



Origin Stories Episode 16: Neanderthals

***Meredith Johnson***

**0:00:09**

This is Origin Stories, the Leakey Foundation podcast. I'm Meredith Johnson.

***Shara Bailey***

There are early modern humans. These are the earliest ones from the near East. So these are casts, but the originals are about one hundred thousand years old and then you have various Neanderthals from different sites up here, but what's really interesting is if you look at Neanderthals and modern humans from even from the same geographic area— here's a—

***Meredith Johnson***

This is Shara Bailey, professor at New York University and a Leakey Foundation grantee.

***Shara Bailey***

I like to call myself a dental paleoanthropologist because I study human origins and human evolution from a dental perspective.

***Meredith Johnson***

Is it okay if we talk about Neanderthals?

***Shara Bailey***

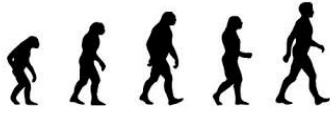
Absolutely. That's my favorite topic.

***Meredith Johnson***

Is it really?

***Shara Bailey***

Yeah, of course.



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### ***Meredith Johnson***

Neanderthals have captured people's imaginations since they were first discovered in the mid-1800s. In 1856, some miners digging in a cave in the Neander Valley in Germany uncovered what they thought were skull and bones from a cave bear. The bones were passed along to a local schoolteacher who realized they were some strange kind of human, but what kind, he had no idea. So he passed the fossils on to an anatomist who measured and compared and said they were unlike anything known to exist and they likely belonged to an “ancient and barbarous race.” These Neanderthal fossils were the very first human fossils known to science. This discovery happened two years before Darwin published on the origin of species and scientists in those early days really struggled to explain what they were. One scientist proposed it was a skeleton of a Russian Cossack with rickets who crawled into the cave to die and that the distinctive heavy brow ridge came from furrowing his brow in pain. Others thought they were the missing link between us and apes.

Science has come a very long way since then and many more Neanderthal fossils have been discovered among tools and other clues to who they were and how they lives. Scientists have even sequenced the Neanderthal genome and the more we learn about them, the more we want to know. So today we’re going to talk with Shara Bailey about our Neanderthal relatives.

### ***Shara Bailey***

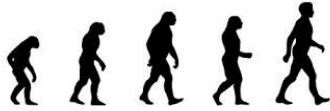
They were so much like us and yet they're not here anymore and the more we learn about them the more we see that perhaps they weren't as different from us as we think.

### ***Meredith Johnson***

People used to see Neanderthals as primitive brutes, but scientists have uncovered an incredible amount of new information that has changed the way we look at Neanderthals. In recent decades there's been a flood of new discoveries, some of them hotly debated, that suggest Neanderthals may have been doing things like eating grains, possibly even cooking. There's some evidence that they controlled fire and wore personal ornaments. That they communicate with each other and cared for the sick and injured. Some argue that they may have even buried their dead.

### ***Shara Bailey***

Once I get to teaching about Neanderthals in my classes, people just have so many questions. They want to know what they ate. They want to know what they did. Did they do things like us? Did they wear clothes and I think that people are just naturally curious about our recent origins and how close we are to Neanderthals and now we know through 23 and Me for example, that we can find out how much Neanderthal DNA we have and yet they disappeared. They’re gone and we’re here and people want to know why. What happened to them? Why did we win and why did they disappear?



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***Meredith Johnson***

Do you have answers to any of those questions?

***Shara Bailey***

Yeah, there's been a lot of really great research done, so Neanderthals existed from— well now it depends on how you're going to define Neanderthals.

***Meredith Johnson***

How do you define them?

***Shara Bailey***

Well, we define them on a set of cranial characteristics and the body type, the short and stocky body type with a very distinct, short, distal limb elements, like the lower leg bone, but most of it comes from their faces, right? If you look at their faces they have these elongated skulls with these big brow ridges and their noses are very large, so they would have these big schnozzes and then there face— I don't know if you can tell here, is like, pulled forward.

