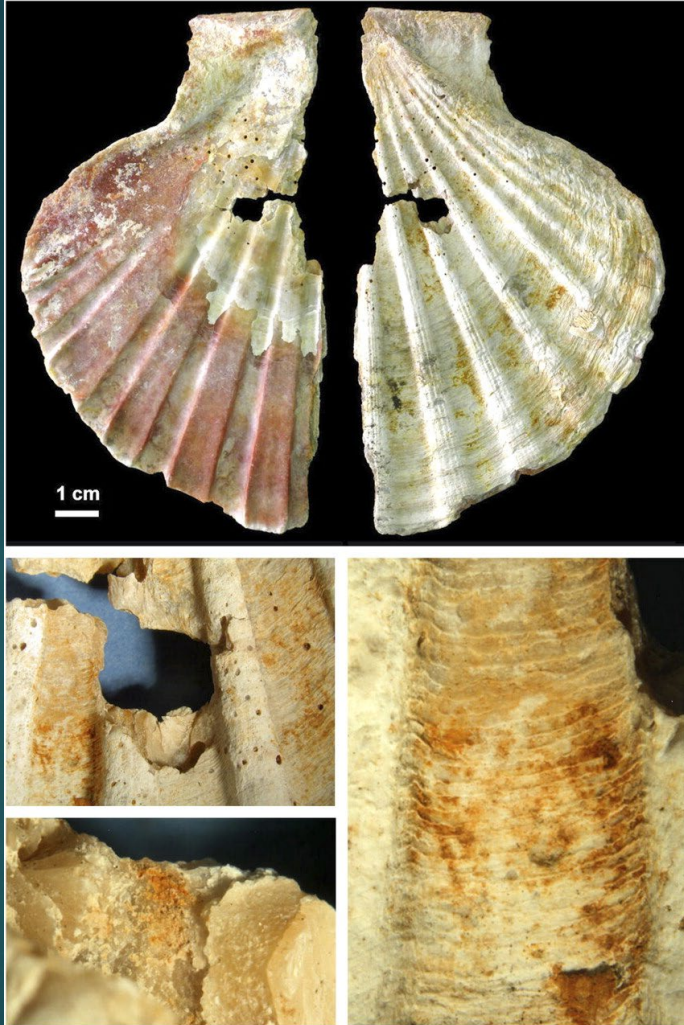
- ▶ 2010: Two N sites of Middle Paleolithic of Iberia, dated to as early as approximately **50 Ka**, yielded **perforated and pigment-stained marine shells**; recovered in Mousterian levels dated to ca 50 ka at Cueva de Los Aviones and Cueva Antón in the Iberian Peninsula.
- ▶ Evidence for body ornamentation, implying behavioral modernity.



This decorative shell ornament, attributed to Neanderthals, shows signs of being painted with orange pigment. It's one of several examples of ornamentation that researchers have found in Spain, at sites that were used by Neanderthals as far back as 50,000 years ago.

Perforated and painted shells indicate Neandertal symbolic behavior:  
Zilhao *et al.*, *Proc. Natl. Acad. Sci. U.S.A.* **107**, 1023 (2010).

K19-3, a **perforated upper half-valve** of *Pecten maximus* from level I-k at Cueva Antón (height: 120 mm).



- The **internal, naturally red** side (Left)
- The **external, whitish** side that was **painted with an orange colorant** made of goethite and hematite to make them look similar.

# Pigments

- ▶ The **Cueva de los Aviones discovery** stimulated speculative headlines about Neanderthal cosmetics and jewellery, but even if that's not true, it's a hugely important find.
- ▶ These **Neanderthals were experimenting, combining substances to create different visual effects**. Moreover, they had to have obtained the ingredients from different rock outcrops, the closest at least several kilometers away.
- ▶ **Dated to 115 Ka; pushes complex pigment use well back in Neanderthal history.**



The **perforated shells** from Cueva de los Aviones (after cleaning):  
(1) *Acanthocardia tuberculata*



Holes drilled by a  
Marine snail

Collected by Ns for  
stringing together

Dated to 115 Ka

Cueva de los Aviones, Murcia, Spain: a quite impressive array of activity seemed to be going on: red, yellow and orange pigments were being mixed up sometimes with pyrite, a shiny rock, and were found in the same levels as perforated marine shells. Some of the shells were collected alive, and have a mix of human-made holes, and natural perforations selected by size, interpreted as personal ornaments.

# Shell with Pigments

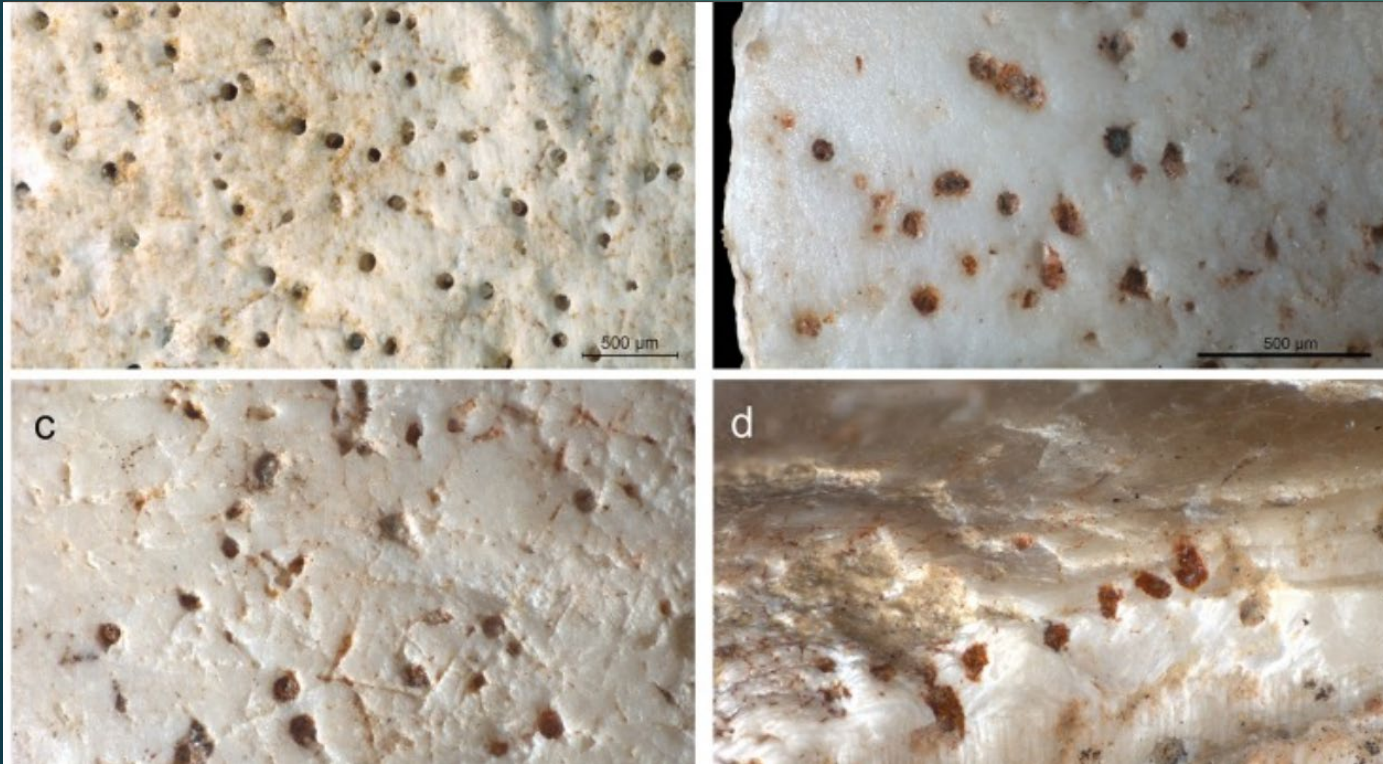
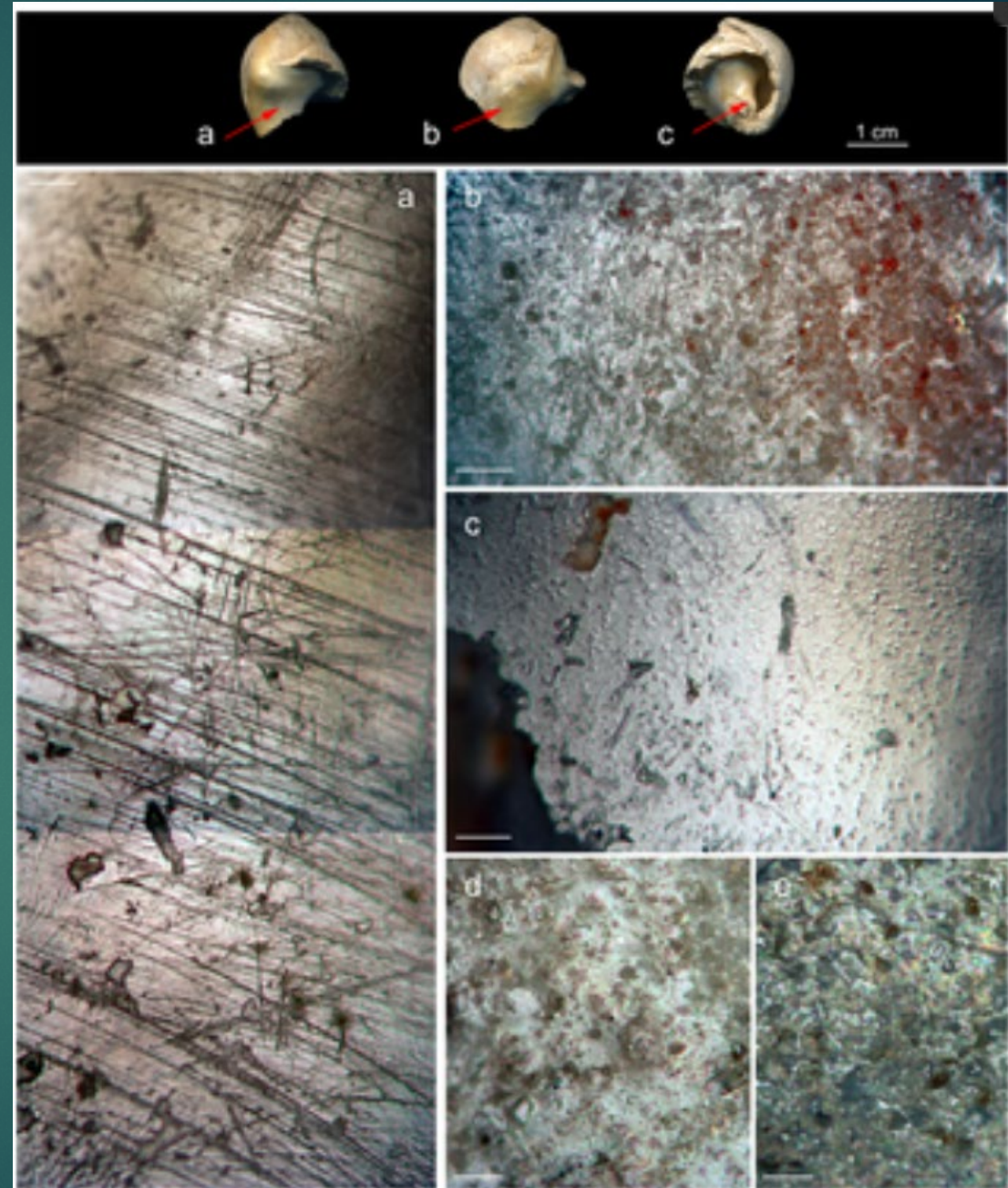
- ▶ Fumane Cave: Neanderthals were applying pigment to shells that definitely weren't food waste. Had once been strung or attached by thong or thread. This was an aesthetic artefact, the color meant to be seen.
- ▶ Sometime around 46 ka, a Neanderthal noticed stone shells eroding from limestone, and picked one up. They carried this tiny piece from place to place; kept it so long its surface became polished.
- ▶ Treaded?; micro-scratches from thread? From 100 miles away

