the geographical area covered is much greater." After many millennia of sparse occupation, suddenly, "it's as though [early humans] said, 'OK, now let's do things properly,' " says archaeologist Clive Gamble of Southampton University in the United Kingdom.

Most researchers believe that this human was a different species from the more ancient Europeans. Its brain cavity ranged from about 1100 to 1300 cubic centimeters, compared to 1000 cubic centimeters or less for Asian *Homo erectus*, and it carried not simple Oldowan tools but Acheulean hand axes. Although opinions are divided as to what to call this European hominid, with some favoring *H. heidelbergensis* after its discovery in Germany and others simply calling it "archaic *Homo sapiens*," many researchers believe that it represents an intermediate step between *H. erectus* and full-fledged modern humans.

These new immigrants were able to firmly establish themselves in Europe where perhaps less hardy hominids had failed. "It seems that *Homo heidelbergensis* was better able to cope with fluctuations in climate," says Gamble. One possible reason is that its Acheulean tool kit allowed it to be a better hunter than earlier humans, who may have survived primarily by scavenging. At Boxgrove, for example, hominid remains are associated with animal bones bearing cut marks and other signs of butchering. Spectacular support for this view may come from Schoeningen, Germany, where 400,000-year-old wooden spears—the oldest uncontested hunting weapons—were found together with the skeletons of more than a dozen horses. "This is *Homo heidelbergensis* at its best!" enthuses Iowa's Ciochon. "It had superb hunting skills far outpacing [those of] any hominid that had come before."

The Atapuerca team believes that *H. antecessor* gave rise to *H. heidelbergensis*, but other researchers are not so sure. Instead, the origins of *H. heidelbergensis* might be traced to similar-looking hominid fossils in Africa, including skulls found at Bodo, Ethiopia, dated to at least 600,000 years ago, notes Ciochon. If the African origin is correct, a possible route for the migration of *H. heidelbergensis* out of the continent may be suggested at the site of Gesher Benot Ya'aqov, on the banks of the Jordan River in Israel (*Science*, 14 January 2000, p. 205; 11 August 2000, p. 944). Although there are no human bones at Gesher, Acheulean hand axes and cleavers closely resembling those found in Africa clock in at 780,000 years old. "One can argue that this species evolved [in Africa] ... and then spread quickly to western Eurasia" with the Acheulean tools, says SUNY's Rightmire.

Many researchers also think that *H. heidelbergensis* later gave rise to the Neandertals, who first appeared in Europe about 250,000 years ago and whose ability to survive in the cold climates of the Pleistocene was unequaled. Indeed, the Atapuerca team believes that the Sima de los Huesos skeletons are a transitional form between *H. heidelbergensis* and the Neandertals. For example, Atapuerca team member Rosas compared more than 30 of the 300,000-year-old mandibles found at Sima with those from Neandertals and other earlier species of *Homo*, including *H. erectus* and *H. heidelbergensis*, and concluded in the January 2001 *American Journal of Physical Anthropology* that a number of their features—such as the shape of the chin and the arrangement of the back molars—are ancestral to the Neandertal fossils.

But according to one leading theory of modern human origins, while this transition was taking place in Europe, the ancestors of modern humans—whatever species they were—remained in Africa. In this "Out of Africa" view, about 100,000 years ago, in one final explosion of migrations, modern humans began moving out of Africa, ultimately pushing the Neandertals and any other remaining hominids in the world aside. Some researchers strongly disagree with this scenario (see sidebar on p. 1728). But if it is true, the nearly 2 million years of hominid wanderings across Europe and Asia that preceded it merely set the stage for events to come. **–MICHAEL BALTER**

