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ARCHAEOLOGY

Europe's first artists were Neandertals

Spanish cave paintings date to before modern humans arrived in region

By **Tim Appenzeller**

For once, the fractious scientists who study the Neandertals agree about something: that a study on p. 912 has dropped a bombshell on their field, by presenting the most persuasive case yet that our vanished cousins had the cognitive capacity to create art. Once seen as brute cavemen, Neandertals have gained stature as examples of sophisticated technology and behavior have turned up in their former territory across Europe. But few researchers imagined them engaging in one of the most haunting practices in human prehistory: creating paintings—vehicles for symbolic expression—in the darkness of caves.

Now, archaeologists may have to accept that Neandertals were the original cave artists. A team of dating experts and archaeologists reports that simple creations—the outline of a hand, an array of lines, and a painted cave formation—from three caves in Spain all date to more than 64,800 years ago, at least 20,000 years before modern humans reached Europe. Shells from a fourth Spanish cave, pigment-stained and pierced as if for use as body ornaments, are even older, a team including several of the same researchers reports in a second paper, in *Science Advances*. Some researchers had already attributed the shells to Neandertals, but the new dates leave little doubt.

The shells amount to only a handful and might have been perforated naturally, causing some researchers to question their significance. Not so the paintings. "Most of my colleagues are going to be stunned," says Jean-Jacques Hublin of the Max Planck Institute (MPI) for Evolutionary Anthropology in Leipzig, Germany, who was not involved in either study. "People saw cave painting as a major gap between Neandertals and modern humans. This discovery reduces the distance."

Just how much is the question. João Zilhão of the University of Barcelona in Spain, an author of both papers, has spent years pressing the case that Neandertals were the mental equals of modern humans, and he sees the newly dated paintings and shells as full vindication. "I'd like to see the expression on some faces as they read the papers," he says. Hublin, who accepts that Neandertals were cognitively sophisticated but believes their cultural achievements fell short of modern humans', is impatient with what he sees as Zilhão's absolutism. "What is the goal—to say that Neandertals were just like modern humans? That is a very far stretch."

And some researchers, trying to absorb findings that fly in the face of their longtime view of Neandertals, aren't sure what to think. "I find [it] incredibly challenging," says Shannon McPherron of MPI, whose own work has cast doubt on claims that Neandertals buried their dead or made systematic use of fire. The new dates, he says, have "shattered my model of Neandertal behavior."

With rare exceptions, cave art could not be directly dated until recently, making it hard to challenge the assumption that the artists were modern humans. For one thing, most cave paintings lack organic residues that can be dated by the radioactive decay of carbon isotopes. But in the early 2000s, scientists devised an alternative dating strategy based on the thin layer of calcite that can form when groundwater seeps down a cave wall and across a painting. The water contains a smattering of uranium atoms that decay into a distinctive isotope of thorium, which accumulates in the calcite over millennia. Grind a few flecks of calcite off a cave painting, measure the ratio of uranium and thorium isotopes, and you can read out the age of the calcite. The underlying painting must be at least that old—and could be much older.

It's not easy, says MPI's Dirk Hoffmann, who was among the first to apply uranium-thorium dating to cave paintings and is the first author of both papers. "The challenge is to find these calcites. You need a wall where you occasionally have a little water coming in that deposits calcite without damaging the painting." Then comes the "nerve-wracking" task of scraping off the calcite without marring the pigment, and the painstaking analysis of a sample of few milligrams. Hoffmann and his colleagues applied the technique to

In Spain's La Pasiega Cave, a set of lines (center) painted by Neandertals was embellished by later artists.

cave art across Italy, France, Portugal, and Spain. Most of the dates fell within the European reign of modern humans, which began 40,000 to 45,000 years ago. But in the three cases described in *Science*, the paintings are far too old to have been made by them.

"To me the biggest question is how good is the dating," says Harold Dibble of the University of Pennsylvania, who has long challenged claims of sophisticated Neandertal behavior. But others see little reason for doubt. Multiple samples from each painting yielded consistent results, and in several cases Hoffmann and his colleagues analyzed scrapings from increasing depths in the calcite layer. The dates grew older as they approached the pigment, adding credibility. "I am confident that the [uranium-thorium] dates are correct," says Rainer Grün, an expert in the technique at Griffith University in Nathan, Australia, who did not take part in the work.

Zilhão predicts that other cave paintings will prove equally ancient, if not more so. "This is just scratching the surface of an entirely new world." He cites two other finds as evidence of a long Neandertal tradition of art and ritual. One is a pair of corral-shaped structures, the larger one more than 6 meters across, assembled from broken stalagmites and scorched by fire, found by cavers more than 300 meters deep in Bruniquel Cave in France. In 2016, a French-led team reported in *Nature* that the structures were built some 175,000 years ago—presumably by Neandertals, perhaps for ritual purposes. And then there are the colored shells from Cueva de los Aviones, a sea cave in southern Spain, where Hoffmann's uranium-thorium dating of a calcite crust covering the objects has just yielded an age of more than 115,000 years.

