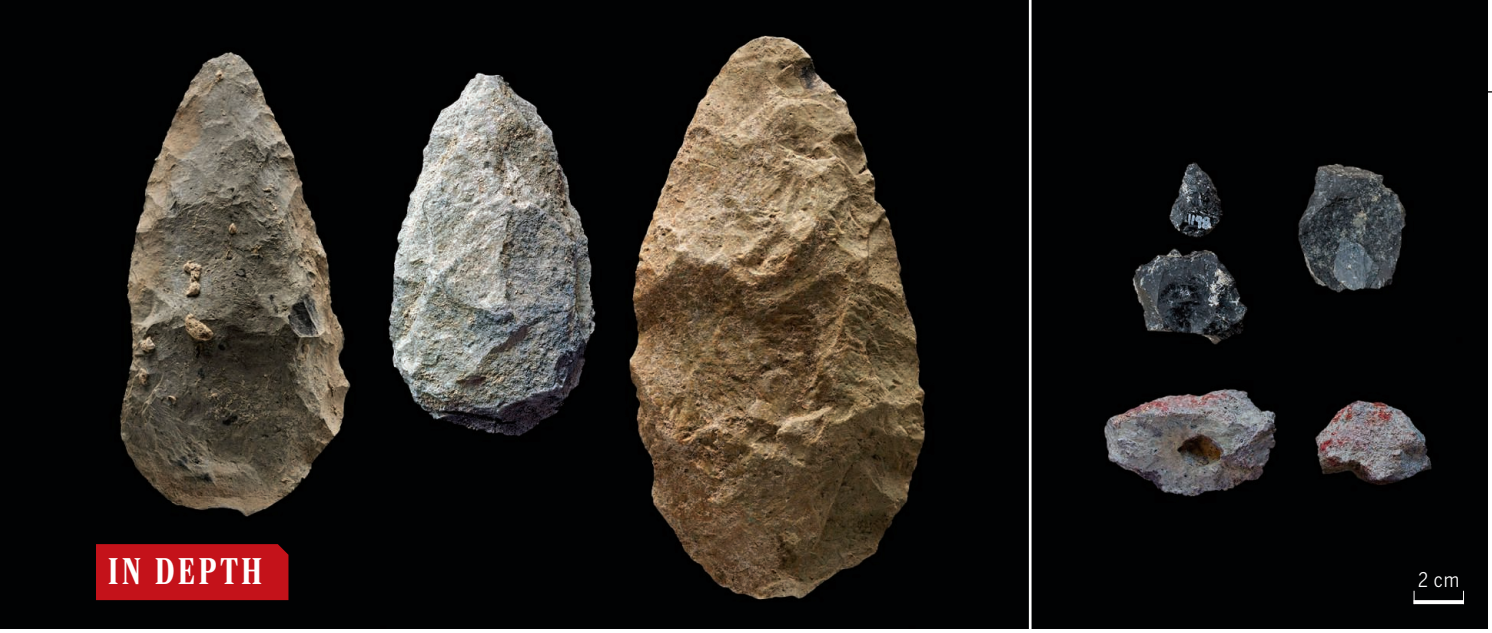


IN DEPTH

ARCHAEOLOGY

Complex behavior arose at dawn of humans

Advanced stone tools, pigment, and extensive networks emerged as environment changed

By **Ann Gibbons**

More than 320,000 years ago in the Rift Valley of Africa, some early innovators adopted a new technology: They eschewed the clunky, palm-size stone hand axes that their ancestors had used for more than a million years in favor of a sleek new toolkit. Like new generations of cellphones today, their Middle Stone Age (MSA) blades and points were smaller and more precise than the old so-called Acheulean hand axes and scrapers.