# An ochered fossil marine shell from the Mousterian of Fumane Cave, Italy



- ▶ A shell from Grotta Fumane in Italy, which was left there ~46 Ka. It's actually a small fossil originally **picked up at least 100 kilometers away**. At some point, a Neanderthal had rubbed the outside of the shell with red mineral pigment that had been gotten from 40 kms away. **As hunter-gatherers with no means of transport except walking, Neanderthals wouldn't have carried anything without value. Ns were beings who were curious about materials, and interested in the aesthetics of engaging with them.**

Fumane, Italy: 46 Ka  
N carried **pigmented fossil shell**  
(*Aspa marginata* shell): **smeard with**  
**a pure hematite powder.**  
**Perforated and used as a personal ornament**



## Aesthetics: pigments

- ▶ Pigments: Belgium – black silt stone – black when rubbed – no practical other use
- ▶ Manganese dioxide – colorant, fire starter
- ▶ Pigments in association with stalagmites in Romania
- ▶ Carbonite crust overlaid red ochre (and black color) on dense geode
- ▶ Pigment with shells – mix of charcoal and crushed bright iron pyrite

## N Symbolic behavior: feathers & pigments

- ▶ There is now growing evidence for Ns transporting of lithics up to 300 km, although such distances remain much less common than in the Upper Palaeolithic.
- ▶ Neanderthal symbolic behavior: although using perishable materials, comes from the identification of intentional removal of large feathers from sizable bird species at Fumane Cave,
- ▶ Unravelling the Palaeolithic Italy, including lammergeier, vulture and eagle, which are interpreted as probably used for decoration.
- ▶ Pigment use: In France black manganese 'crayons' were rubbed onto soft surfaces such as skin at Pech de l'Azé.

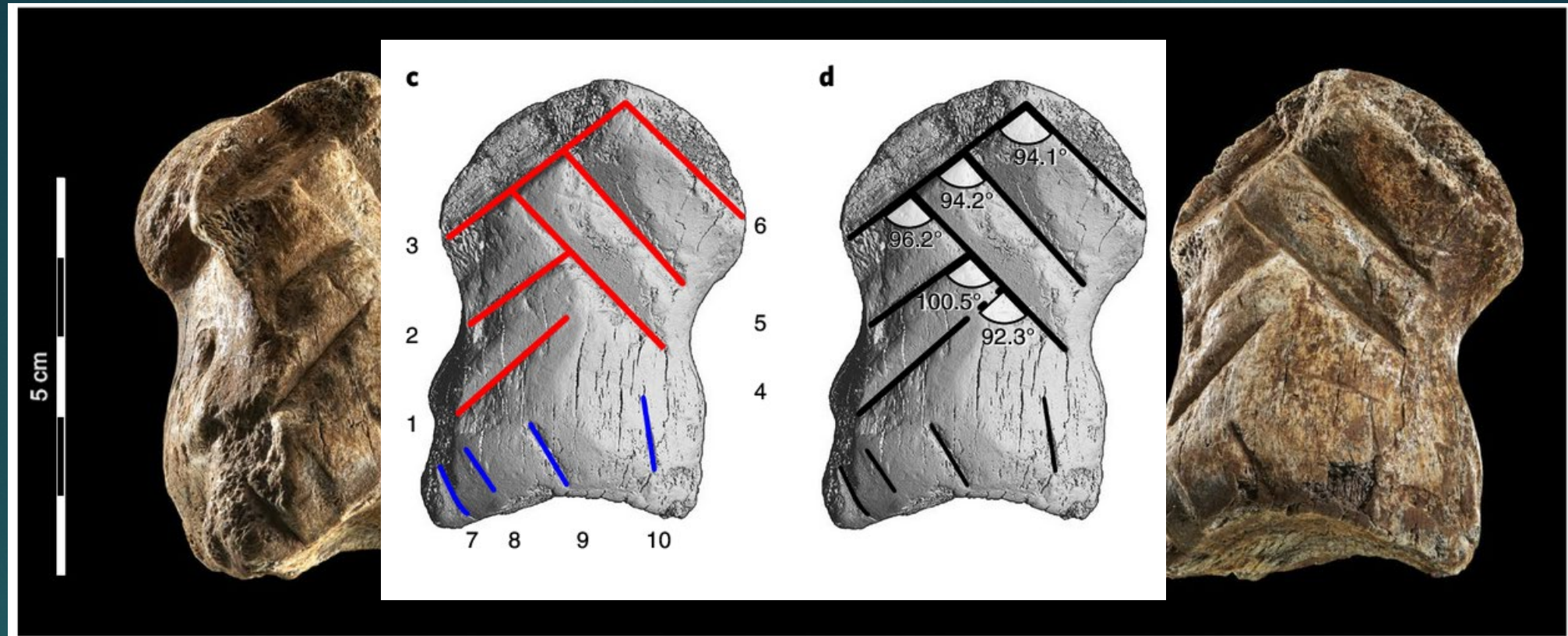
## N symbolic behavior: Pigments

- ▶ Ocher can play a functional role as an ingredient in hafting mastics or skin preparation, but the contexts in which pigments are found suggests a symbolic function.
- ▶ At two recently published LMP Spanish sites (Cueva Antón and Cueva de los Aviones), red, yellow and orange pigment preparations (including mixes with pyrite) sourced from 3–7 km distant were found on the surfaces of marine shells had anthropogenic and natural (selected by hole size) perforations, suggesting their use as personal ornaments.
- ▶ Such artefacts are recognized as a form of symbolic storage, transmitting information about cultural/personal identity that is context specific

# Aesthetics

- ▶ **Sense of beauty**: Kept a small beautiful **piece of unused mineral crystal** in the cultural layers of Chagyrskaya Cave, of Altai Mts
- ▶ **51,000-year-old engraved giant deer phalanx from Einhornhöhle, northern Germany**





**51,000-year-old engraved giant deer phalanx** found at the former cave entrance of Einhornhöhle, northern Germany. The find comes from an apparent Middle Palaeolithic context that is linked to Neanderthals. The engraved bone demonstrates that conceptual imagination, as a prerequisite to compose individual lines into a coherent design, was present in Neanderthals. Therefore, Neanderthal's awareness of symbolic meaning is very likely.

# Crystal lithics at Abri des Merveilles



# N use of shell tools

- ▶ From 120 ka onwards Neanderthals developed true shell-based technologies. So far 13 sites - all in Greece and Italy - have produced several hundred worked shell tools.
- ▶ At Cavallo Cave, southern Italy, the richest level is Eemian with over **120 retouched shell parts**. And in the same region and period, Neanderthals at Moscerini Cave also produced shell tools. Along with unretouched fragments, **170 shell tools** came from a very small excavated zone.
- ▶ Once again, **shell tools show how Neanderthals were choosy about their materials.**
- ▶ What all the shell sites have in common is **local scarcity of high-quality rock, with Neanderthals forced to use poorer stuff, including very small beach pebbles.**

# Shell tools

- ▶ Smooth clams (*Callista chione*) were especially favored, being a decent, palm-filling size, and with striking glossy surfaces.
- ▶ Similar species, though, were hardly used, while mussels at Moscerini were eaten or knapped. Clams were used to cut skin and meat and scraping wood. Some sourced from 10 miles away.
- ▶ But shell tools were absent in Iberia

# Ns = Pigments on walls

- ▶ Pigment use was probably a lot more common among Neanderthals than the tiny surviving traces would lead us to believe. They used it on canvases rather larger than shells.
- ▶ Three Iberian caves full of Upper Palaeolithic paintings: Red pigments on walls by Ns
- ▶ At Ardales Cave, Malaga, various stalagmites and flowstone formations in different areas of the cave have obvious red daubing's. Dates had minimum ages before 45 ka, and one was an astonishing 65 ka.

## Pigments on walls

- ▶ Claim that **Neandertals**, not just Upper Paleolithic moderns, painted in caves.
- ▶ An **irregular red disk painted on the wall of El Castillo Cave in Spain** yielded a minimum date of 40.8 Kya, and **several hand stencils and geometric forms** found with it may be of the same age.

