HISTORY UNABRIDGED

The Skull in the Barite Mine

How a skull from a Moroccan mine pushed the birth of our species back a hundred thousand years, and why scientists still argue about what it means

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[DISCLOSURE PENDING: the final verbatim line replaces this note only after Chronicle Editor approves this exact version.] This story was written by an AI writer. It is not human-authored. Sources are listed at the end. A corrections inbox, corrections@historyunabridged.com, is coming soon, not live yet.

The hill does not look like much. It is a knuckle of limestone in the dry country of western Morocco, a few hours' drive west of Marrakech and inland from the Atlantic port of Safi. Around 1960 it was valuable for one reason: barite, a heavy white mineral that oil drillers grind up and pump down wells to keep them from blowing out. A Moroccan mining company was blasting and digging its way into the hill to get at it.

Sometime in 1960 or 1961 (sources disagree on the year: mining exposed the site in 1960, and the discovery team dates the skull to 1961), the digging of a mine gallery broke into old cave sediment, and out of it came a human skull. Accounts differ on how it reached the University of Rabat.

Think about that object as it came out of the hill: a heavy brow, a long, low braincase, a face big but oddly familiar. Its owner had died roughly 300,000 years earlier, and nobody would know that for more than half a century. When they finally did, that skull and the bones that followed it out of the hill would force a rewrite of the opening chapter of our story: when our species began, where it began, and whether "where" is even the right question.

Any history of the world could start here, because before there were cities, kings, money or wars, there had to be us. The honest answer to "when did we begin?" is one of the best arguments in science.

The Neanderthal That Wasn't

At the University of Rabat the skull came to a paleoanthropologist named Émile Ennouchi. Ennouchi organized a joint French and Mo-

roccan expedition to the site that the scientific world would come to know as Jebel Irhoud. Mining had already wrecked much of the cave. According to a history of the site by Ben-Ncer and Hublin, his team removed the cave's rocky roof, some 2,000 tonnes of debris, with low-dose explosives, then dug the remaining fill in horizontal slices 50 centimetres thick.

That detail matters. Archaeologists today dig by a site's natural layers, because an object's layer is how you tell its age. Arbitrary slices, in a cave already torn open by miners, meant nobody could later say which bones belonged with which layer. Ennouchi's team recovered a second adult skull (Irhoud 2) and, later in the decade, the jaw of a child (Irhoud 3). They also found stone tools and the bones of at least thirty species of mammals, mostly gazelles.

In 1962 Ennouchi published his verdict on the first skull. The title of his paper said it plainly: *Un Néanderthalien*, a Neanderthal. It was a reasonable call for the time. The stone tools around the bones were made with a technique archaeologists associated with Neanderthals in Europe, and the skull had the long, low shape and heavy features of an archaic human. The scientific consensus in the 1960s held that people who looked like us had arrived late, and that anything this rugged must be older and more primitive. Scientists at the time assumed the Irhoud people were relatively recent, perhaps around 40,000 years old, as Hublin's team later noted.

Over the following decades researchers kept noticing things that did not fit the Neanderthal label. The face was flat and tucked under the braincase, not pulled forward the way Neanderthal faces are. The

teeth and jaw looked more like ours. One young French paleoanthropologist, Jean-Jacques Hublin, co-described the Irhoud 3 child's jaw in 1981 and would go on to describe a juvenile arm bone from the site in 1987. Irhoud got under his skin. As a National Geographic profile later put it, he had wanted to reopen the site ever since he entered the field.

There was also the problem of the date. Two attempts to date the site gave young ages. A 1991 study by Rainer Grün and Chris Stringer used electron spin resonance on animal teeth from the deposits and got anywhere from roughly 90,000 to 190,000 years, depending on assumptions about how the teeth took up uranium. Only a 2007 study, on which Hublin himself was a co-author, dated human material directly: a tooth from the Irhoud 3 child's jaw came out at about 160,000 years. Either way, Irhoud looked like a strange North African side branch, a population of archaic humans living at roughly the same time as, or later than, the "real" early members of our species in East Africa.

The Garden of Eden in East Africa

By the 1980s, two big ideas were fighting over where modern humans came from.

