

Was North Africa The Launch Pad For Modern Human Migrations?

A growing number of researchers suspect that long-neglected North Africa was the original home of the modern humans who first trekked out of the continent

LAST YEAR, ARCHAEOLOGISTS EXCAVATING at the Grotte des Contrebandiers (Smuggler's Cave) on Morocco's Atlantic coast unearthed a rare prize: the skull and partial skeleton of a 7- or 8-year-old child. The fossils, dated to 108,000 years ago, appear to belong to an early member of our species, although study of them has just begun.

But one feature stands out already: "It has huge teeth," says Harold Dibble of the University of Pennsylvania, co-leader of the dig team. That's a feature the child shares not only with other hominin fossils found across North Africa but also with some of the first modern humans to leave Africa. And so the new fossil may contain clues to an enduring mystery in human origins research: Just where in Africa did the modern humans who first col-



Old youngster. This fossil child had big teeth.

onized the rest of the world come from? "It's a very exciting specimen," says anthropologist Jean-Jacques Hublin of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany.

For Hublin, who was born in Algeria, the Contrebandiers child adds to growing evidence that North Africa was likely a major source of the modern humans who first left humanity's homeland and spread into Europe and Asia as early as 130,000 years ago. "If you look at a map and think how modern humans would have moved out, you would logically look at North Africa," he says.

Nevertheless, until very recently, most researchers studying the origins of *Homo sapiens* looked elsewhere, focusing instead on the fossils of East Africa and the

sophisticated tools and ornaments of famed South African sites such as Blombos Cave (*Science*, 16 April 2004, p. 369). Few scientists thought that much of evolutionary significance had gone on in North Africa, or that the region's big-toothed, somewhat archaic-looking hominins might be closely related to the ancestors of many living people. "We've left North Africa off the map for so long, and now it deserves to be there," says paleoanthropologist Chris Stringer of the Natural History Museum in London.

Indeed, a flurry of research has now put the region firmly on the map of human evolution. Thanks to new excavations and more accurate dating, North Africa now boasts unequivocal signs of modern human behavior as early as anywhere else in the world, including South Africa. Climate reconstructions and fossil studies now suggest that the region was more hospitable during key periods than once thought. The data suggest that the Sahara Desert was a land of lakes and rivers about 130,000 years ago, when moderns first left Africa for sites in what is today Israel. And new studies of hominin fossils suggest some strong resemblances—and possible evolutionary connections—

Digging for our roots. Modern humans occupied many North African sites, like this one at Contrebandiers, Morocco.

between North African specimens and fossils representing migrations out of Africa between 130,000 and 40,000 years ago.

This barrage of new evidence is reported in recent papers and in two new edited volumes (see Additional Reading below). Human evolution researchers working in other parts of Africa are taking notice. The new studies are “long overdue,” says anthropologist Stanley Ambrose of the University of Illinois, Urbana-Champaign, who works in East Africa. They “show that North Africans may be responsible” for both early and later *H. sapiens* migrations out of Africa. Adds archaeologist Curtis Marean of Arizona State University, Tempe, “If I were not working in South Africa, I would probably be in North Africa.”

But a key question, Marean and other researchers say, is whether modern humans in North Africa were foremost among the migrants that eventually left Africa, or whether those populations represented an evolutionary cul-de-sac that was left behind when humans from other parts of the continent began moving into Asia and Europe. The evidence that North Africa was a population pool for migrations to Eurasia is not yet conclusive, says anthropologist Gerhard Weber of the University of Vienna. Marean is also cautious for now but says the new work should provide “some good answers in the future.”

Old tools, new dates

Given what researchers already know about modern human evolution, the long neglect of North Africa might seem surprising. Most anthropologists think that our species, *H. sapiens*, first evolved in sub-Saharan Africa about 200,000 years ago and began migrating out of Africa between 70,000 and 50,000 years ago, eventually colonizing the globe. And although the expansion has often been considered a single migration, many researchers are beginning to suspect that moderns left Africa in two or more waves.

Some of these early migrants may have gone east, across the Red Sea and along the southern coast of Arabia. But the earliest known modern human fossils outside Africa suggest a northern route, perhaps through the Nile Valley: Modern human skulls and other bones discovered in the early 20th century in the Skhul and Qafzeh caves in Israel are now dated to between 100,000 and 130,000 years ago, although researchers debate whether these early colonizers traveled any farther at that early date (*Science*, 9 October 2009, p. 224).