# El Sidrón: Neanderthals were Earth's first cave painters.

300



- ▶ In El Castillo cave, hand stencils join a red disk (not pictured) that may be one of Earth's earliest cave art.
- ▶ The oldest being a simple red disk.
- ▶ Dated to more than 40,800 years old

Photograph courtesy Pedro Saura via Science/AAAS

One of the irregular red disks painted on the wall of El Castillo Cave in Spain yielded a minimum date of 40.8 Kya





# N art

- ▶ When the same dating technique was applied to artistic expressions in three Spanish caves – a red linear motif at La Pasiega, a hand stencil in Maltravieso, and painted speleothems at Ardales – all were dated in excess of 64.8 Kya.
- ▶ These dates are significant because they preclude the possibility that modern humans are responsible for the art.
- ▶ The dating of these Spanish sites has been debated. However, the ability of Neandertals to produce such aesthetic expressions seems to be increasingly supported by accumulating evidence

## Neandertal Art:

- **Earliest artists in Europe:** Cave art at three sites in Spain (La Pasiega, Maltravieso and Ardales), wall art at 65 Ka.
- **White-tailed eagle talons from Krapina** (Croatia), interpreted as part of a jewellery assemblage, 130 Ka.
- Example of one of **many cut-marked raptor phalanges** interpreted as symbolic objects **at 10 archaeological sites across Europe, 130-40 Ka**

# Neandertal Modified White-Tailed Eagle Talon necklace, 130 K



White tail Eagle

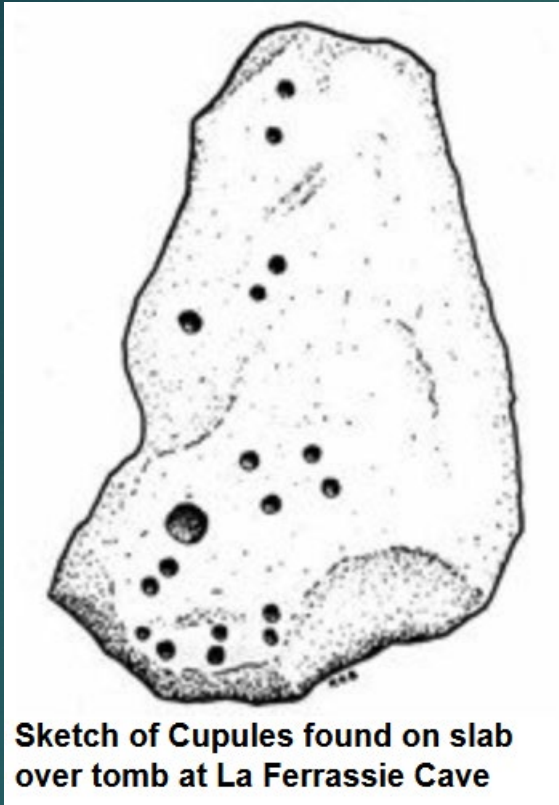


Neandertal Pendant, 130K

Krapina, Croatia

- Presence of eight talons indicates that the Krapina Neandertals acquired and curated eagle talons for some kind of symbolic purpose.

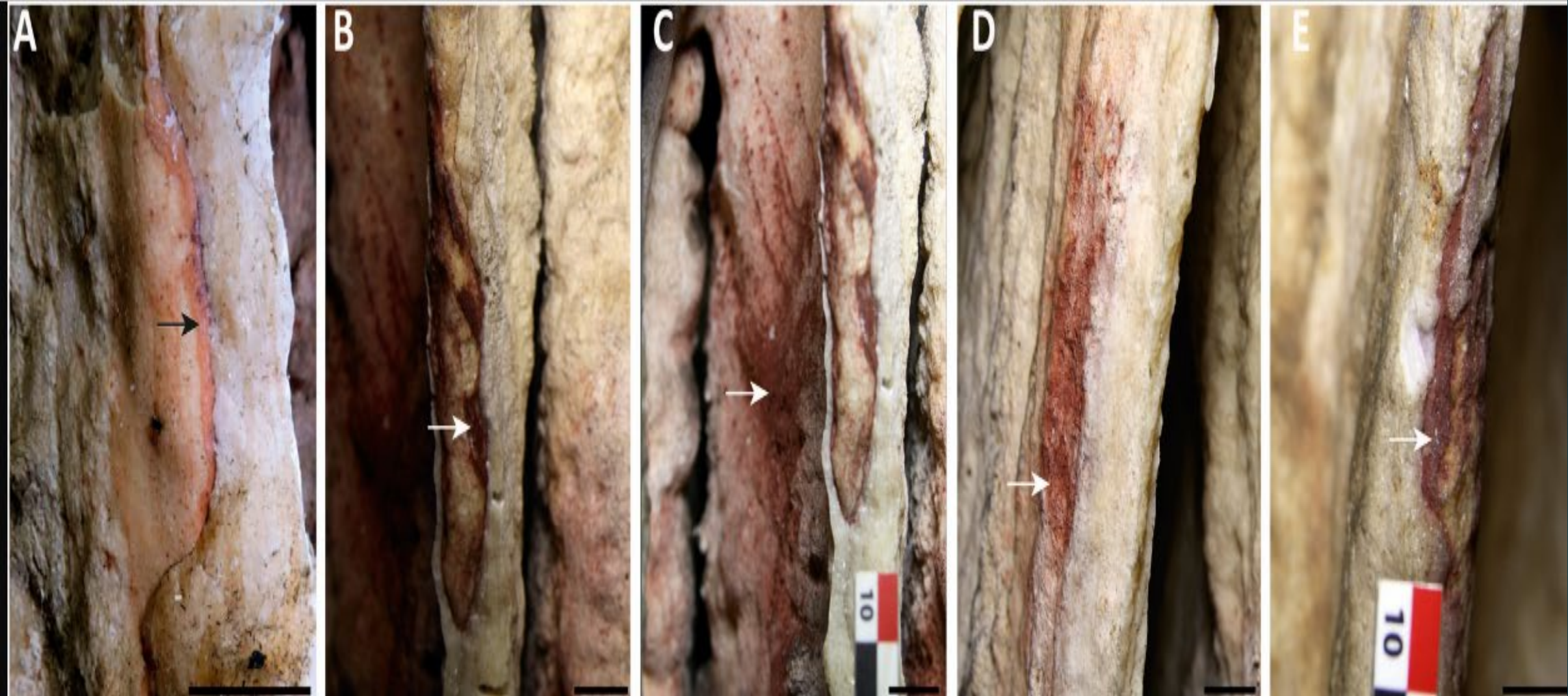
# La Ferrassie Cave Neandertal Cupules (~ 60 kya)



**Series of cupules** - a primitive form of rock art - dating back to Mousterian culture (c 60 Ka) which makes it among the oldest prehistoric art in Europe.

**At La Ferrassie burial 6, a large limestone slab was found covering the grave of a Neanderthal child.** On its underside was found an arrangement of cupule-art, consisting of **2 larger hollows and eight pairs of smaller holes.**

# Cueva de Ardales, Spain: Red ocher painted on flowstones



Flowstone formation in the Sala de las Estrellas at Cueva de Ardales (Malaga,

# Neanderthals indeed painted Andalusia's Cueva de Ardales

- ▶ Many generations of Neanderthals visited this cave and colored the draperies of the great flowstone formation with red ocher. This behavior indicates a motivation to return to the cave and symbolically mark the site, and it bears witness to the transmission of a tradition down through the generations.
- ▶ Dated to 45 to 65 Ka: represents 2-4 painting events
- ▶ The evidence from Cueva de Ardales supports the notion that speleothems played a fundamental role in the symbolic systems of some Neanderthal communities. Rock art may therefore have begun in Europe as a form of place marking,

# The symbolic role of the underground world among Middle Paleolithic Neanderthals

- ▶ Neanderthals developed a form of cave art more than 20,000 years before the emergence of anatomical modernity in Europe. In this study, we confirm that the **paintings on a large speleothem from one of these sites, Cueva de Ardales, were made, and we show that the pigments do not come from the outcrops of colorant material known inside the cave.**
- ▶ Variations in the composition of the paint correspond to differences in the age of the paintings, supporting the hypothesis that **Neanderthals used the speleothems symbolically over an extended time span.**

A groundswell of scientists  
running for Congress p. 860

A blood test for  
cancer pp. 866 & 920

Preempting epidemics via a  
Global Virome Project p. 872

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## MINDS AT WORK

Oldest dated cave art points to Neandertal  
symbolic behavior pp. 852 & 912

## It's Official: Neanderthals Created Art



Cave art was being created in three sites at least 20,000 years prior to the arrival of *Homo sapiens* in western Europe.



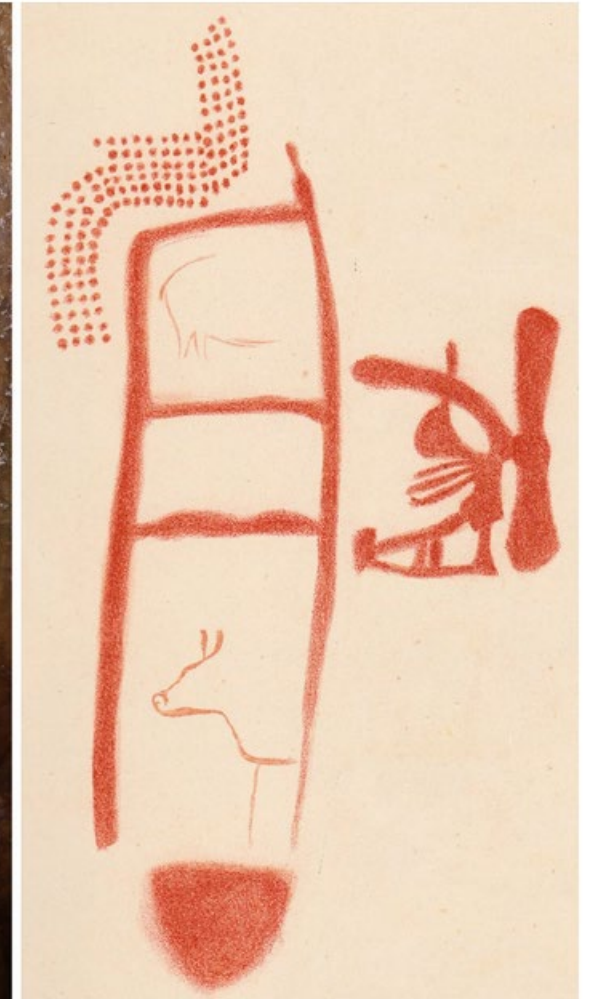


64 Ka: La Pasiega Cave, in N Spain



Oldest artwork in the world

This ladder shape made of red horizontal and vertical lines. The artwork dates to more than 64,000 years ago, created by Neanderthals.



