Seeking Africa's First Iron Men

Archaeologists are battling over when—and how—ancient African cultures entered the Iron Age

According to myth, Rwanda's ancient line of kings descended from a man with secret knowledge: He could transform chunks of ordinary rock into smooth, gleaming iron. With this new technology, he taught his people to make hard, durable weapons for defeating their enemies and sharp axes for cutting the forest to make fields. By the time the first Europeans arrived in the 19th century, iron had become power in the kingdom of Rwanda. Its kings had taken the blacksmith's hammer and anvil for their royal regalia, and at least one Rwandan ruler was buried with his head resting on two iron anvils.

Other traditional African societies tell stories of mythical ironworkers who descended from heaven or came from other lands. The prevalence of such legends underlines the importance of ironworking in these cultures, and archaeologists have long wondered if the arrival of iron metallurgy spurred the growth of complex early societies. Did foreigners in fact bring ironworking to Africa, or did Africans invent it themselves?

Entering the Iron Age was not easy. Metalworkers had to smelt ore at precise temperatures and then repeatedly hammer and reheat the spongy metal, known as a bloom, that first emerged from their furnaces. The traditional view is that metallurgists in Anatolia, the Asian part of Turkey, were the first to smelt iron ore deliberately, beginning around 1800 B.C.E. Initially, they reserved the new metal for precious ornaments or ritual objects. But by 1200 B.C.E., workers in the Levant were churning out considerable amounts of iron.

The metal had a major impact on societies. "Iron was a transformative metal," says archaeologist Scott MacEachern of Bowdoin College in Brunswick, Maine. Iron ores are much more abundant than copper or the tin needed to make bronze. Bronze was therefore costly and largely limited to use in ritual objects and goods for elites. But once cultures learned to smelt iron, they could put iron tools into the hands of ordinary people for clearing forests and tilling the soils. According to some models, this boosted agricultural yields, increased the numbers of villages, and triggered ever more social complexity.

A long debate has raged, however, about the origin of ironmaking in Africa. According to traditional thinking, iron metallurgy diffused slowly from one society to the next in the Old World, reaching northern Africa by 750 B.C.E. but not crossing the barrier of the Sahara Desert until 500 B.C.E. or later.

Now controversial findings from a French team working at the site of Ôboui in the Central African Republic challenge the diffusion model. Artifacts there suggest that sub-Saharan Africans were making iron by at least 2000 B.C.E. and possibly much earlier—well before Middle Easterners, says team member Philippe Fluzin, an archaeometallurgist at the University of Technology of Belfort-Montbéliard in Belfort, France. The team unearthed a blacksmith's forge and copious iron artifacts, including pieces of iron bloom and two needles, as they describe in a recent monograph, *Les Ateliers d'Ôboui*, published in Paris. "Effectively, the oldest known sites for iron metallurgy are in Africa," Fluzin says.

Some researchers are impressed, particularly by a cluster of consistent radiocarbon dates. The new finds should prompt researchers to explore how sub-Saharan metal smiths could have worked out iron production without the benefit of an earlier Copper or Bronze Age, says archaeologist Augustin F. C. Holl of the University of Michigan, Ann Arbor.

"We are in a situation where we have to rethink how technology evolves," he says.

Others, however, raise serious questions about the new claims. Archaeormetallurgist David Killick at the University of Arizona in Tucson says the Ôboui iron artifacts are far too well preserved for the dates given: "There is simply no way that they have been sitting in the ground for 3800 radiocarbon years in acidic soils and a seasonally moist environment like the western Central African Republic."

AN INVISIBLE EQUATION

The idea that iron metallurgy diffused to Africa from the Middle East, rather than being invented independently, receives its strongest support from the sheer complexity of iron smelting. Working meteoritic iron is fairly straightforward, but to extract iron from hematite and other common ores, early metalworkers had to bring the ore to a precise range of temperatures, so the iron could fuse with carbon released from the burning of charcoal. To pull off this feat, smelters had to master an invisible equation, placing the ore out of sight in a clay furnace fueled with the correct amount of charcoal and fed with just the right amount of air for combustion. According to the diffusion theory, only people who possessed millennia of experience working copper, such as the Anatolians, would have had sufficient knowledge to begin experimenting with iron.