Despite this early connection to the Middle East, not so long ago most experts thought that modern humans occupied North Africa itself relatively late. The earliest known modern human fossils were from East Africa: Skulls and bones found near Kenya’s Omo River by Richard Leakey and others are now dated to 195,000 years ago, and skulls found at Herto in Ethiopia clock in at about 160,000 years old. Then, in recent years, Hublin, Stringer, and others convinced most anthropologists that a 160,000-year-old skull from Jebel Irhoud in Morocco was that of an archaic modern human and not a Neandertal, as previously thought. But that skull was considered an anomaly, perhaps representing a population that got trapped north of the Sahara and then died out.

This picture of North African hominins as Johnny-come-latelies was reinforced by assumptions about the dates of characteristic stone tools in the region. Called Aterian after their discovery in 1917 at the site of Bir

O pioneers. Early modern humans like this one from Dar es-Soltan (computer reconstruction, right) may have spread across North Africa and into Eurasia.

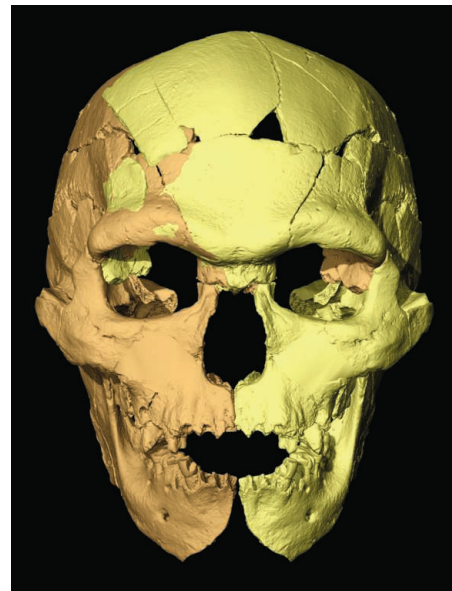
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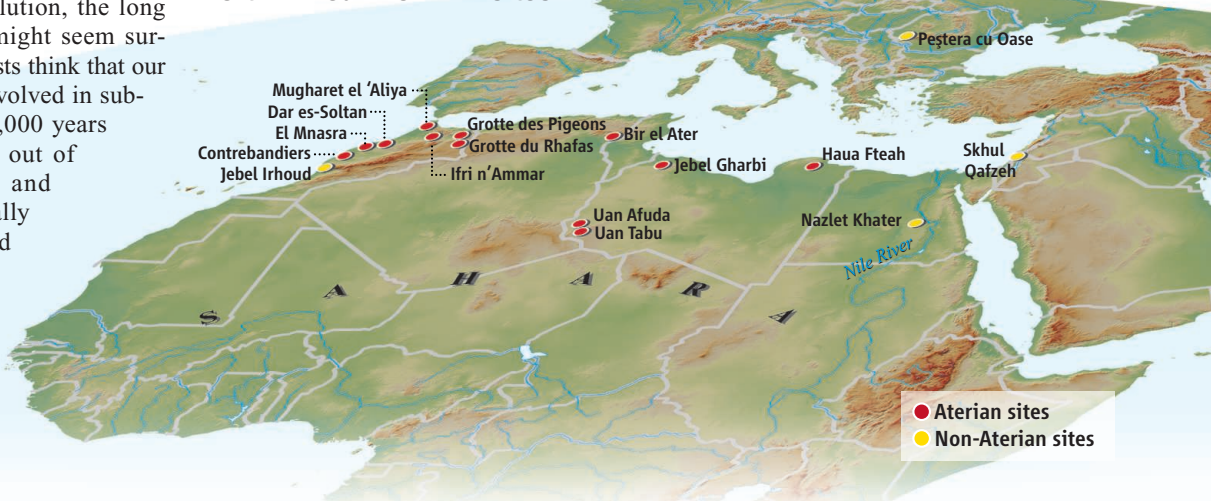
Podcast interview
with author
Michael Balter.

el Ater in eastern Algeria, the tools include triangular objects that some suggested were used as arrowheads or spear points (see photo, p. 23). At least 100 Aterian sites have now been uncovered across North Africa, including in what is now the Sahara Desert. But when archaeologists radiocarbon-dated these sites, they tended to throw out any results older than 40,000 years, says archaeologist Elena Garcea of the University of Cassino in Italy, because such dates were at the limit of the radiocarbon technique and considered unreliable (*Science*, 15 September 2006, p. 1560). “In the past, the Aterian was thought to be relatively late and not terribly exciting, ... a sideline or a dead end,” says archaeologist Nick Barton of the University of Oxford in the United Kingdom.

By 1998, however, it began to look like archaeologists might be throwing away the



North African hominin sites



wrong dates. That year, researchers used the new techniques of optically stimulated luminescence (OSL) and thermoluminescence (TL) to date Aterian sites in Libya back to 70,000 years, and soon afterward similar dates using these and other methods were found at other Aterian sites in the region.