Left, the ladder-like painting in the La Pasiega cave, composed of red horizontal and vertical lines. Right, a rendering made by an archaeologist in 1913. C.D. Standish, A.W.G. Pike and D.L. Hoffmann

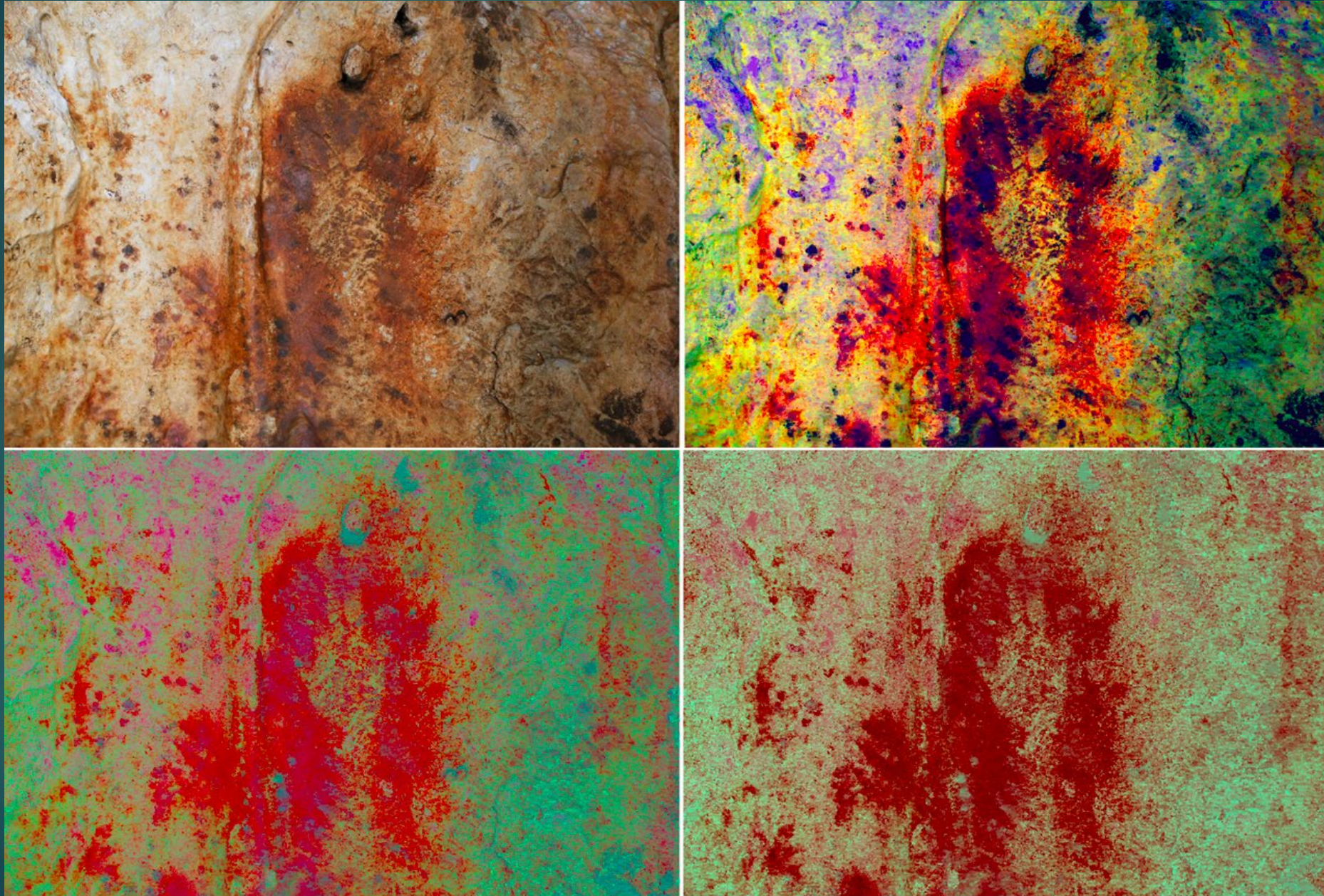
# N Cave Paintings

- ▶ At **La Pasiega, Cantabria**, one sampled area of millimeter-thick crust covering a vertical red line pointed to it being painted well before 60 ka ago.
- ▶ **Maltravieso** in central Iberia was already well known for hand stencils made by spraying or daubing paint. On the ceiling of an isolated area a faint example was revealed by photographic processing, and when adjacent calcite samples were dated, the oldest came out at more than 54,000 years old. This would be the first intentional image of a Neanderthal hand

Maltravieso: first intentional image of a Neanderthal hand, 54 Ka



# Cave of Maltravieso: hand prints: 64 Ka

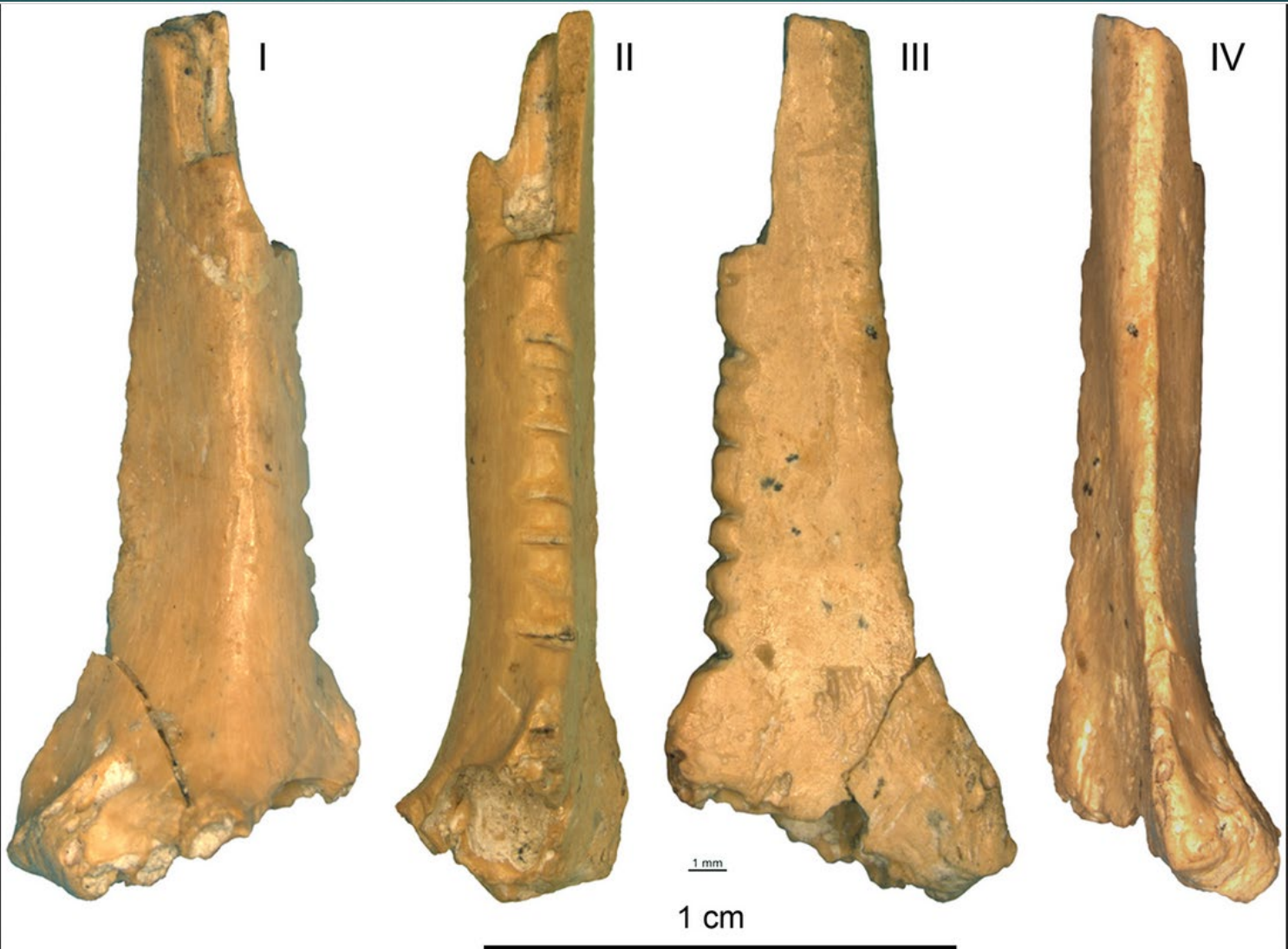


# Markings

- ▶ Neanderthals spent much of their time incising, scraping and creating markings on different substances.
- ▶ But increasingly, sometimes the marking was itself the point, and occasionally they even engraved pigment itself.
- ▶ In the same level at **Les Bossats** where large stones had been brought in, over 80 small, reddish-orange nodules were found. Rather than local iron-rich formations, Neanderthals had used minerals brought in from across the Loing River.
- ▶ Extensive presence of red, orange and black colorants, which are rarely found in the Middle Palaeolithic.



A *Corvus corax* raven's bone fragment with notches from Zaskalnaya VI, layer III.





# Symbolic material

## ▶ Bone engravings:

▶ One was made on a broken, already old hyaena bone from Les Pradelles, and

▶ the other on a raven's wing from Zaskalnaya VI rocksheiter, in the Crimean Mountains. Has tiny sequences of evenly spaced incisions.

▶ Five out of the seven notches on the Zaskalnaya bone are deeply sawn, but two that appear to have been added in-between are far shallower cuts, probably using the same tool but held differently. Without those two additions, the overall effect would have been perceived as uneven: they are about aesthetics.

# Pradelles hyena bone

- ▶ **The Pradelles hyena bone** is even more exceptional. On a surface just 2 in. long, a Neanderthal made **nine parallel incisions**, with extremely similar shapes. All cut in the same direction with a single tool and probably at the same time,
- ▶ **Both the Zaskalnaya and Les Pradelles markings go beyond most other Neanderthal engravings by showing regularity and structure.** The raven bone hints at a desire to maintain a pattern.

# The Pradelles hyaena bone: possible tally system



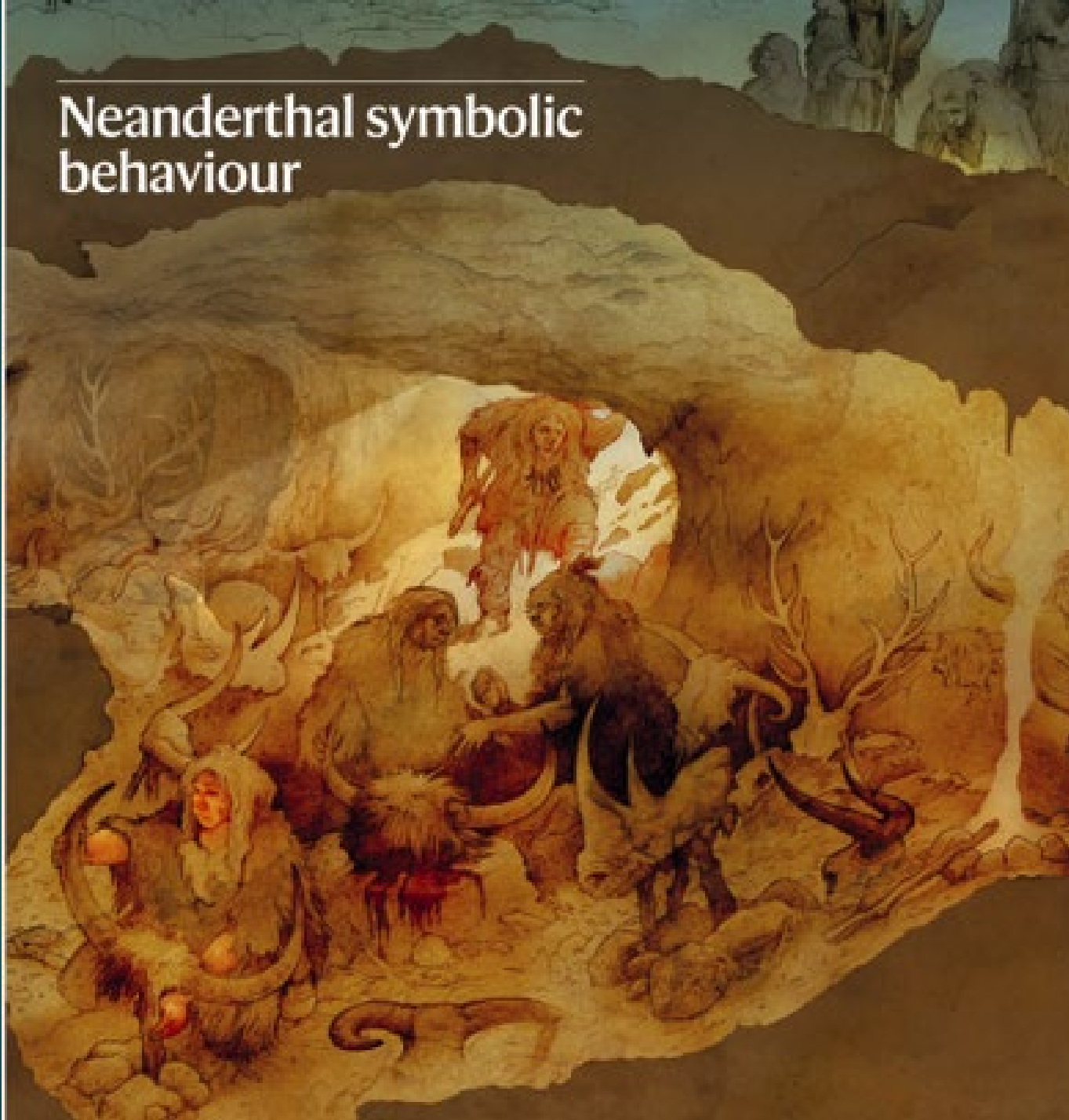
A bone from a raven's wing (38-43 K, Crimea) with seven regularly spaced notches carved into it is evidence that Neanderthals had an eye for aesthetics.