***Meredith Johnson***

Their short and stocky body type and big, wide noses helped them adapt to cold climates. Neanderthals also had brains that were as big or bigger than ours compared to body size and they didn't have chins. Chins are a unique feature that only modern humans have. Neanderthals also had distinctive teeth and this is Bailey's specialty. When she was doing her dissertation, people thought that Neanderthal teeth were pretty much like modern human teeth.

***Shara Bailey***

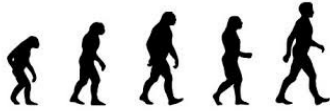
I was looking at casts like I have here, and I was saying to myself, "I think there are actually differences in them," and through my dissertation I was able to identify number of those differences which include the shape of the tooth and the Neanderthal molar has this very skewed shape and that's just classic Neanderthal. Like, if you gave me one upper first molar, I can tell you whether it's Neanderthal or not. It's that different.

***Meredith Johnson***

So those are the ways scientists define Neanderthals. Let's cover some other basic facts, like when and where did the Neanderthals live.

***Shara Bailey***

I would say Neanderthals start evolving somewhere around 3-400,000 years ago. The genetic evidence all kind of converge on a date somewhere in that range too and then they exist, doing



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quite well, sometimes not as well as others, but they continue to come back until about thirty nine thousand years ago, based on the newest dating techniques.

### ***Meredith Johnson***

Neanderthals have been found across Europe and in the Middle East, but not been found in Africa.

### ***Shara Bailey***

We can go as far as West as the Iberian Peninsula. We find them in Germany, we find them in Europe and then in the near East, we find them out as far as Uzbekistan, and then through DNA, extraction of some remains out in Siberia we know that there are Neanderthals as far north and as far east as that.

### ***Meredith Johnson***

What is the world like?

### ***Shara Bailey***

It depends on the time period. So during the coldest time periods, there would have been glaciers covering a lot of Europe, definitely the whole area around the Alps would've been spread out and you know, of course you can't live on a glacier but it's very difficult to live around the glacier as well because it's going to be tundra or grassy steppes. The steppes are okay if you have a lot of large mammals living there and we know the Neanderthals were hunting large mammals.

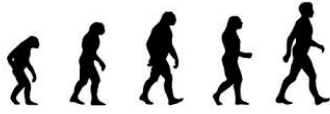
### ***Meredith Johnson***

And the mammals on the steppes of ice age Europe were very large. There were mammoths and woolly rhinoceroses and a kind of giant deer that stood almost 7 feet tall at the shoulders with antlers that were 12 feet from tip to tip. There were also time periods when the temperatures were warmer and during those periods, there would have been more forests.

### ***Shara Bailey***

And there's some evidence that suggests that Neanderthals were better adapted to hunting in these forested areas whereas the early modern humans that came in might've been better adapted to hunting in the savannah steppe regions which would have then partitioned them into different niches, if you will, because we know they overlapped in time in Europe.

### ***Meredith Johnson***



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So they lived in some time periods when the climate was moderate and not so bad and they lived in times when it was really cold and during those are really cold periods, Neanderthals disappeared from the northern regions and show up farther south, like in Israel.

***Shara Bailey***

And during those really cold time periods there may have been shrinkage of their populations because you have to imagine a world that has maybe ten thousand a world, right? The entire world has only maybe ten thousand people in it. So imagine how big Europe is and the near East, they're going to be pretty far apart and there's going to be areas where local populations went extinct and there is evidence from the genomes of Neanderthals that suggest they went through what we call bottleneck.

***Meredith Johnson***

A bottleneck is where a larger population shrinks down to a very small one and then maybe get bigger again and that's probably what happened during these very cold periods.

***Shara Bailey***

There's a really cool study where they looked at the amount of clothing that people wear around the world in various latitudes and how much of your body has to be covered to live at certain temperatures.