During the past 2 years, the dates have gotten even older. In 2009, Barton and Abdeljalil Bouzouggar of the National Institute of Archaeological and Heritage Sciences in Rabat reported OSL dates of at least 110,000 years from the Aterian site of Dar es-Soltan in Morocco; and in a new volume edited by Garcea, the team reports similarly old dates from three other Moroccan caves. Then in September, TL dates of about 145,000 years were reported for Ifri n'Ammar in Morocco. "The Aterian goes back at least 145,000 years," Stringer says. "That's an incredible length of time."

Those early dates are coupled with a growing realization that the Aterians were just as behaviorally sophisticated as modern humans in other parts of Africa. In addition to their skillfully made tools, they made personal ornaments—a key sign of modern, symbolic behavior—from shell beads 82,000 years ago at Morocco's Grotte des Pigeons (Pigeon Cave). That's somewhat earlier than when the same genus of shells, *Nassarius*, was used to make beads at Blombos Cave thousands of kilometers away in South Africa 75,000 years ago. *Nassarius* beads show up at Qafzeh in Israel even earlier, at least 100,000 years ago (*Science*, 23 June 2006, p. 1785). Researchers are now studying 108,000-year-old perforated *Nassarius* shells from Contreband-

iers to determine whether they, too, were used as personal ornaments.

All this implies that the Aterian was not a sideshow but a "[cultural] package that may be linked with the emergence of modern human behavior," says Barton. That's not direct evidence that the Aterians were the source of out-of-Africa migrations, but it suggests that they met an important prerequisite: Rather than being a small, isolated population unlikely to go on the move, they apparently were part of extensive social networks that used ornaments to signal the identities of different groups that were in contact with one another, perhaps across long distances (*Science*, 9 April, p. 164).

This is in contrast to recent genetic research, which has suggested that the humans who dispersed to Europe, Asia, and Australia by 50,000 years ago originated in sub-Saharan Africa (*Science*, 1 May 2009, p. 575). But Hublin argues that such studies, which are based on the genetic diversity of humans today, might not capture past patterns. For example, some of the Aterians in the Sahara area—along with their genes—may have moved east or south when the Sahara became hotter and drier after 60,000 years ago.

Leading geneticists support the idea that some of the populations that live south of the Sahara today may have Aterian roots. "This



Facing the past. The Max Planck's Jean-Jacques Hublin sees similarities between the Aterians and the first modern humans to leave Africa.

is entirely plausible," says Sarah Tishkoff of the University of Pennsylvania. "We can only study populations present today, and their present-day distribution probably doesn't reflect where they originated from tens of thousands of years ago."

Rain over the Sahara

Today, no sensible hominin would think of trying to cross the Sahara Desert. This vast landscape of sand dunes, rocky plains, and

plateaus covers 5 million square kilometers from the Atlantic Ocean in the west to the Red Sea in the east. The Sahara overall receives less than 8 centimeters of rain each year, and the driest parts might not see rain for years on end. But during key periods in human prehistory, new data from multiple sources suggest, at least parts of the Sahara featured lakes, rivers, and trees.

Scientists are now working to correlate the cyclical greening of the Sahara with archaeological signs of human occupations. For example, satellite radar imaging has revealed a system of more than 800 kilometers of channels, some more than 5 kilometers wide, buried under the eastern Sahara sands. A 2008 study of 120,000-year-old snail shells suggests that these are river corridors, which could have supported human migrations (<http://scim.ag/wetsahara>). And trees increased markedly 120,000 and 50,000 years ago, according to work published last year on isotopes from plant leaves in a marine core off the coast of northwest Africa.

Other recent work suggests that Libya, Chad, Tunisia, and Egypt were dotted with huge "megalakes" about 120,000 years ago; about 10% of Libya might have been underwater around that time, concludes geographer Nick Drake of King's College London. These wet phases lasted for thousands of years.

"One of the wettest times was around 120,000 to 130,000 years ago," says geologist Jennifer Smith of Washington University in St. Louis (WUSTL). That's about when modern humans first left Africa and are found in the Israeli caves of Skhul and Qafzeh.

A wet Sahara between 100,000 and 130,000 years ago may also help explain how shell bead ornaments ended up in both North and South Africa some tens of



European connection? Some features, such as the molars, of these 40,000-year-old specimens from Romania resemble those of earlier North African hominins.



"We've left North Africa off the map for so long, and now it deserves to be there."