Pesturina Cave: 10 fan-shaped lines on a old bear neck



At Pesturina Cave, Serbia, 10 fan-shaped lines on a probable old bear neck bone have no feasible origin during butchering. Instead they're more like the Kiik-Koba cortex lines, terminating before the bone's edge, like a design within the space.

## Neanderthal symbolic behaviour



Why were Ns  
collecting large  
horned animal  
heads?

A Neanderthal  
trophy cave

Nature Human Behavior  
March 2023

# N trophy collection

- ▶ The discovery and interpretation of the archaeological material from level 3 of Cueva Des-Cubierta (Madrid), accumulated in a two-meter-deep deposit between 43 and 70 ka has been published.
- ▶ An astonishing accumulation of 35 megafauna skulls (bison, aurochs, deer, rhinoceros) stands out in this set.
- ▶ It has been interpreted as a possible accumulation of hunting trophies or another ritual action carried out by Neanderthals continuously at different times.

# Steppe bison (2 meter tall, 2000 lb) - hunting trophy?



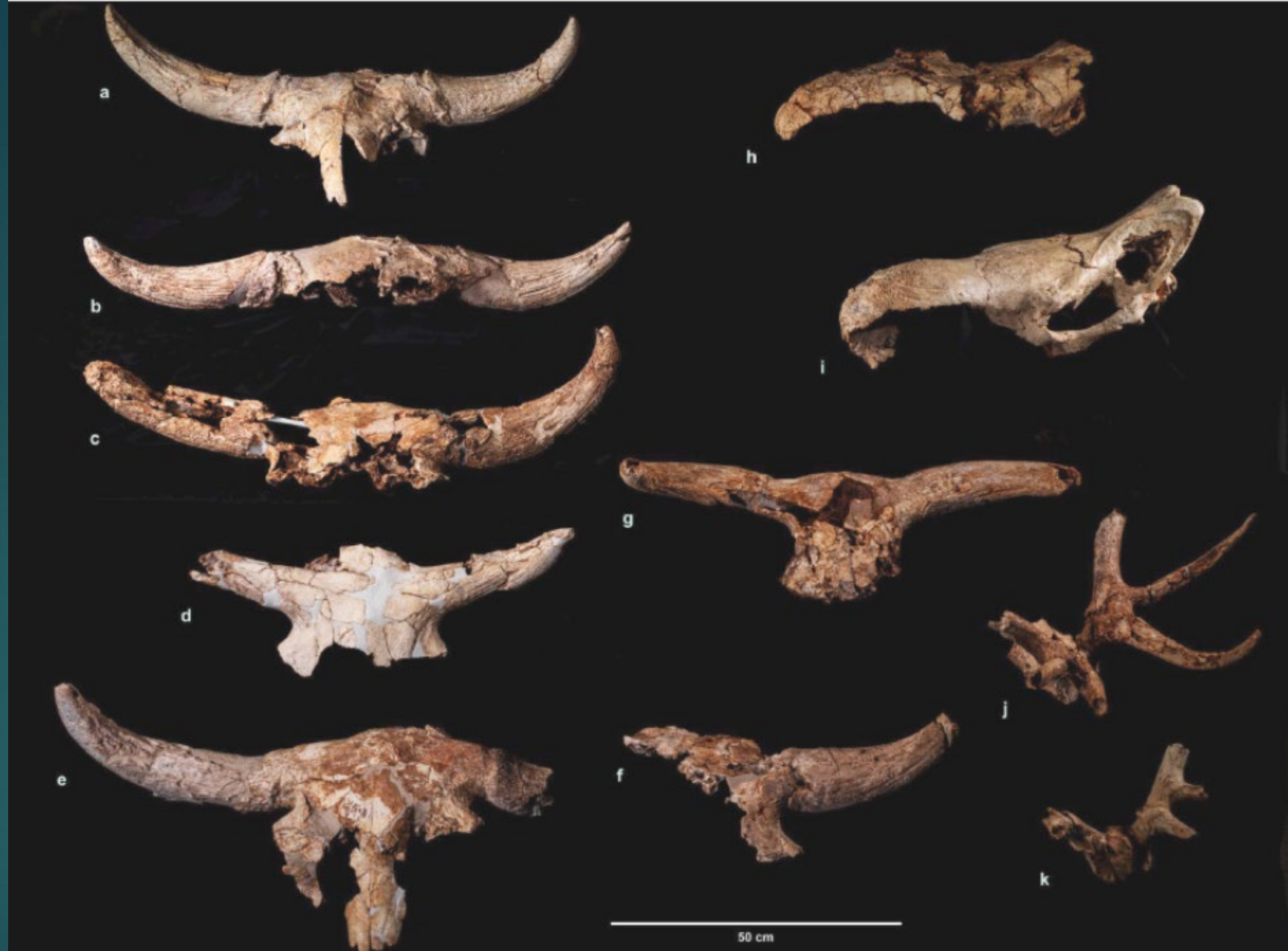
# A symbolic Neanderthal accumulation of large herbivore crania

- ▶ Alongside evidence of Mousterian lithic industry, Level 3 of the cave infill was found to contain an assemblage of mammalian bone remains dominated by the crania of large ungulates, some associated with small hearths.
- ▶ The scarcity of post-cranial elements, teeth, mandibles and maxillae, along with evidence of anthropogenic modification of the crania (cut and percussion marks), indicates that the carcasses of the corresponding animals were initially processed outside the cave, and the **crania were later brought inside**.



# A symbolic Neanderthal accumulation of large herbivore crania

- ▶ A second round of processing then took place, possibly related to the removal of the brain.
- ▶ The continued presence of crania throughout Level 3 indicates that this behavior was recurrent during this level's formation.
- ▶ This behavior seems to have no subsistence-related purpose but to be more symbolic in its intent.



Some of the **best preserved crania** from the **Uncovered Cave Level 3**: a,b,c,d,e,f = *Bison priscus*; g = *Bos primigenius*; h,i = *Stephanorhinus hemitoechus*; j,k = *Cervus elaphus*

- ▶ Studies involving **modern hunter-gatherer groups** have shown that the heads of large animals are usually discarded and not taken back to camp, since they are heavy and of lower use as food.
- ▶ The **introduction of the crania**, and not of other parts of the carcasses of greater nutritional interest, **into the Cueva Des-Cubierta** thus **seems to have been deliberate and not related to subsistence**. Rather, it seems **more related to their symbolic use**.

# Hunting trophies

- ▶ Today, the accumulation and display of large mammal skulls in the form of hunting trophies is linked to sport hunting.
- ▶ Similar practices been documented for the most recent hunter-gatherer societies. **Indeed, cultures worldwide have invested animal skulls with a strong symbolic content and have protected or displayed them with due attention.**

## Cueva Des-Cubierta as a hunting shrine

- ▶ In the present case, the fact that the crania all belong to species with cranial appendages (unshed antlers in the case of the deer) suggests that they may represent trophies.
- ▶ Their concentration in a small space also suggests that the accumulation might be considered a hunting shrine.
- ▶ However, other interpretations cannot be ruled out, such as a link with ritual and fire (given the proximity of the evidence of the latter's use), some expression of the symbolic relationship between Neanderthals and the natural world, or some kind of initiatory rite or propitiatory magic.

# N repeat behavior: Cultural phenomenon

- ▶ The finding of crania, thermoaltered materials and lithic elements throughout, along with the continued presence of the tools necessary for that exploitation over the entirety of Level 3, indicates that the site's Neanderthal occupants repeated the same type of behavior over a long period (years, decades, centuries or even millennia).
- ▶ The intentional deposition of large mammal crania over the time that Level 3 formed suggests the transmission of this behavior between generations, which would be consistent with its interpretation as a cultural phenomenon.
- ▶ The accumulation of crania in the Cueva Des-Cubierta reported here provides further evidence of Neanderthal symbolism associated with the animals these humans hunted.

# Bruniquel Cave, SW France

- ▶ In February 1990, thanks to a 15-year-old boy named Bruno Kowalszczewski, footsteps echoed through the chambers of Bruniquel Cave for the first time in tens of thousands of years. He took 3 years excavating to get to cave via very small crawling entrance.
- ▶ Some 336 meters into the cave, he discovered a vast chamber where several stalagmites had been *deliberately* broken and moved.
- ▶ Instantly, Bruniquel became one of the most important Neanderthal sites ever found.





# Bruniquel Cave, SW France

- ▶ More than 400 pieces from the central parts of the stalagmite columns were placed in layers, some balanced on top of each other, others standing in parallel.
- ▶ Many had been extensively burned, and blazes had been kindled in the small piles. At least some of the fuel was bone, potentially including a bear, which isn't easy to set and keep alight.
- ▶ So far there are no artifacts, and no explanation for the rings, but these structures would have taken time and planning to create, and the foresight to provide sufficient illumination underground.