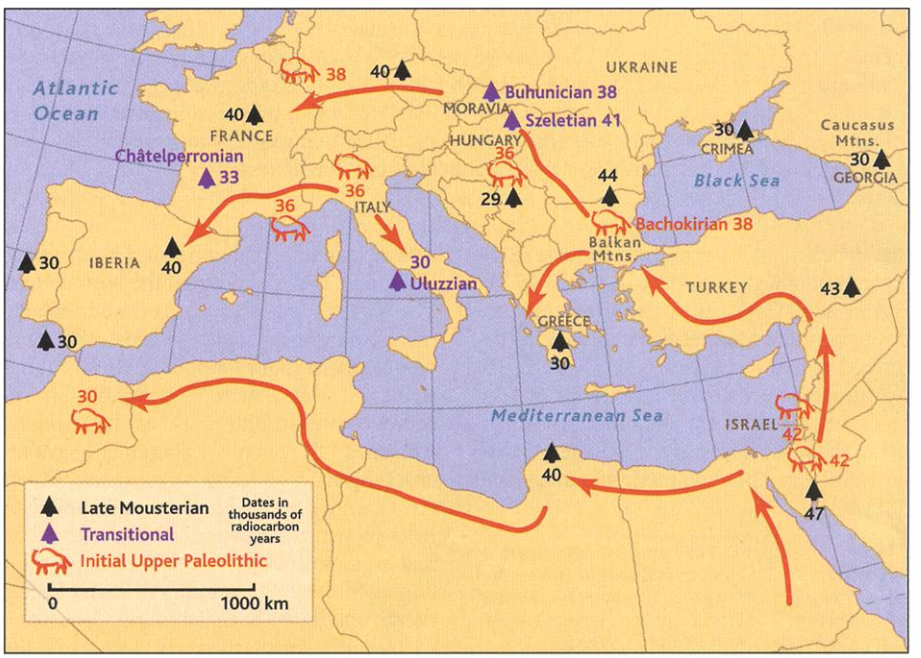
NEWS

The Riddle of Coexistence

Neandertals and modern humans lived side by side for thousands of years in Europe—with apparently dramatic consequences for each group

Forget first contact with aliens. For real drama, consider close encounters of the human kind. Forty thousand years ago, for example, our ancestors wandered into Europe and met another type of human already living there, the brawny, big-brained Neandertals. Such a collision between groups of humans must have happened many times. Several early human species coexisted in Africa, and when our ancestors left Africa and spread around the globe, they probably came across other kinds of humans, such as *Homo erectus*, who had left Africa in a previous migration. But the European encounter with Neandertals was probably the last such meeting. And so it has proven to be irresistible terrain for anthropologists and novelists alike, who often explore the same themes, including the question of sex (see sidebar on p. 1726), and come up with similar endings to the story: Anatomically modern Cro-Magnons arrive, prevail, and abruptly wipe out the brute Neandertals.

The real story from the archaeological and fossil records, however, is far more interesting. It suggests that Neandertals were neither stupid nor easily driven to extinction. They vanished about 25,000 to 30,000 years ago, and many researchers think that they were indeed replaced, with little or no interbreeding, by modern humans—although



Cultural diversity. As modern humans and their sophisticated tools arrive from Asia (red), Late Mousterian tools made by Neandertals (black) persist in refugia in Europe and Asia. "Transitional" tools, perhaps made by both kinds of people (purple), also appear at this time.

CREDIT: O. BAR-YOSEF/HARVARD UNIVERSITY

But Did They Mate?

If Neandertals and modern humans lived in close proximity for thousands of years (see main text), the obvious question is, did they mate? Novelists like Jean Auel, with steamy sagas of brute Neandertals and lissome moderns, have tended to answer with a resounding yes. And some scientists agree: "I think that one thing that was going on was sex," says Fred Smith, a paleoanthropologist at Northern Illinois University in DeKalb. But there's no way to track these Paleolithic trysts—unless they created offspring. Thus, for scientists, the possibility of children is the key issue. Successful reproduction would imply that Neandertals and humans were part of the same species and shared a recent evolutionary history. "I'm not interested in whether Neandertals and modern humans had sex, but whether Neandertals contributed genes to modern humans," says geneticist Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany.

But even this seemingly more tractable question is hard to answer. Indeed, the species question is so tricky—and the field of paleoanthropology so divided (see sidebar on p. 1728)—that most researchers avoid it, thus creating some nomenclatural chaos. Paleoanthropologist Milford Wolpoff of the University of Michigan, Ann Arbor, who believes that Neandertals and moderns were members of the same species, advises against using those names (although most anthropologists do), because it "makes them separate." Others, such as Harvard University paleoanthropologist David Pilbeam, suggest simply calling them separate populations.

Whatever you call them, those who think the two groups did indeed mate and bear children cite as evidence a 4-year-old child buried in Lagar Velho, Portugal, about 24,500 years ago. The skeleton, says Joao Zilhão of the Portuguese Institute of Archaeology in Lisbon, is anatomically modern but has features inherited from Neandertal ancestors. The mix of inherited features—short arms and a broad trunk like a Neandertal, but a modern-looking chin and pubic bone—implies that this child was not the result of a chance affair and that Neandertals and moderns interbred extensively for many generations, according to a 1999 report in the *Proceedings of the National Academy of Sciences* (*PNAS*). Or, as *Time* magazine quoted co-author Erik Trinkaus of Washington University in St. Louis: "This is not one Neandertal and one modern human making whoopee in the bushes." If Trinkaus is right, Neandertals disappeared because most of their traits were swamped out when they interbred with modern humans, whose population size was much greater. But other paleoanthropologists doubt that the Portuguese boy is a hybrid. Ian Tattersall of the American Museum of Natural History in New York City and Jeffrey Schwartz of the University of Pittsburgh argued in a commentary in the same issue of *PNAS* that he looks simply like a "chunky" modern human child, "lacking any suggestion of Neandertal morphology."