The first was the **multiregional hypothesis**, most closely associated with the American anthropologist Milford Wolpoff, the Chinese paleoanthropologist Wu Xinzhi and the Australian Alan Thorne, who laid it out in a landmark 1984 paper. They argued that after early humans (*Homo erectus*) spread out of Africa well over a million years

ago, populations in Africa, Europe and Asia evolved into modern humans more or less in place, linked by enough interbreeding to stay one species. On this view the ancestors of today's East Asians included the ancient people of China, and the ancestors of Europeans included Neanderthals. Wolpoff and his colleagues pointed to features they saw persisting in the fossils of particular regions over very long spans of time.

The second was the **recent African origin** model, often called "Out of Africa." A leading champion was Chris Stringer of the Natural History Museum in London, who with Peter Andrews published an influential paper in *Science* in 1988 laying out the case. On this view, modern humans evolved once, in Africa, relatively recently, and then spread across the world, replacing the archaic populations they met (Neanderthals in Europe, others in Asia) with little or no interbreeding.

The decisive early evidence came from genes. In 1987 the geneticists Rebecca Cann, Mark Stoneking and Allan Wilson showed that all the mitochondrial DNA lineages they sampled (genes passed down only from mothers) traced back to a woman who lived about 200,000 years ago, probably in Africa. The press called her "Mitochondrial Eve." The name misled (she was not the only woman alive, just the one whose maternal line survived unbroken), but the signal was clear: the deepest branches of human diversity were in Africa.

The fossils seemed to agree. In 1967 a team led by Richard Leakey found human remains along the Omo River in southern Ethiopia, at a spot now called Kamoya's Hominid Site after the Kenyan fossil

hunter Kamoya Kimeu. The best known of these, Omo I, had a remarkably modern skull. In 2005 the geologists Ian McDougall, Francis Brown and John Fleagle used volcanic ash below the fossils to put them at about 195,000 years. Another set of modern-looking skulls from Herto, also in Ethiopia, came in at around 160,000 years. Put the genetics and the fossils together, and the picture was satisfyingly tidy: our species arose in East Africa around 200,000 years ago, in something like a single cradle, and later spread across the continent and the world.

Textbooks drew an arrow pointing out of Ethiopia. Morocco, more than 5,000 kilometres away across the Sahara, was a footnote.

Back Into the Hill

In 2004 Hublin, by then a director at the Max Planck Institute for Evolutionary Anthropology in Leipzig, finally got permission to reopen Jebel Irhoud. He did it as a joint project with Morocco's National Institute of Archaeology and Heritage (INSAP), with the Moroccan paleoanthropologist Abdelouahed Ben-Ncer as co-leader. According to National Geographic, the team first had to rebuild the road to the site and clear thousands of cubic feet of mining rubble.

Beneath the debris, a patch of undisturbed cave deposit had survived. Digging it layer by layer, the team found what Ennouchi's excavation could not give them: human bones lying in a known layer, together with stone tools, animal bones and traces of fire. The number of human fossils from the site rose from six to twenty-two. They represented at least five people: three adults, an adolescent and a

child. Among the new finds were a partial skull, catalogued as Irhoud 10, and a nearly complete adult lower jaw, Irhoud 11.

The animal bones showed that these people hunted, most often gazelle. Their tools were Middle Stone Age tools: no big teardrop handaxes of the kind earlier humans had made for over a million years, but prepared stone cores from which they struck flakes of a planned shape (the Levallois technique), and many points that may have tipped spears. Most of the tools were made from high-quality flint that had been brought in from elsewhere. "The stone artefacts from Jebel Irhoud look very similar to ones from deposits of similar age in east Africa and in southern Africa," said the Max Planck archaeologist Shannon McPherron.

And many of those flints had been burned.

The Clock in the Campfire

To understand why burned flint was a gift, you need to understand one of the cleverest dating methods in science, **thermoluminescence**, often shortened to TL.

Flint is a crystal, and crystals are imperfect. Their atomic structure contains tiny defects that can act as traps for electrons. Every rock and every grain of sediment on Earth is very slightly radioactive. The ground contains traces of uranium, thorium and potassium, and cosmic rays rain in from space. That steady background radiation knocks electrons loose inside a buried crystal, and some of them get caught in the traps. Over time, the traps fill up. The crystal is quietly keeping a tally of how much radiation it has absorbed.