***Meredith Johnson***

They looked at where Neanderthals lived and where early modern humans lived and they found that Neanderthals lived in places where they wouldn't have needed to wear very much and also places where up to sixty percent of their bodies would need to be covered.

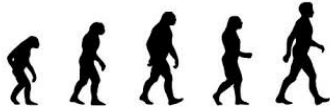
***Shara Bailey***

Which indicates that they had to be wearing some kind of clothes, right? Some kind of skins, furs and when we talk about sixty percent of your body being covered, that could be just like a fur over your shoulders and something tied around your waist and maybe some leg things tied around your legs obviously. When you get to eighty, ninety percent you're talking about hats, gloves, shoes, things like that.

***Meredith Johnson***

And they found that early modern humans were living in sites at higher latitudes for they would've had to cover more of their bodies.

***Shara Bailey***



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So even though Neanderthals were cold adapted with their body proportions these early modern humans were able to live in climates that were much colder than Neanderthals. Why do you think that would be?

***Meredith Johnson***

Because we made more clothes?

***Shara Bailey***

Yeah! Right. So that's where you get the idea of tailored clothing and we have evidence of, very early evidence, I can't remember if it's thirty-nine or forty thousand years ago, of bone needles with modern humans. Not with Neanderthals, but with modern humans. So they were probably making tailored clothing and that's the kind of stuff you need to live at these high latitudes. So yeah, there's clothing. What else do you want to know? I could probably tell you.

***Meredith Johnson***

What kind of technology were modern humans using compared to Neanderthals?

***Shara Bailey***

So modern human tool technology is distinguished from that of the Neanderthals by the production of blade tools, which are stone tools that are at least twice as long as they are wide. They're produced in a different fashion. So if you take a rock about the size of a baseball and a Neanderthal might take that core and knock flakes off around the side, knock flakes off around the top, turn it on its side and then hit it and knock a flake off, which we would call Levallois flake. If they could modify it, they modified it. In some places they modified it to put half onto a spear and other places they didn't put it on a spear. We don't know why or at least there's no evidence that they were hafting it to something wooden.

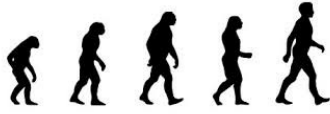
***Meredith Johnson***

A modern human might take the same piece of flint the size of a baseball and modify it into flat platform. Then they can just go around kind of in a circle and knock off these long blades.

***Shara Bailey***

Those blades can then be modified into so many other things. They can be modified into awls to make holes to put threads through if you're making clothing. They can be made smaller to make microliths which you can then embed into bone and make specialized composite tools and those are the kinds of things we see with the modern humans. Harpoons indicate that they were fishing. We don't see harpoons with Neanderthals.

***Meredith Johnson***



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Was it always clear which toolkit belonged to which?

***Shara Bailey***

That's a really good question. No, not everywhere. So in Europe you have big differences in the toolkits between these two. Again during this time period, right before they go extinct, not only are they possibly making some art kind of objects, but they're also making it a different kind of toolkit and it's unclear whether they are trying to copy what they see with modern humans doing or whether— some people think they came up with it independently which other people think is actually too much of a coincidence that it happens at just that same time period.

***Meredith Johnson***

Bailey wanted to figure out which group was making which tools during this time period when modern humans and Neanderthals overlapped in Europe. In 2015, she published a study in the journal *Science* looking at tools from a transitional period called the proto-ordination. Scientists hadn't been sure which group was responsible for making the proto-ordination tools. She analyzed some baby teeth that were found associated with the tools and found that the teeth and the tools belonged to modern humans.