The archaeological data on early iron- working in northern Africa are frustratingly spotty, but current evidence suggests that Phoenician traders carried the technology to their colony of Carthage in northern Africa around 750 B.C.E. Other travelers brought iron technology to Egypt, which already possessed copper, by 660 B.C.E., if not earlier. The wealthy Nubian kingdom just to the south possessed bronze and began smelting iron between 800 and 500 B.C.E. In the Nubian city of Meroë, workers created an iron industry that one writer dubbed "the Birmingham of Africa," because as with the British town, iron was the source of Meroë's wealth. The city produced an estimated 5 to 20 tons of the metal annually for hoes, knives, spears, and other everyday goods, as Thilo Rehren, an archaeometallurgist at University College London, wrote in a 2001 article in *Mitteilungen der Sudanarchäologischen Gesellschaft*. From North Africa, the technology was thought to have crossed the Sahara Desert around 500 B.C.E., spreading to southern lands that lacked both copper and bronze- working traditions.

Evidence contradictory to this model has cropped up since the 1960s, however. Several French and Belgian archaeologists have pointed to evidence from sites in Niger, Rwanda, and Burundi suggesting that Africans invented ironworking independently as early as 3600 B.C.E. Their analyses were strongly criticized by prominent researchers in the United States, who argued that the early radiocarbon dates likely came from wood older than the iron artifacts. In reviewing the debate in a 2005 paper in the journal *History in Africa*, independent scholar Stanley Alpern suggested that Francophone researchers had fallen under the influence of African nationalism and pride, which blinded them to problems in their data. The critiques persuaded many researchers outside France that the earliest good evidence for sub-Saharan African ironworking came from carefully excavated sites dated between 800 and 400 B.C.E., such as Walalde in Senegal, where a complex society of pastoralists and craft specialists may have developed a trading system using precious iron bars for exchange.

Meanwhile, French proponents of the very early dates dismissed such charges as the last gasp of scientists wedded to the diffusion model. A frosty impasse ensued: Many Francophone Africanists stopped attending Anglophone meetings and informally sharing their research results. "There is a taboo there," fumes Holl. "People just have this conception that iron technology in sub-Saharan Africa has to be later than 500 B.C.E., and when it is earlier than that, they start looking for [alternative] explanations."

The deep chill lasted until the fall of 2008, when Anglophone researchers learned that a French team led by archaeologist Etienne Zangato of the University of Paris X had published the Ôboui monograph a year earlier with sensational new evidence for ancient African ironworking. Now the controversy has fired up again.

AN ANCIENT FORGE

Zangato's most important data come from Ôboui, a site where horticulturists and fishers lived for millennia; by 800 B.C.E., people in the region were erecting megaliths and burying important people in impressive tombs.

Zangato began excavations at the site after a violent storm struck in 1992, sweeping away part of the capping sediments and exposing a layer of metallic objects, potsherds, and stone tools. Zangato and his team spent nine field seasons at the site, opening more than 800 square meters. They recovered 339 stone artifacts and a host of evidence for ironsmithing: a blacksmith's forge, consisting of a clay-lined furnace, stone anvil, and part of a ceramic pot that likely held water for cooling or possibly tempering red-hot iron. They also found charcoal storage pits, 1450 pieces of slag, 181 pieces of iron bloom, and 280 small iron lumps and objects, including two needles.