In the "replacement" view, Neandertals became extinct without fertile offspring. But this debate may never be settled by morphology, partly because there is little consensus on the criteria used to classify Neandertal and early modern human skulls. There is some genetic evidence, however: Studies of the maternally inherited mitochondrial DNA (mtDNA) from three Neandertals show it to be distinctly different from that of living humans, suggesting that Neandertal genes do not survive today and supporting a replacement view (*Cell*, 11 July 1997, p. 19; *Science*, 11 July 1997, p. 176).

But a new genetic study of an anatomically modern man who died 62,000 years ago at Lake Mungo, Australia, raises another possibility, according to a report in January in *PNAS* (*Science*, 12 January, p. 230). The Lake Mungo man apparently possessed a now-extinct lineage of mtDNA, although this has not yet been confirmed in an independent lab, a step most ancient DNA researchers say is essential. But all researchers agree that the man is anatomically modern and therefore might have contributed genes to living people. If a mtDNA sequence present in an ancient modern human could simply become extinct, then something similar could have happened to the mtDNA of Neandertals. "Then the absence of Neandertal mtDNA in living humans does not reject the possibility of some genetic continuity with modern humans," John Relethford of the State University of New York College at Oneonta wrote in *PNAS*.

Further complicating the debate is the lack of any genetic yardstick for species definition and the fact that the variation between Neandertals and modern humans falls within the range of mtDNA variation between subspecies of chimpanzees, says Pääbo, whose lab sequenced the Neandertal mtDNA. Another genetic tack is to examine Cro-Magnon mtDNA to see if these modern humans who lived in Europe in the past 40,000 years are ancestral to living Eurasians. mtDNA has been extracted from two late Cro-Magnons from Gough's Cave in England, but analyses that tie them to recent Europeans have yet to be published in detail, says paleoanthropologist Christopher Stringer of the Natural History Museum in London. In the meantime, barring the discovery of a cave artist's depiction of the event, there is no consensus on whether Neandertals and modern humans mixed it up.

–A.G.

that debate remains one of the fiercest in paleoanthropology (see sidebar on p. 1728). But a new look at archaeological sites throughout the Mediterranean region, as described in two recent books,* shows that the two groups coexisted in Europe for at least several thousand years and took turns occupying the same caves in the Middle East for much longer. Although modern humans had a clear technological and cultural advantage in Europe, they did not rout the Neandertals. There are no signs of war or rapid replacement. So far the evidence suggests that there was plenty of room for both groups for thousands of years, with competition for resources intensifying only as the climate worsened. "It was not a blitzkrieg," says archaeologist Steve Kuhn of the University of Arizona in Tucson. Rather, fossils and artifacts show that Neandertals hung onto prime real estate in Europe before eventually splitting up into retreats in southern Italy, Greece, Iberia, and the hilly Balkans and Caucasus.

Despite—or perhaps because of—the competition, this time of contact apparently stimulated both sides: Neandertals and moderns both reached new heights of cultural achievement, as represented by new styles of stone tools, ivory beads and body ornaments, cave art, and bone carvings (see photos on p. 1727). "When you get these new people moving into Europe, all sorts of cultural excitement is going on," says Fred Smith, a paleoanthropologist at Northern Illinois University in DeKalb. "Both groups are trying out new styles of tools and culture."

There's no doubt, however, that the modern humans' lifestyle quickly surpassed that of the Neandertals. Soon after they arrived in Europe, the modern newcomers made barbed projectile points and bone needles, painted vivid scenes on cave walls, carved animals out of ivory, and adorned themselves with bone pendants. Meanwhile, although some Neandertals experimented with

* O. Bar-Yosef and D. Pilbeam, *The Geography of Neandertals and Modern Humans in Europe and the Greater Mediterranean* (Peabody Museum of Archaeology and Ethnology and Harvard University, Cambridge, Massachusetts, 2000).
C. C. Stringer, R. N. E. Barton, J. C. Finlayson, Eds., *Neanderthals on the Edge: 150th Anniversary Conference of the Forbes' Quarry Discovery, Gibraltar* (Oxbow Books, Oxford, 2000).

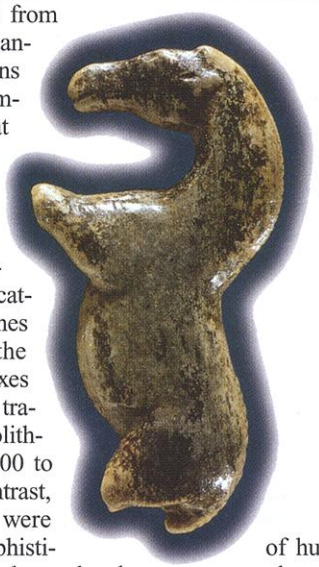
new technologies, they generally continued using much simpler artifacts. "If you look at this coexistence for several millennia, it is striking how limited the influence is on each other," says paleoanthropologist Jean-Jacques Hublin of the University of Bordeaux in France. "It's not like one group was gradually digested by another one. They maintain their own identity for millennia."