***Shara Bailey***

Yeah, so actually it was a big question if you see Neanderthals one way you'll say, "Hey, look they have art, they're making this transitional tool stuff. Maybe they're evolving into moderns," but it's very clear now that that's not the case and so I mean to me it's just amazing to be able to take these little stubs of teeth that seriously you just couldn't do anything with ten years ago and now say they're modern humans and they're making this transitional industry in Italy and they're making the proto-ordination and we know they're making the ordination and so we know that their "modern" toolkit evolved with modern humans. So it's a huge step for us. I mean, it's amazing.

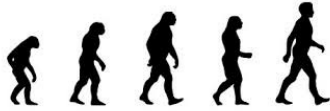
***Meredith Johnson***

And this brings us back to one of the big mysteries about Neanderthals. Why did they disappear?

***Shara Bailey***

The last Neanderthals, the ones that existed just around the same time that modern humans were coming into Europe were living during a really cold time period, around thirty-five, thirty thousand years ago, the earth undergoes a really marked cold snap. So it's very cold and the climate is also highly variable. So perhaps even with in their lifetime you could see a 4 degree Centigrade shift in temperatures which is going to shrink or grow the forests. It's going to change the world they live in. And it's during that time period that they go extinct. The weird thing is, is they lived through periods like that sixty thousand years ago, something similar





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happened, but they come back. But, around thirty-five, forty thousand years ago they don't come back. The only thing that's different during that time period is that we are on the scene.

***Meredith Johnson***

So how would having modern humans around have contributed to the demise of Neanderthals and why do we have Neanderthal DNA today? How did that happen?

***Shara Bailey***

There are different opinions on why they disappeared. There are some people who would suggest that modern humans came in and we're the direct cause of their extinction either through bringing in some kind of pathogen that Neanderthals were not immune to that could've possibly wiped them out or through some kind of conflict. We don't have a lot of evidence of interpersonal conflict. There is a handful of Neanderthals that look like they got bonked on the head by somebody or stabbed by somebody, but it's not terribly compelling, but I think that if you say that Neanderthals went extinct on their own, you're ignoring this very obvious difference between the fact that they made it through these cold periods before, but they didn't make it through this last one and the only difference between those time periods is the presence of another hominin, another human form on the landscape and to me, there's the evidence of the change in their tool types, the possible evidence—I'm kind of on the fence about how much of that is actual art—but let's just say, okay, they were doing some artistic things. You can count on two hands the number of artistic artifacts that are there found with Neanderthals and almost all are limited to this time periods when Neanderthals and modern humans overlapped. To me that's compelling evidence that there was some cultural transmission going on. There's some kind of interaction between the two and as to why we have their DNA, it's because we had some biological interaction between them.

***Meredith Johnson***

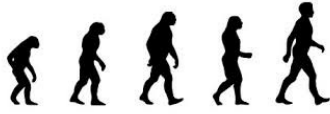
Biological interaction, as in making babies. So now people with European and Asian ancestors carry some Neanderthal DNA. You can even take a test and find out just how much Neanderthal DNA you have.

***Shara Bailey***

The amount of DNA in modern humans, your average modern human, is somewhere between two and four percent, but you have to keep in mind that not every modern human has the same set of Neanderthal genes. So if you were then to go and look at all the modern humans, look at all the Neanderthal DNA in modern humans and put it together it's more like twenty percent of our collective DNA come from Neanderthals. Does that make sense? That way of explaining it?

***Meredith Johnson***





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I hadn't heard that before.

***Shara Bailey***

Yeah, because your Neanderthal DNA, whatever you have, is probably not the same as the Neanderthal DNA I have, right? So then that increases it. So when you add all of it up, it's a lot more. That sounds really compelling, like wow! But how much interaction would you have to have or how much gene flow would you have to have between Neanderthals and modern humans to get that?