# Bruniquel Cave, 174 Ka

- ▶ Meticulous study found **complexity at every level**. Over 400 stalagmites had been snapped off, and from among the broken pieces Neanderthals had selected wide, straight mid-portions, obviously with particular sizes in mind. They formed two rings on the chamber floor.
- ▶ The largest is more than 6.6 by 4.4yd, and contains two small speleofacts (cave structure), with another two heaps placed externally at either end. A second smaller, but more circular, ring is set to one side.
- ▶ **This isn't a random jumble, but a built construction.** Each ring is made from up to four layers, some sections buttressed with vertical pieces, and one zone features five elongated speleo pieces stood up side by side. **The intricacy goes beyond support and into architecture.**

# 2016: A Neandertal structure of stalagmites, 176 kya



# Bruniquel Cave, 174 Ka

- ▶ Tucked in behind the five 'sentinels' is a doubly poised creation: a flat plate balanced on a cylinder, itself holding up other pieces.
- ▶ This is **already a place that goes beyond unique, into jaw-dropping**. But there's other things going on. Burning was identified at multiple points along the rings, and within the small piles. In fact, about a quarter of all the speleofacts have been exposed to fire, and in some cases it seems as if blazes were lit on top of the structures.
- ▶ Both the **speleofact constructions and the burning event that charred that bone piece took place between 178.6 and 174.4 ka**. No possible natural process could explain the rings.

# Bruniquel Cave, 174 Ka

- ▶ The **mystery of Bruniquel only deepens the more one thinks about it.** It's not a place for staying like other caves or rockshelters: so deep into the hillside, continuous illumination would have been needed.
- ▶ That means not only a herculean effort in terms of fuel collection, but also choking smoke. Moreover, building fires on top of the ring walls makes little sense if this was a structure for living inside. Flowstone covers most of the floor between the structures, but there's no visible lithic or butchery detritus.

# Bruniquel Cave

- ▶ And **constructing the rings was no casual feat.** The total weight of arranged speleofacts is over two tons, and even assuming multiple individuals were involved, it must have taken at least six to seven straight hours to build. Why would Neanderthals spend hours - maybe days - deep underground, breaking and hefting heavy rock, piling, balancing and burning them?
- ▶ The significance of Bruniquel's ring chamber is enormous: the only monumental construction known to have been made by Neanderthals.
- ▶ Bruniquel laughs in the face of austere, survival-only explanations for Neanderthal behavior. It surely was made by thinking, but also feeling, minds.

# Bruniquel Cave, 174 Ka

- ▶ And this returns us to **the enigma of Bruniquel**, a reminder that the tests we set for symbolic significance may well have had nothing to do with what was meaningful for Neanderthals.
- ▶ **Monumental in scale and vision, it's the first great art project, and at the same time truly weird**, as in the original meaning of wyrd: destiny-changing power.
- ▶ Hominins might have made nothing like it for another 160,000 years, and **the 'why' behind those stacked circles is still a mystery**.

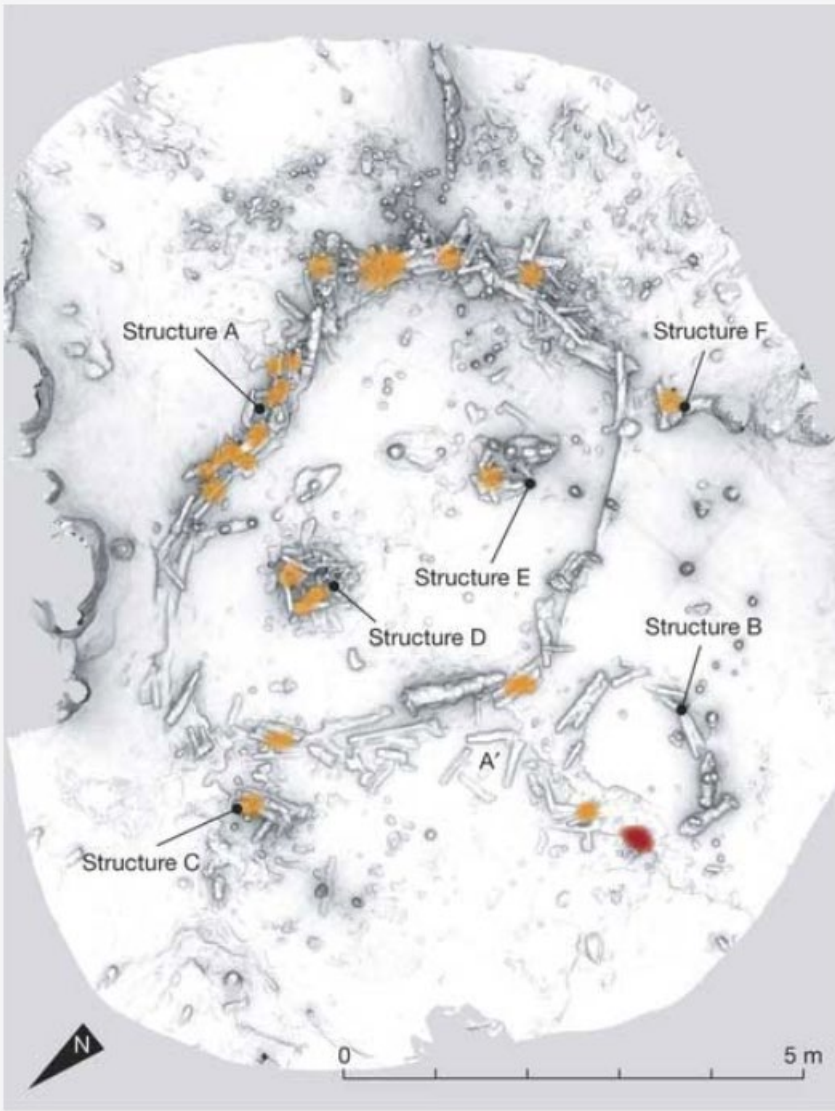
Mystery in the Dark – N Stonehenge: Bruniquel Cave, 175 Ka, 300 m inside, chosen by size, burnt areas & items; built structures; 2 tons of material



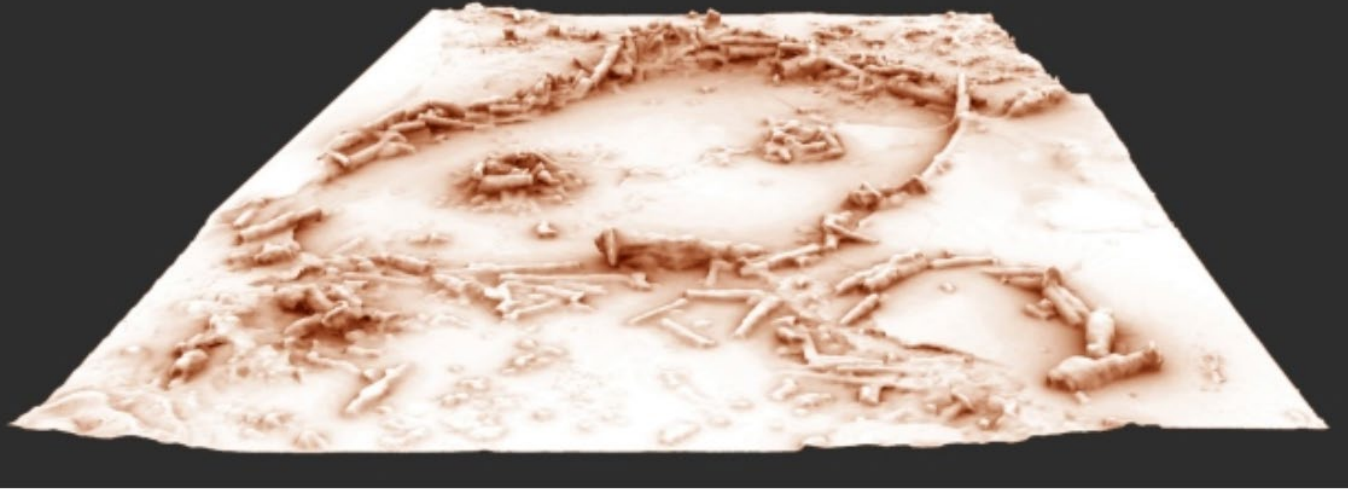


**Reconstruction of La Folie, France.** The site features a circle of postholes and traces of activity within, showing that its Neanderthal inhabitants used the interior space in different ways.





Jaubert et al. 2016.



Xavier MUTH - *Get in Situ, Archéotransfert, Archéovision -SHS-3D*, base photographique Pascal Mora

A 3D reconstruction of the structures in the Bruniquel Cave.



# The New Imaging of Neandertals: The new N artists

- ▶ John Gurche,
  - ▶ Elisabeth Daynès,
  - ▶ Alfons and Adrie Kennis,
  - ▶ Mauricio Antón
  - ▶ Tom Björklund
- 
- ▶ **Note:** Often use European norms, from skin and eye color, hair texture and color, and beard patterning, to features like eyelid shape and lips. They often underestimate genetics of pigmentation.

# The New Neandertals



# Neandertals Were People, Too.



Based on the 2 Gibraltar skulls:  
called Nana and Flint

New York Times, 1/15/17:  
[Adrie & Alfons Kennis](#)