Fluzin detected none of the telltale waste produced by the first stage of smelting, implying that Ôboui's smiths imported iron bloom from elsewhere or that excavators have yet to find the site's smelting area. But microscopic examination of thin slices from iron samples collected near the anvil demonstrates that people at Ôboui purified the bloom by repeatedly heating and hammering it. Some lumps contained as much as 85% iron and revealed visible traces of hammering, such as deformations caused by crushing, under the microscope. "It is undeniable that these samples correspond to metalworking, already quite advanced, of fragments of bloom," concludes Fluzin. His comparative studies of minerals in the ore suggest that the most likely source was an ancient mine located 12 kilometers away.

To date the site, seven charcoal samples were taken from inside and outside the furnace. They were radiocarbon dated by Jean-François Saliège in the Laboratory of Dynamic Oceanography and Climatology at the University of Paris VI to between 2343 and 1900 B.C.E—long before the Anatolians were working iron.

Those dates are early, but they fit well with a newly emerging pattern, says Zangato. Excavations he directed between 1989 and 2000 at the three nearby sites of Balimbé, Bétumé, and Bouboun each uncovered layers containing ironworking debris, he says. Those layers were radiocarbon dated by Zangato, Saliège, and Magloire Mandeng-Yogo of the Institute of Research for Development in Bondy, France, to between 1612 and 2135 B.C.E. at Balimbé and Bouboun, and to sometime between 2930 and 3490 B.C.E. at Bétumé. "There is no longer any reason to cling to the diffusionist theory for iron metallurgy in Africa," says Zangato. "I believe more and more in local development [of the technology]."

The evidence is very convincing, says Patrick Pion, a University of Paris X archaeologist who specializes in the European Iron Age. The metallographic analysis is clear proof of ironworking at Ôboui, he says, and "the series of C^{14} dates obtained are coherent, done by a laboratory and a specialist recognized for C^{14} dating in Africa. I see no reason intrinsically to question them." MacEachern agrees that the seven consistently early dates from the forge are persuasive. "This is not the common situation that we've had in the past in African metallurgy, where we've had isolated dates from debatable contexts," he says.

But Killick and others are completely unconvinced by the dates, though they agree that the forge is real. "Although it seems that the seven oldest radiocarbon dates form a coherent group, they are all coming from a few square meters in a very disturbed archaeological site," says Bernard Clist, an archaeologist at the Institute of Research for Development in Grasse, France. "They are closely bounded by pits and structures well dated to around 2000 B.P. and later." This means that later ironworkers could have dug into ground laced with charcoal from an earlier occupation or forest fire, giving dates that are far too old. To push back the dates convincingly, say critics, the team needs to publish more detailed stratigraphic data and charcoal studies. They also need several consistent lines of chronological evidence. such as thermoluminescence (TL) dates on clay furnaces, accelerator mass spectrometry (AMS) dates on short-lived plant remains, and indirect dates from sequences of ceramic styles.

Zangato concedes that the team's case would have benefited from more dating. But he says that the €500,000 he received for the 15-year project from France's Ministry of Foreign Affairs was insufficient to cover expensive TL and AMS dates: he opted for additional radiocarbon dates instead. He and Fluzin dismiss the charge that the iron artifacts are too pristine for their age, saying that a dense, difficult-to-excavate upper layer of sandy clay at Ôboui prevented the diffusion of water and oxygen, and so reduced corrosion. Killick counters that the high soil temperatures at the site should in fact speed corrosion. If Ôboui's iron bloom really dates back to 2000 B.C.E., then its open pores "ought to be completely full of corrosion products, leaving small islands of metal in a sea of corrosion," says Killick. There is no sign of this in the published photos. Even MacEachern finds the relative lack of corrosion puzzling. "I'd certainly like to know more about the preservation of the iron tools," he says.

Neither Zangato nor Fluzin is backing away from their claims, however. Zangato and Holl are working on a paper for the World of Iron conference in London from 16 to 20 February. Expect lively sessions, says conference organizer and archaeometallurgist Xander Veldhuijzen of University College London: "The earliest iron debate is currently in a very interesting phase, as a lot of new evidence is just appearing."

—HEATHER PRINGLE

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