—CHRIS STRINGER, THE NATURAL HISTORY MUSEUM IN LONDON

thousands of years later, says Hublin, if far-flung populations were in touch across the continent. "If you look before 100,000 years ago, North Africa was very much connected to the rest of Africa," he says, adding that fossils of sub-Saharan animals such as rhinos, giraffes, and hippos have been found at North African sites. "We had a network of early modern populations all over Africa, sometimes connected and sometimes separated."

Yet despite some evidence, for example from the tree study, that parts of the Sahara continued to experience wet periods as late as 50,000 years ago, the climate data suggest that the Sahara had greatly expanded by that time. Indeed, Garcea says, no Aterian sites are found in the Sahara after about 60,000 years ago, although the Aterian continues until about 40,000 years ago all along Africa's northern Mediterranean coast.

Bones tell a new tale

Did the Aterians themselves die out, or did they live on to join the exodus out of Africa? The bones they left behind offer some tantalizing clues. The Aterians were kind to human evolution researchers: They left not only ample artifacts but also one of Africa's best collections of modern human fossils. Now new analyses of Aterian faces and teeth suggest that at key times, populations across North Africa and the Middle East were "relatively closely related," says paleoanthropologist Katerina Harvati of the University of Tübingen in Germany. For example, in a paper in an upcoming volume co-edited by Hublin, Harvati and Hublin compared an Aterian skull with those of other early hominins.

They analyzed the facial features of a partial skull found at Dar es-Soltan—now dated to about 80,000 years ago—using the three-dimensional coordinates of 19 facial landmarks. The Dar es-Soltan skull most closely resembled two 100,000-year-old skulls from Qafzeh as well as the 160,000-year-old Jebel Irhoud skull; it showed much less affinity with Neanderthal skulls or with younger modern humans from any continent.

In a second paper, Hublin, along with dental experts Shara Bailey of New York University and Tanya Smith of Harvard University, compared the size and shape of

more than 50 hominin teeth from Aterian sites with more than 200 teeth from Neandertals as well as modern humans from several continents. The Aterian teeth, which have very large molars and a distinctive pattern of cusps, clustered most closely with those from Qafzeh and Skhul. And they also strikingly resembled those of the earliest known modern humans in Europe: a cranium and mandible, dated to about 40,000 years ago, from the site of Peștera cu Oase in Romania.



Signs of sophistication. The Aterians made personal ornaments (*above*) and advanced stone tools (*below*).



Earlier, other researchers had also found resemblances—such as the robust shape of the lower jaw and forward-facing cheekbones—between Oase and a 40,000-year-old skull from the site of Nazlet Khater in Egypt, providing another potential North African link to the earliest Europeans. "There are indeed some affinities between Oase and Nazlet Khater," says anthropologist H el ene Rougier of California State University, Northridge, who worked on some of these studies, although she notes that the contemporaneous skulls differ in other traits.

The big teeth "certainly potentially link the Aterians with Oase," says the Natural History Museum's Stringer, making the Aterians candidates for the ancestors of later Europeans.

But to nail down those evolutionary relationships, Stringer says, "we need good samples from northeast Africa," because most Aterian fossils are from Morocco in northwest Africa. "The people in Morocco could have been marginal." He adds that the early Oase skull from Romania might not have been closely related to the modern humans who later colonized the rest of western Europe and left the famed Aurignacian and Gravettian cultures; those cultures could represent a later wave of more gracile, smaller-toothed *H. sapiens*.

Other researchers remain even more skeptical. Paleoanthropologist Erik Trinkaus of WUSTL, who has extensively studied the Oase fossils and thinks they represent admixture between Neandertals and moderns, rejects any close connection between them and the Aterians. He sees "some superficial resemblances in terms of large molars" between Oase and Aterian specimens but few other similarities. In fact, he thinks the Aterians weren't fully modern humans but "archaics" living in an isolated corner of Africa who were an evolutionary dead end. North Africa was "just another cul-de-sac," he says.

But that view of the Aterians is rejected by many other anthropologists. The emerging evidence, Hublin and others say, suggests that at the critical time, prehistoric North Africans enjoyed the right climate, engaged in the right symbolic behavior, and possessed the right anatomy to be leading candidates for the ancestors of at least some of the *H. sapiens* who left Africa. So for a growing number of researchers, North Africa is a very promising place to look. Says Dibble: "We have exactly the kind of thing everyone has been searching for, right here." —MICHAEL BALTER

Additional Reading:

E. A. A. Garcea, Ed., *South-Eastern Mediterranean Peoples Between 130,000 and 10,000 Years Ago* (Oxbow Books, 2010).

J.-J. Hublin and S. McPherron, Eds., *Modern Origins: A North African Perspective* (Springer, in press).



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Vertebrate Paleobiology and Paleoanthropology

Series Editors: Delson, E.; Sargis, E.J.

ISSN: 1877-9077