# N the Thinker



*Sebastian Willnow/Getty Images*

# Neandertal Museum in Germany: Stone Age Clooney



# Many MHs carry N DNA

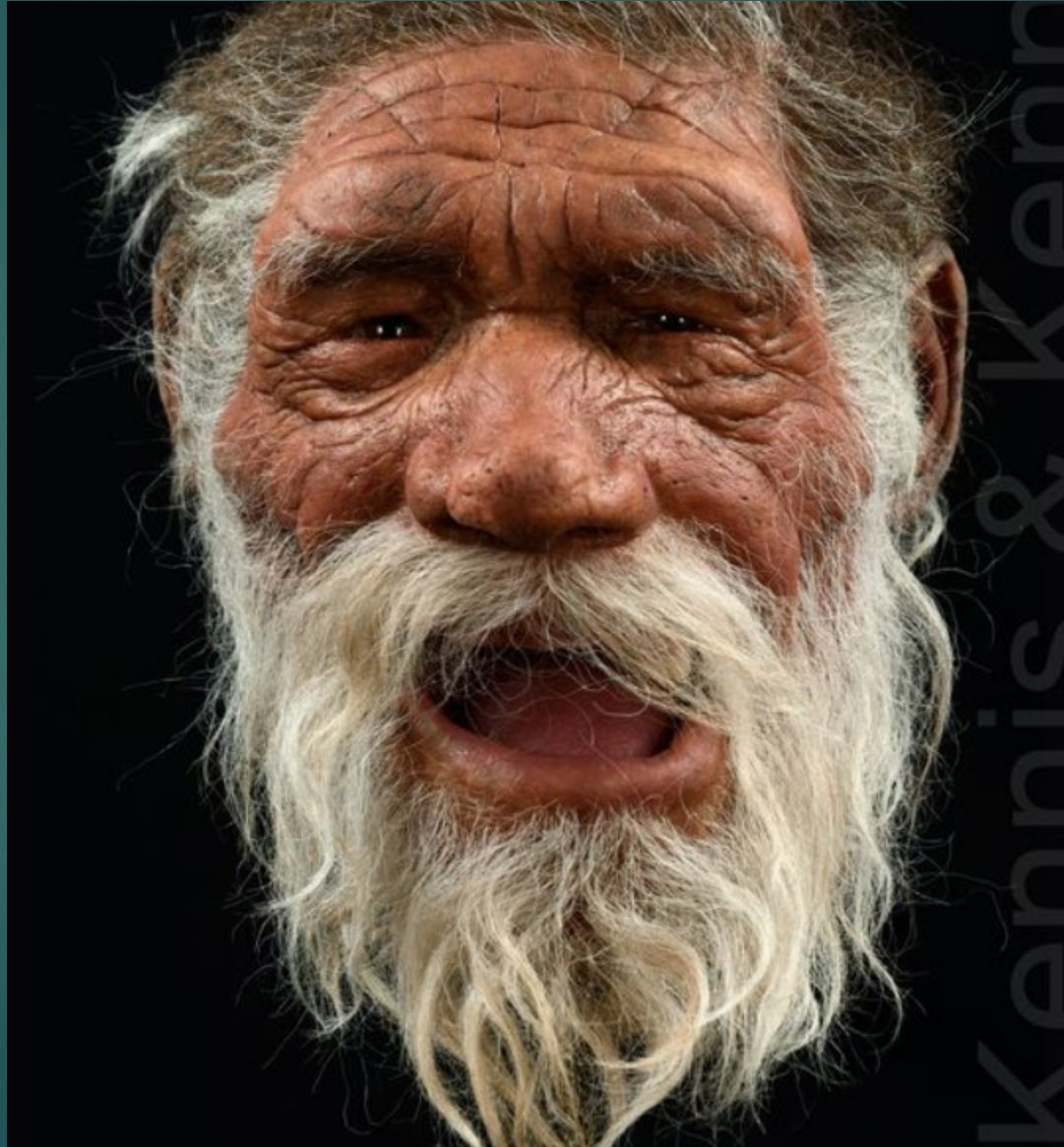


Many of us carry DNA inherited from Neanderthals

DPA Picture Alliance Archive / Alamy Stock Photo



*H. neanderthalensis*: La Chapelle aux Saints



# Newer reconstructions by Kennis brothers



**Neanderthal**  
(National Geographic,  
by A. Kennis & A. Kennis, photo Joel McNulty)



# Neandertal became part of us



Felderhofer



Kennis & Kennis





# Wilma

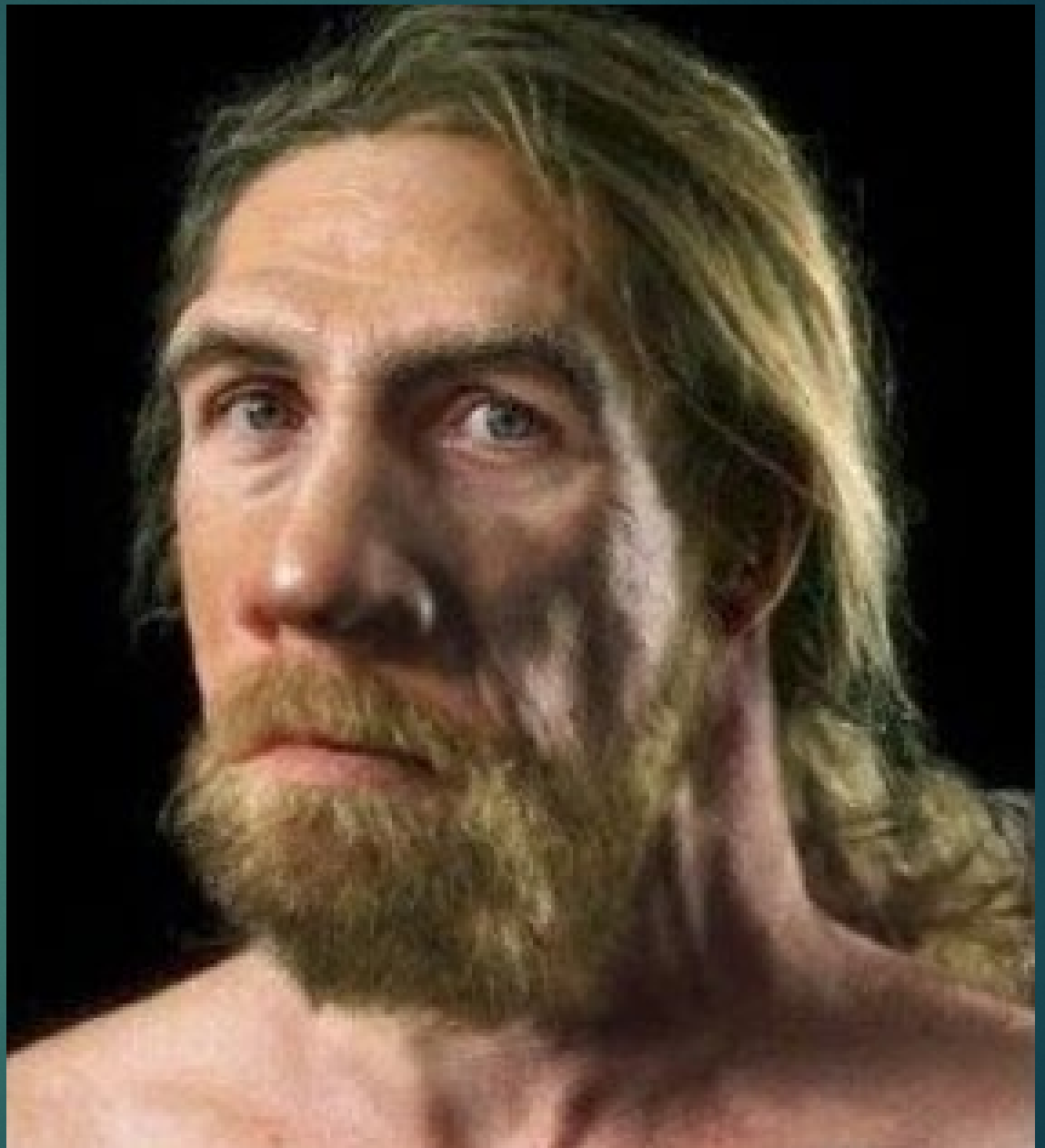


Kennis & Kennis





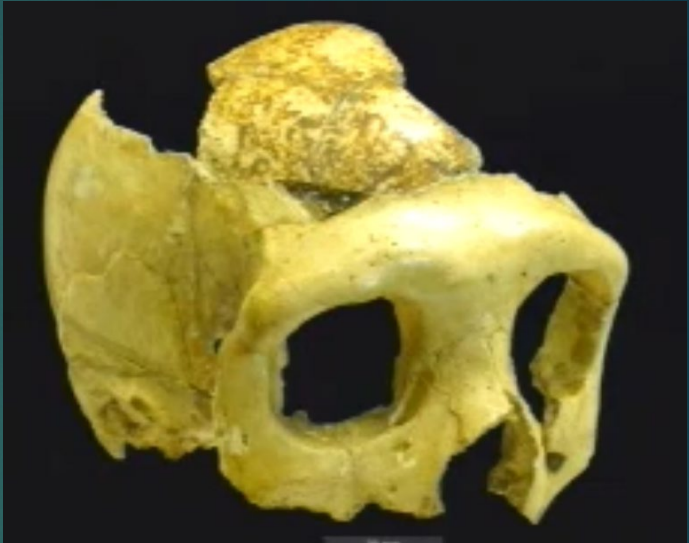
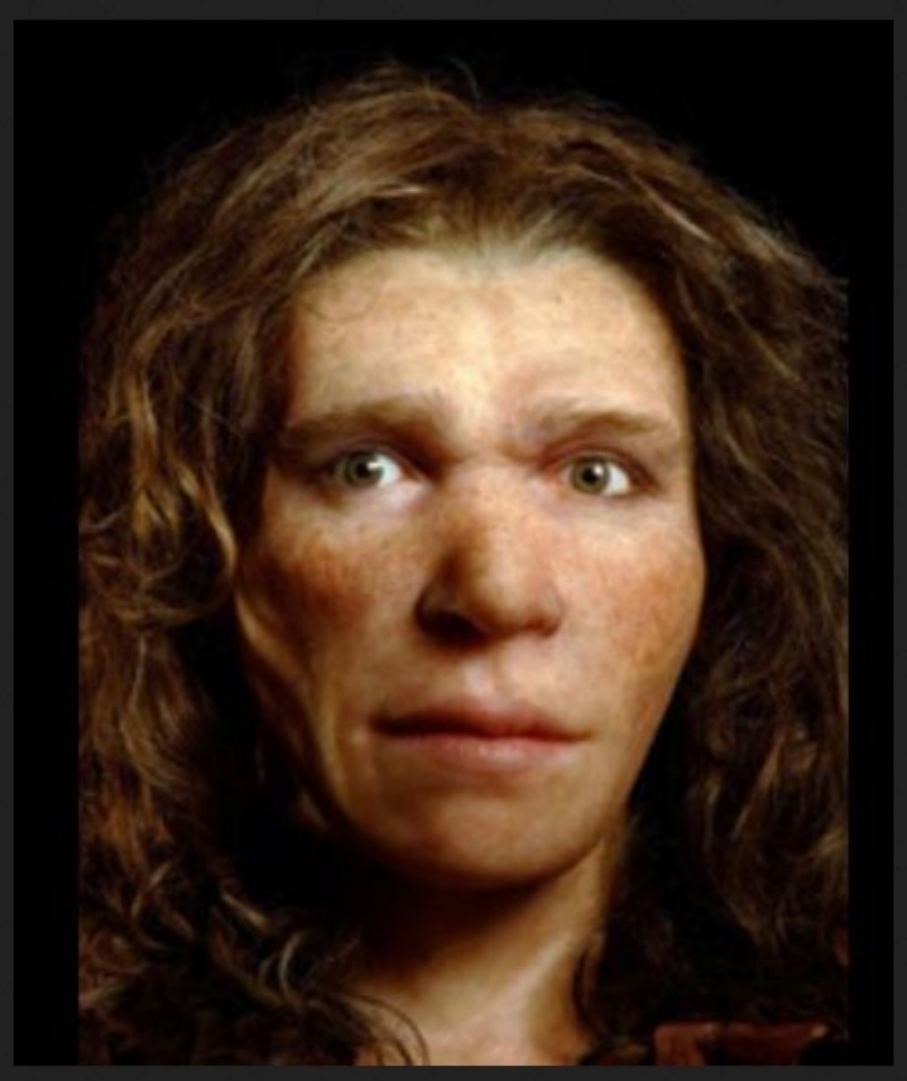
Approximation of Cleveland, by sculptor John Gurche