These toolmakers in the Olorgesailie Basin in Kenya chose as raw materials shiny black obsidian and white and green chert, rocks they had to get from distant sources or through trade networks. In another first, they chiseled red and black rocks, probably to use as crayons to color their bodies or spears—an early sign of symbolic behavior. "This is indicative of a gear change in behavior, toolmaking, and material culture," says evolutionary psychologist Robin Dunbar at the University of Oxford in the United Kingdom, who studies social networks.

A trio of papers released online in *Science* today documents this remarkable technological transition. Although other sites have yielded MSA tools, the new, securely dated chronology nudges the transition back by at least 20,000 years, matching when our species, *Homo sapiens*, is now thought to have emerged. By analyzing artifacts over time at one site, the papers also show that these behaviors developed as climate swings intensified, supporting the idea that environmental variability drove innovation.

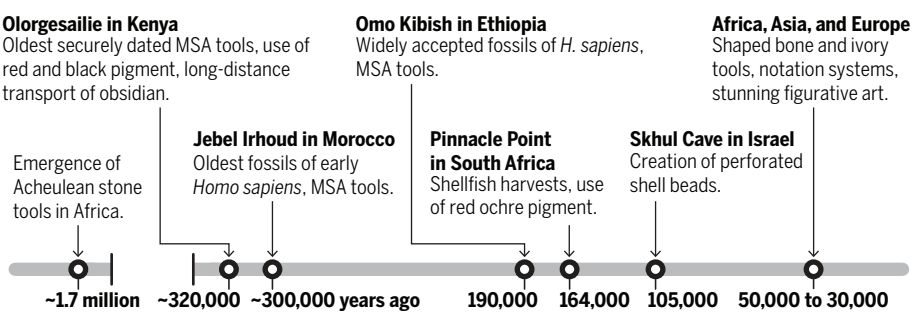
A team led by paleoanthropologists Rick Potts of the Smithsonian Institution's National Museum of Natural History and Alison Brooks of The George Washington University, both in Washington, D.C., gathered artifacts from sediments spanning 1.2 million years at Olorgesailie. Unfortunately, ancient erosion stripped away layers between 499,000 and 320,000 years ago, erasing the time when the MSA was probably invented. But by looking at more than 20,000 animal fossils associated with tens of thousands of stone tools, and multiple clues to the ancient environment, the team provides a detailed picture of life before and after the transition to the MSA. They pin down the timing with what geochronologist Michael Storey of the Natural History Museum of Denmark in Copenhagen calls "very impressive" dating.

About 900,000 years ago, a skull cap shows that the human ancestor *H. erectus* lived at Olorgesailie and used big Acheulean hand axes and scrapers to butcher meat. About 800,000 years ago, the climate began fluctuating more intensely from wet to dry, and the environment became more arid and grassy. At about 615,000 years ago, early humans began to make smaller Acheulean tools they could carry farther, and to more carefully select basalt as raw material, perhaps shifting hunting tactics in a changing environment, Potts says. The last hand ax at the site dates to 499,000 years ago, before the gap.

By the time the archaeological record restarted at 320,000 years ago, the Acheulean tools were gone and the basin had changed dramatically. The wet-dry cycle was even

The roots of modern human behavior

Many complex technologies and signs of symbolic behavior, such as sophisticated Middle Stone Age (MSA) tools and pigment use, appeared first in Africa and then in fits and starts around the world.



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At Olorgesailie in Kenya, big hand axes (left) gave way to smaller, more precise blades and points (right).

more extreme. More than 80% of mammal species had vanished and new kinds of elephants, pigs, foxes, and springboks gathered at tree-lined streams. MSA tools—relatively sophisticated blades and points that would have been hafted onto spears—were plentiful.

The site yielded no human fossils in this key time frame, so researchers can't be sure who the new toolmakers were. But discoveries elsewhere offer a strong hint. For years archaeologists had thought the MSA tools were too old to have been made by our species. Then, last year, fossils resembling *H. sapiens* were found near MSA tools and dated to nearly 300,000 years ago at Jebel Irhoud in Morocco (*Science*, 9 June 2017, p. 993)—timing that fits the Olorgesailie chronology.