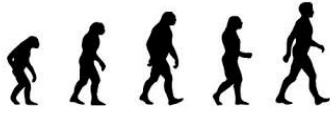
***Meredith Johnson***

A study published in the journal *Nature* in February of 2016, looked at just how much gene flow take to get two to four percent Neanderthal DNA in a person living today and how it might've happened. Scientists took DNA from the tiny toe bone of a Neanderthal woman who lived over fifty thousand years ago in the Altai Mountains of Siberia. The results suggested that groups of human expanded out of Africa and met up with Neanderthals more than once and much earlier than previously thought. The scenario this paper proposes is that a group of early modern humans left Africa over a hundred thousand years ago. They mixed with Neanderthals in the Middle East or the Arabian Peninsula where fossils and stone tools from both groups have been found. A different group of modern humans left Africa much later and mingled with a different group of Neanderthals.

***Shara Bailey***

The second one was closer to sixty thousand, fifty thousand. We see them in Israel. They get into Europe around, as I said, between forty-five, fifty thousand years ago, but their population is growing, right? So on expanding front like that, and you can probably visualize this that even a little bit of gene flow is going to be transferred then to lots and lots of people, right? So what they have modeled is that it would've taken only one interbreeding episode every fifty years to get the amount of Neanderthal DNA that we see in modern humans today. Which isn't a lot if you consider how many Neanderthals— so over five thousand years, one genetic exchange between modern humans and Neanderthals every fifty years over a period of five thousand years, during which they overlapped.

So again, I mean, our field can be somewhat divided sometimes and I think it has a little bit to do with how we think about Neanderthals and how much like us they are and there are people who would say, "Well, that two to four percent, that's a lot, actually." And then if you, like I said, expand it out twenty percent Neanderthal DNA can be found in modern humans that's really significant, but then you can look at how many matings it would've taken to get that and you could say it really didn't happen that much and so it probably wasn't all that significant, but some of the coolest stuff is that they are able to identify some of the genes, the Neanderthal genes, that



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were preserved in modern humans and they have linked some of those at least, to immunity which would make sense. So if modern humans coming from Africa didn't have natural immunity to diseases in Europe or in Asia, but the Neanderthals did then those are the genes that would be selected for and that's what we find.

***Meredith Johnson***

And researchers say that these Neanderthal genes might also be responsible for things like red hair and allergies.

***Shara Bailey***

So that's pretty cool and so then if you think about it that way, well it really is significant because without Neanderthal admixture maybe we wouldn't have been as successful. So when you think about how significant it was, it really depends on what you want to call significant.

***Meredith Johnson***

That really helps explain it to me. Thank you for that.

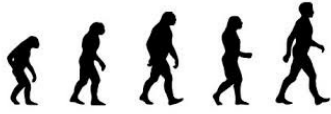
Thanks to Shara Bailey for talking with us about Neanderthals. Our understanding of Neanderthals' story is changing all the time as new things are discovered in fossil sites and through DNA analysis, but we're getting closer all the time to figuring out why the Neanderthals were the ones who disappeared, while we survived.

Thank you for listening.

Origin Stories is a project of the Leakey Foundation. [The Leakey Foundation](http://TheLeakeyFoundation.org) advances human origins research and offers educational opportunities to cultivate a deeper collective understanding of what it means to be human. We provide venture capital for scientists through research grants and we share their groundbreaking discoveries through our podcast, website, and lecture programs. We are in the final month of our million dollar fundraising challenge and we are so close to meeting our goal. A generous sponsor is matching every donation dollar for dollar up to one million dollars. We have until the end of August to meet this challenge, so please help us fund more science. Visit [leakyfoundation.org/donate](http://leakyfoundation.org/donate) every dollar counts and we appreciate your generous support.

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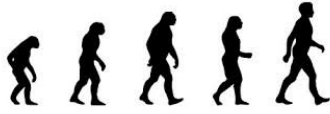


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Today's episode was produced by me, Meredith Johnson. Our editor is Audrey Quinn. Our theme song is by Henry Nagel.

Transcript and pre-production transcript by [Adeptwordmanagement.com](http://Adeptwordmanagement.com)



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