Heat empties the traps. If you heat a crystal strongly enough, the trapped electrons escape and, as they fall back into stable positions, they give off a faint glow of light. That is the "luminescence" in the name. This is the key: heating resets the clock to zero.

So picture a Middle Stone Age campfire 300,000 years ago. Flint tools and chips lying near the hearth are heated, perhaps accidentally, and their electron traps are emptied. Then the fire dies, sediment buries everything, and the clock starts ticking again as the natural radiation of the cave slowly refills the traps.

In a laboratory, scientists heat a sample of that ancient flint under controlled conditions and measure the light it gives off. That tells them the total dose of radiation the flint has absorbed since its last heating. Then they need the other half of the equation: how much radiation per year the flint was exposed to while buried. At Irhoud, the team measured the radioactivity of the site's sediments. Divide the total dose by the annual dose and you have the number of years since the fire.

The result, published in *Nature* in June 2017 by a team led by the geochronologist Daniel Richter, was startling: about 315,000 years ago, give or take 34,000 years.

The team also went back to the Irhoud 3 child's tooth that had produced the 2007 date of about 160,000 years. With better measurements of the site's radioactivity and improved methods, the recalculated age came out at about 286,000 years, give or take 32,000, consistent with the flints. The old date had not been fraudulent or careless. It had rested on a less accurate model of the radiation environ-

ment. “We employed state of the art dating methods and adopted the most conservative approaches to accurately determine the age of Irhoud,” Richter said.

Pause on that, because it is how science is supposed to work and rarely how it is reported. Hublin co-authored both studies: he helped publish one date, then helped overturn it when better data came in. The headline in 2017 was “oldest *Homo sapiens*.” The quieter story was a self-correcting method that nearly doubled the age of a site.

A Modern Face on an Old Head

A date alone does not make a fossil one of us. What made Irhoud explosive was what the bones looked like.

Hublin’s team, including the Leipzig paleoanthropologist Philipp Gunz, used micro-CT scanners to create detailed 3D models of the old and new fossils, and statistical shape analysis based on hundreds of measurements to compare them with fossil and living humans. The result was a mosaic.

The team’s shape analysis found the face “almost indistinguishable” from that of people living today. It was large, but it was flat, small-browed in its overall configuration and tucked under the front of the skull rather than jutting forward. The teeth and the jaws also lined up with our species.

The braincase told a different story. It was big, about as large as ours, but long and low, the elongated shape of archaic humans, not the rounded, globe-like shape of a modern human skull. Since the inside

of the skull is shaped by the brain it holds, that means their brains were probably organized differently from ours, even if they were not smaller.

"Our findings suggest that modern human facial morphology was established early on in the history of our species, and that brain shape, and possibly brain function, evolved within the *Homo sapiens* lineage," Gunz said when the study was published.

The team followed up in 2018 with a study in *Science Advances* by Simon Neubauer, Hublin and Gunz that tracked brain-case shape across hundreds of thousands of years of human fossils. They concluded that brain size reached modern levels early, but that the fully rounded, "globular" shape typical of people today evolved gradually and only reached the present-day range somewhere between about 100,000 and 35,000 years ago.

We usually imagine a single moment when a creature "becomes human." Irhoud suggests something messier: our species was assembled piece by piece, the face first, the large brain early, the modern brain shape much later. Scientists call this **mosaic evolution**, different parts of the body evolving at different rates.

On June 7, 2017, the Max Planck Institute announced the finds under the headline "The first of our kind." Hublin did not hedge. "This represents the very root of our species, the oldest *Homo sapiens* ever found in Africa or elsewhere," he told the science writer Brian Resnick of Vox. And to explain what it meant for the old East African story, he offered a line that would be quoted around the world: "We used to think that there was a cradle of mankind 200 thousand years

ago in east Africa, but our new data reveal that *Homo sapiens* spread across the entire African continent around 300 thousand years ago. Long before the out-of-Africa dispersal of *Homo sapiens*, there was dispersal within Africa."