But was this Neandertal artistic creativity equivalent to the art and symbolism practiced by modern humans? At sites across Africa, our direct ancestors were making shell beads and etching abstract designs into egg shells and minerals 80,000 years ago and more. Neandertal achievements were fully comparable, Zilhão insists, and to suggest otherwise implies a double standard.

Hublin disagrees. The startling new dates for the paintings "show that Neandertals had the same potential as modern humans in a number of domains," he acknowledges. But he and others see differences in cognition and culture that even the new research does not erase. And Hublin notes that soon after their arrival in Europe, "modern humans replaced [Neandertals], and there are reasons."

Like the gap between these two kinds of humans, the rift among Neandertal experts has narrowed. But it has not yet closed. ■

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INFECTIOUS DISEASES

Worms living in your veins? Seventeen volunteers said 'OK'

A controversial study infects people with schistosomiasis to speed up drug and vaccine development

By **Kai Kupferschmidt**, *in Leiden, the Netherlands*

At 12:05 p.m. on a Thursday in February, a lab technician takes a six-well plate containing a solitary red snail and places it in a heated water bath under a strong light. The light and warmth signal hundreds of tiny larval parasites to stream out of the mollusk. Now, the clock starts ticking for Meta Roestenberg, an infectious disease physician here at Leiden University Medical Center. She has about 4 hours to launch a unique, controversial experiment in which she will let the parasites burrow into the arms of four healthy volunteers. If she waits too long, the larvae start to die.

Roestenberg and her colleagues are infecting people with *Schistosoma mansoni*, one of five tiny waterborne worm species that cause schistosomiasis, a disease that sickens millions of people in Africa, the Middle East, and Latin America and kills thousands each year. There is no schistosomiasis vaccine and only one old, inadequate drug, praziquantel, to treat it. Infecting humans could help speed up the development of new interventions. Roestenberg has designed the experiment to prevent the parasites from reproducing, and she says the risk to volunteers is extremely low.

But not low enough, some scientists argue, because there is no guarantee that subjects will get rid of their parasites when the study is over. "I would not volunteer for this study and if I had a son or daughter who wanted to volunteer, I would recommend against it," says Daniel Colley, a schistosomiasis researcher at the University of Georgia in Athens.

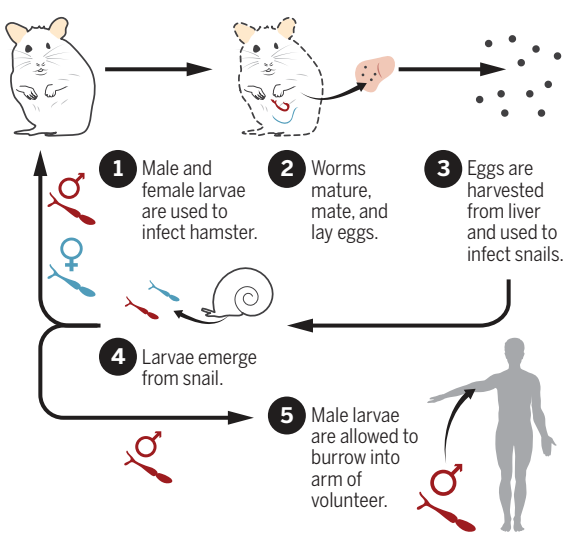
At 1:05 p.m., the technician takes the plate out of the bath. The larvae are ready to be harvested. Viewed under a microscope, they move around frantically, like minipropellers. Another technician removes one drop, dilutes it, adds iodine to kill the parasites, and counts them. That allows the researchers to calculate how many are left in the well: 574. They need only 80 today, 20 per volunteer.

A snail population in an African lake could shed millions of these larvae into the water on a single day, each equipped with a chemical sensor that lets it home in on humans entering the water. After penetrating the skin, they migrate to the liver, where they mature and mate. Male-female couples stay together and move to blood vessels in the bowel, where they can reside for years, shedding hundreds of eggs a day. Most eggs end up in urine and feces, and if they make their way back into the lake they may infect fresh snails. But some get trapped in the liver, kidneys, or spleen, causing damage and leading to pain, blood loss, malnutrition, and sometimes death.

Researchers in this same lab recreated the parasite's life cycle decades ago, with hamsters taking the place of

Parasites to the people

Researchers have long grown *Schistosoma mansoni* in the lab, using hamsters. Now, they are also infecting humans with the parasitic worms.



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