Features of the MSA tools also suggest they were the handiwork of sophisticated humans. The toolmakers were highly selective about their raw materials, importing obsidian from up to 90 kilometers away. Such far-flung connections are a "hallmark of human social organization, and an important buffer in forager societies," whose members may move to distant places in hard times, Brooks says. The tools also are smaller, more precise, and more uniform in shape than Acheulean tools. They represent a milestone in abstract thinking: A hand ax preserves the shape of the original lump of rock, but creating a blade from an already prepared core forces toolmakers to visualize its shape in advance, Brooks says.

The team also found chunks of black rock and pieces of red ochre that had been punctured by sharp stone chisels. They propose both were used as pigments to create marks of individual or group identity, suggesting a high degree of social organization.

Expanded social networks are "a key unique feature of modern humans," says archaeologist Curtis Marean of Arizona State University in Tempe, although he suspects there will be some debate about the evidence for long-distance networks, noting that most of the stone came from just 25 to 50 kilometers from the site.

By combining artifacts with environmental data, the papers help explain what drove the MSA, says archaeologist Shannon McPherron of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. "They were able to use the long time-sequence at Olorgesailie to demonstrate how changes in the environment and the fauna correspond to the shift to the MSA."

But these MSA toolmakers hadn't developed the full package of sophisticated behavior, Dunbar cautions. "It's at the bottom of the scale of modern behavior," he says. "We're not talking about Salvador Dalí." ■

PHOTO: REUTERS/STRINGER

INFECTIOUS DISEASE

Nigeria hit by unprecedented Lassa fever outbreak

As efforts to contain it mount, researchers are racing to find out what is driving this year's surge in cases and deaths

By **Leslie Roberts**

By early January, it was clear something "really, really extraordinary" was going on in Nigeria, says Lorenzo Pomarico of the Alliance for International Medical Action (ALIMA). Cases of Lassa fever, a rare viral hemorrhagic disease, were skyrocketing across the country—more were recorded in the first 2 months of 2018 than in any previous year. Unprepared for a disease that has no vaccines or drugs and kills 20% to 30% of those it sickens, eight health care workers were infected early on and three died. "Something was going very wrong with the outbreak," Pomarico says.

Since then, the situation has only gotten worse. The rodent-borne disease is endemic in Nigeria and several other West African countries, fluctuating with the seasons and usually causing "a trickle" of cases a year, says Chikwe Ihekweazu, who heads the Nigeria Centre for Disease Control in Abuja. But as of 11 March, 365 cases and 114 deaths had been confirmed across 19 states, with many more suspected. Ihekweazu says the record-setting figures are sure to be underestimates, because the disease is maddeningly hard to diagnose, and many cases go unreported.

Already, Nigeria's fragile health care system is overwhelmed. The one dedicated Lassa fever ward in the country at Irrua Specialist Teaching Hospital in Edo state has just 24 beds. Without access to proper training and personal protective equipment, health care workers continue to become infected—by now 16 cases have been reported, with one additional death.

As the government and its international partners scramble to set up isolation wards and deliver protective gear to health workers, researchers on three continents are racing to figure out what is driving the unprecedented outbreak. Is it simply better disease surveillance in the wake of Ebola, the similar but more deadly disease that began its rampage across West Africa in 2014? Has the virus changed in some way? Are there more of the rats that carry it, or are more of them infected? Or is another rodent capable of spreading the virus as well?

"There are lots of possible explanations," says Stephan Günther, who heads the virology department at the Bernhard Nocht Institute of Tropical Medicine in Hamburg, Germany, and whose team has long collaborated with Nigerian researchers. Considering how lethal Lassa fever is, shockingly little is known about it, he says. "We don't

This year, the rats that carry Lassa fever may be more numerous, or more likely to harbor the virus.