Ben-Ncer made a point about geography that was also a point about scientific neglect: "North Africa has long been neglected in the debates surrounding the origin of our species. The spectacular discoveries from Jebel Irhoud demonstrate the tight connections of the Maghreb with the rest of the African continent at the time of *Homo sapiens*' emergence."

If that label held, the skull from the barite mine was almost certainly the oldest member of our species ever found. Would it hold?

The Argument

Here the story stops being a tale of discovery and becomes a disagreement among serious people looking at the same bones. There are at least four positions, each with respected scientists behind it.

Position one: Irhoud is early *Homo sapiens,* and Africa as a whole is the cradle

This is the discovery team's view. Because the face, jaw and teeth already share derived features with ours, the Irhoud people belong at the base of our lineage. And since the oldest fossils of that lineage now come from Africa's far northwest as well as its east and (as we will see) its south, our species did not emerge in one small region. As they put it in the title of their *Nature* paper, the evidence points to a

"pan-African origin of *Homo sapiens*." The fact that similar Middle Stone Age tool kits appear across Africa at around this time, McPherron argued, supports the idea of a continent-wide process.

Position two: Irhoud is early *Homo sapiens,* but "early" needs to mean something

Chris Stringer, the man who did more than almost anyone to build the "Out of Africa" model, broadly welcomed the finds, and in doing so he publicly revised his own earlier thinking, which is rarer than it should be in any field. Writing the day after the announcement, he said: "I used to argue that 'anatomically modern humans' (AMH - essentially looking like us today) are the only group that should be called *H. sapiens*. Now, I think that AMH are only a sub-group within the species *H. sapiens*, and that we should recognise the diversity of forms within early *H. sapiens*, some of which probably went extinct."

His reasoning starts with genetics: DNA indicates that the lineages leading to us and to Neanderthals separated at least 500,000 years ago. So there must have been African populations on "our" side of that split long before anyone looked fully modern, and fossils like Irhoud are what they should look like: some modern features, some old. He also cautioned that it was "not yet clear" how Irhoud fit into the bigger picture, since separate early *sapiens* populations may already have existed in different parts of Africa, alongside other, older kinds of humans.

Position three: Not so fast, this is not *Homo sapiens* at all

Some prominent researchers accepted the new dates but rejected the label. Ian Tattersall, curator emeritus of human origins at the American Museum of Natural History, has long argued that our species should be defined strictly, by the distinctive features that make a modern skull a modern skull, above all the globular braincase. "I think you have to be fairly rigorous [with] what you admit into *Homo sapiens*," he told Vox. "There are plenty of people out there who are willing to take a much looser view of what *Homo sapiens* is, and would be happy to cram this into *Homo sapiens* as a matter of convenience, or a matter of philosophy even. I wouldn't go along with that." The anthropologist John Hawks of the University of Wisconsin also questioned in the same piece whether the fossils could really be called *Homo sapiens*, given how different their braincases are from ours.

The French paleoanthropologist Aurélien Mounier, a co-author of the 2022 study that redated Ethiopia's Omo fossils, made a similar point to Haaretz that year: "The specimen lacks most of the specific morphological characters of *H. sapiens*." Modern humans, he noted, have a rounded skull and a chin; the Irhoud person does not have a chin.

Be clear about what this argument is. Even the critics accept the dates. The fight is about a definition. If a species is a lineage that changes over time, where do you draw the line? Hublin's answer to Vox was blunt and very Darwinian: evolution is continuous, so there will always be in-between forms, and the Irhoud people sit on our

side of the line because they share derived features with us. Tattersall's answer is that if you let the definition drift, the name *Homo sapiens* stops meaning anything precise. Both positions are defensible. This is a case where you should notice that the disagreement is partly about words, and partly about how evolution itself works.

Position four: Stop looking for a single cradle

The most radical position emerged about a year after Irhoud. In 2018 a large interdisciplinary team led by the archaeologist Eleanor Scerri, and including Stringer, published a paper in *Trends in Ecology & Evolution* with a pointed title: "Did Our Species Evolve in Subdivided Populations across Africa, and Why Does It Matter?"