J. Gurche



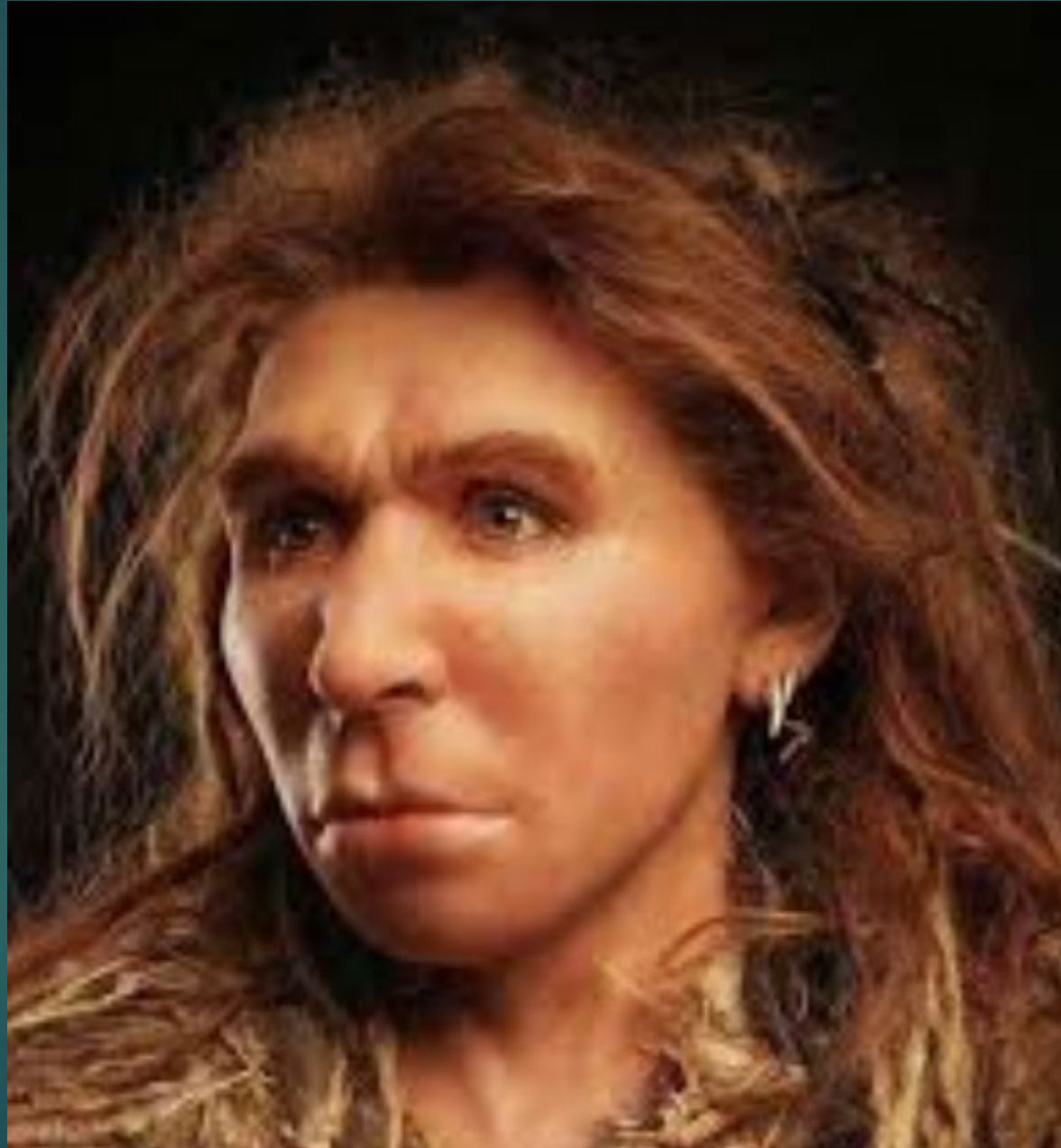
# N women



Based on Krapina 3



Some newer  
reimaginings of  
Neandertals



A reconstruction of a  
Neanderthal woman  
from the Saint Césaire  
site in France.  
( E. Daynès ).

E. Daynes



2008 - Human



Sebastien Plailly & Elisabeth Daynes/Science Source



Subscribe





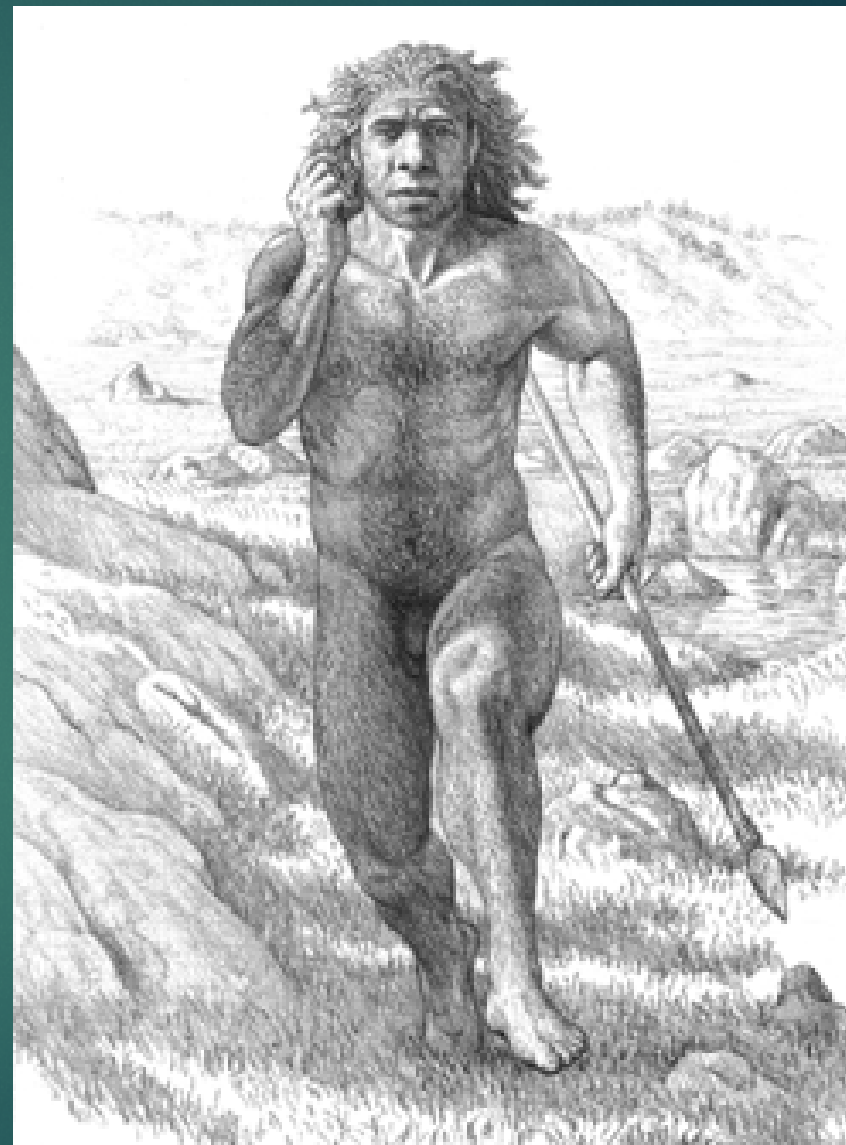
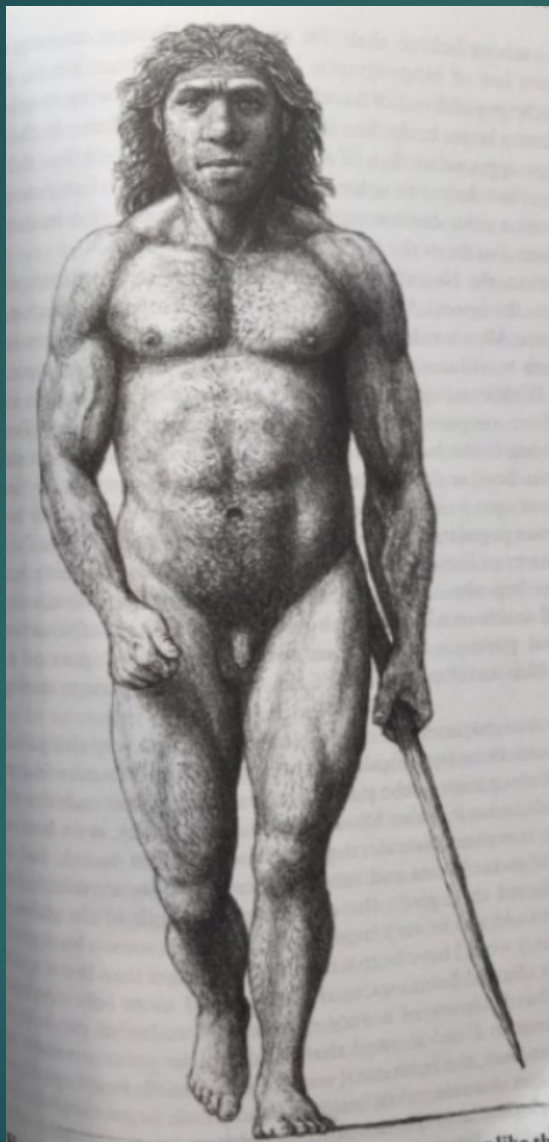
Model of a Neanderthal child by Elizabeth Daynes, at the National Museum of Prehistory at Les Eyzies



# At Krapina Museum



# Spanish N reconstruction



Anton: Juan Luis Arsuaga and Ignacio Martínez



Doug Henderson

# Altamura N



Kennis & Kennis:

Spy (Sp-ee)



# La Quina



# Gibraltar: Nana and Flint



Kennis & Kennis:







Evidence of black corvid feather use





A striking reconstruction of a Neanderthal wearing an animal pelt head covering. "Neanderthal Female Reconstruction" by Viktor Deak

## BBC2: CGI generated N, based on Shanidar 1 skull



Suffered a major injury 20 years before he died, which fractured his skull, injured his brain and probably blinded him in one eye.



Oscar Nilsson

Artist:  
Tom Björklund  
has done a  
major  
Neandertal  
Image update



























C. 1941  
K. 1941  
2011











Much more  
interesting as  
a potential  
mate?



# What else we need to cover about Neandertals

- ▶ Ns as stone artisans and technicians
- ▶ N brain
- ▶ Ns nomadic lifestyle
- ▶ N hunting and diet
- ▶ N caregiving
- ▶ Reasons for N demise
- ▶ Etc.

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