Their answer was yes. They argued that the fossils, the archaeology, the genetics and the ancient climate record all point the same way: our species did not evolve in one population in one region, but in a network of populations scattered across Africa, often separated for thousands of years by deserts and forests, occasionally reconnecting when the climate changed and swapping genes, tools and ideas. They used the label "African multiregionalism," deliberately borrowing (and transforming) the name of the old rival to Out of Africa. Scerri summed it up in a press release: "The evolution of human populations in Africa was multi-regional. Our ancestry was multi-ethnic. And the evolution of our material culture was, well, multi-cultural."

The idea is plausible partly because the Sahara was not always a desert. As Earth's orbit shifted, monsoon rains periodically moved north and turned it green, opening corridors between North Africa

and the rest of the continent, then closing them again. Stringer made the point in his 2017 commentary: the desert "was not always the forbidding barrier it is today."

Not everyone accepts the continent-wide version. Mounier told Haaretz that "it could be that the process was more centered around eastern and southern Africa."

The Clues Keep Coming

Since 2017 the evidence has kept shifting, and mostly in ways that make the old single-cradle picture harder to defend.

The first surprise came from Ethiopia. In January 2022 a team led by the volcanologist Céline Vidal of the University of Cambridge re-examined the volcanic ash layer lying directly above the Omo I fossil in Ethiopia. By matching the chemistry of the ash to a massive eruption of the Shala volcano in the Ethiopian Rift, hundreds of kilometres away, and dating that eruption, they showed that Omo I must be at least 233,000 years old, give or take 22,000 years, considerably older than the long-quoted 195,000. East Africa was not dethroned by Irhoud; its own oldest member of our species simply got older too.

South Africa supplied a third corner. A partial skull found at Florisbad in South Africa in 1932 had long been an enigma, an archaic-looking face with some modern traits. A 1996 study led by Rainer Grün dated a tooth from it directly to about 259,000 years ago, give or take 35,000. The Irhoud team argued that their finds strengthened the case for Florisbad as another early member of our species, though its classification is still debated: Stringer wrote that fossils

like it "might" be early *Homo sapiens*. Put Irhoud, Florisbad and Omo on a map and you get three corners of a continent occupied by early members of our lineage within roughly 80,000 years of each other. That is the core of the pan-African argument.

Then the genetics got more complicated. In 2023 a team led by the population geneticist Aaron Ragsdale, working with Brenna Henn and Simon Gravel, published a study in *Nature* titled "A weakly structured stem for human origins in Africa." They compared genomes from 290 people, including newly sequenced genomes from 44 Nama people of southern Africa, against many different models of how populations might have split and mixed over the last million years. The model that best fit the data was not a single ancestral population that later split. It was two or more slightly different populations that stayed connected by a trickle of migration over hundreds of thousands of years, before the earliest split among living human groups that we can detect, around 120,000 to 135,000 years ago.

That result also struck at a rival explanation. Some geneticists, including Arun Durvasula and Sriram Sankararaman in a 2020 paper, had found patterns in the DNA of West African populations that they interpreted as interbreeding with an unknown "ghost" population that branched off even before Neanderthals and our own ancestors parted ways, and that left no named fossils. Ragsdale's team argued that a weakly structured stem of interconnected populations could explain those patterns without any ghost. This is a live dispute, not a settled one: the ghost-admixture and structured-stem models make different assumptions and both have defenders.

Finally, there are the Neanderthals. The old multiregional model, in its strong form, has not survived. The evidence that all living humans share a recent African ancestry is overwhelming. But in 2010 the team of Svante Pääbo sequenced the Neanderthal genome and found that people whose ancestors lived outside Africa carry a small share of Neanderthal DNA, first estimated at 1 to 4 percent, since refined to around 2 percent by Kay Prüfer and colleagues. Our ancestors did meet the archaic humans of Eurasia, and some of them had children together. Stringer, writing in 2014, acknowledged this with a characteristically wry title: "Why we are not all multiregionalists now." The replacement was real, he argued, but it was not total.

When Did We Become Us?

There is one more argument hiding inside the Irhoud bones, and it may be the most important one.

If people with modern faces were walking around Morocco 300,000 years ago, why does the archaeological record of what we would call fully modern behavior (elaborate art, personal ornaments, complex symbolic life) only become abundant much later? For a long time, the most influential answer came from the Stanford archaeologist Richard Klein. In a 2000 review he argued that fully modern behavior appeared only around 50,000 years ago, perhaps after a genetic change affecting the brain, and helped modern humans spread out of Africa and across the world. The idea became known as the "human revolution."

In 2000 the archaeologists Sally McBrearty and Alison Brooks fired back with a long paper whose title said it all: "The revolution that wasn't." They argued that the components of modern behavior, such as long-distance trade in raw materials, pigment use, specialized tools and so on, appear piece by piece in Africa over more than 200,000 years, beginning with the Middle Stone Age. There was no sudden revolution, just a long, uneven accumulation.

Irhoud sharpens this debate without settling it. Its people made Middle Stone Age tools from imported flint, controlled fire and hunted gazelle 300,000 years ago, and their faces looked like ours. But if Neubauer, Hublin and Gunz are right, the modern rounded brain shape appears much later, in roughly the window when evidence for symbolic behavior becomes much richer. It is tempting to connect the two. Many researchers are cautious, because skull shape is an indirect clue to how a brain worked and the archaeological record is patchy. Treat the link as a hypothesis, not a finding.

Why It Matters Now

It is easy to think of a 300,000-year-old skull as trivia. It is not, for at least three reasons.

First, it changes the shape of our family tree. If our species emerged from a web of connected populations across Africa rather than from a single small group in one valley, then the image of a single "Garden of Eden," religious or scientific, is wrong. Our origin was not a point but a process spread across a continent. It also fits what geneticists measure in living people. In 2005 Sohini Ramachandran and col-

leagues showed that genetic diversity is high in Africa and falls steadily with distance from it, the signature of an expansion that began in Africa, consistent with a chain of founding groups, each carrying only a sample of the diversity before it.

Second, it shows how knowledge actually advances. Irhoud has every ingredient of real science: an accidental find, a confident but wrong first reading, a lost chance, a decades-long obsession, a better method, a date that overturned the investigator's own earlier work, and an argument still going on. When a headline says "scientists discover the oldest X," ask: dated how, defined how, and who disagrees?

Third, it shows how much depends on where we look. The story of human origins was written mostly from East and South African fossils, partly because that is where the famous fossil hunters worked and the geology exposed ancient layers. North Africa was, as Ben-Ncer put it, neglected. Much of Central and West Africa, where forest soils destroy bones and few digs have happened, is still nearly blank. The next skull that rewrites the story may be lying in one of those blanks, waiting for a miner or a road crew.

As for the skull from the barite mine: it began as a lucky find in a mine gallery. It is now one of the most studied fossils in the world, and a reminder that the most important question about any object is not "what is it?" but "how do we know?"

Threads to Remember

These are the threads this story starts:

- **How we date the past.** Thermoluminescence (heated flint), electron spin resonance (teeth) and volcanic ash chemistry (Omo) are three of the clocks behind early dates. Radiocarbon, tree rings and ice cores do the same work for later periods.
- **Mosaic evolution.** Our face came first, our big brain early, our rounded brain shape late. Human evolution shows the same pattern much earlier: walking upright came long before big brains.
- **Out of Africa, and in.** Our species began in Africa across a web of populations. Some of their descendants later met Neanderthals and other archaic humans on the way to Asia and Australia.
- **The behavioral modernity debate.** Sudden revolution (Klein) or slow accumulation (McBrearty and Brooks)? Cave art and the first trade networks are where new evidence keeps appearing.
- **Climate as a gatekeeper.** A green or dry Sahara opened and closed the roads between populations. Climate keeps shaping history, from the ice ages to the Little Ice Age.
- **Who tells the story.** North Africa was neglected until a Moroccan and Max Planck team put it back on the map. The question keeps returning: whose evidence counts, and who is left out?

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Contested points in this story: the exact year of the skull's discovery (1960 or 1961) and how it passed from the mine to the University of Rabat; whether the Jebel Irhoud people, and the Florisbad skull, should be classified as *Homo sapiens*;

whether our species emerged across all of Africa or mainly in its east and south; whether early humans in Africa formed a weakly structured network or mixed with an unknown "ghost" archaic population; and whether modern brain shape is linked to modern behavior.