Even with more advanced humans nearby, the Neandertals were "quite successful in surviving for quite a long time," says Harvard University archaeologist Ofer Bar-Yosef. "They lost the war, but they were not dummies."

The birth of modern behavior

All this is quite different from the classical view of Neandertals as inferior humans doomed by their innate limitations. Hublin recalls that as a graduate student in the 1970s he was taught a simple story: Neandertals made primitive stone tools, whereas modern humans made more sophisticated ones. Neandertal bones are often found with the thick flakes and hand axes known as the Mousterian tradition of the Middle Paleolithic, the period from 270,000 to 45,000 years ago. By contrast, Cro-Magnon people were found in Europe with sophisticated blades, slender-hafted spearheads and bone tools, and body ornaments that are hallmarks of the Aurignacian tradition of the Upper Paleolithic, the period from 45,000 to 10,000 years ago. The Aurignacian is the first Upper Paleolithic tradition in Western Europe and is famous for its artwork, such as the stunning cave paintings seen in France's Grotte Chauvet (*Science*, 12 February 1999, p. 920), which are often cited as evidence of fully modern behavior. Meanwhile, the Neandertals buried their dead, hunted the same game, and exploited the same small animals and plants as the neighboring modern humans did. But overall they behaved like earlier Neandertals, who had survived the harsh climate of Europe since the onset of the last interglacial 127,000 years ago, relying on physical strength and Mousterian tool kits to survive.

The timing of the transition from simple to sophisticated artifacts coincided with what was then thought to be the disappearance of the Neandertals. So, many anthropologists concluded that the Neandertals in Europe had in fact quickly evolved into the more advanced modern humans, such as Cro-Magnon. This view was supported by tool assemblages that seemed to be "transitional industries" between the Mousterian and Upper Paleolithic. "There was this linear view of human evolution, with Neandertals as the ancestors of modern humans," says Hublin. Now, as he tells his students: "This glorious march of the hominids is completely wrong."



Art nouveau. Châtelperronian ivory ring *(top)* and pierced teeth for pendant *(above)* are advanced but can't rival Aurignacian carved horse.

The first major blow to this long-standing view came in the late 1980s, when the remains of anatomically modern humans from caves at Qafzeh and Skhul in Israel were dated by modern radiometric methods to 92,000 to more than 100,000 years old. That's 40,000 years before Neandertals inhabited the neighboring cave of Kebara, only 100 meters away from Skhul. Clearly, modern people could not have evolved from these Neandertals. And the anatomically modern people here behaved just like the Neandertals—they used the same tool kits, hunted the same wild oxen and deer, and exploited the same small animals and plants. Both groups buried their dead.

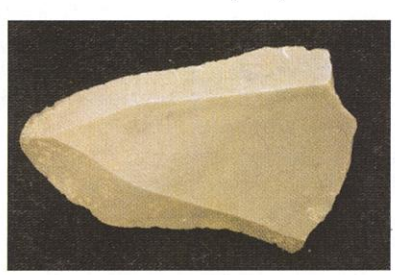
But then, 50,000 to 40,000 years ago, anatomically modern humans began to act modern in many places, first in Africa, then in the Levant and Europe. By 45,000 years ago, modern humans in the Levant had the sophistication to retouch, or correct, the stone points they made to put on the tips of spears. Beads appeared about 42,000 years ago in Africa and southeast Turkey, says Arizona's Kuhn. "We begin to see these so-called transitional industries that combine some old and new features," says Bar-Yosef, who thinks these tools in the Levant are the handiwork of the ancestors of moderns who later brought their techniques to Europe and refined them.

It is in Europe where the technological and cultural revolution reached its height, starting 40,000 years ago when modern humans began to enter the continent from western Asia. Once in Western Europe, they underwent a creative explosion, and suddenly new so-called "transitional" industries came and went. But it was apparently not only the Cro-Magnon whose abilities flourished in Europe at this time: More and more evidence now suggests that the Neandertals advanced, too. "The Aurignacian is widely agreed to be made by moderns," says Harvard University paleoanthropologist David Pilbeam. "At issue is who made the transitional industries."

Transitional tools

All the transitional technologies are close in time to the arrival of modern humans. So if the Neandertals made some of those technologies, it might suggest some sort of response to the modern human invasion, whether direct copying, more subtle imitation—or even a honing of their own abilities in the face of new competition for resources, says Kuhn.

And there is at least one strong case for Neandertal sophistication: the artifacts of the Châtelperronian tradition in France. These are a mix of Mousterian and Upper Paleolithic stone tools and include grooved teeth, bone and shell pendants, beads, and body ornaments. This 35,000- to 40,000-year-old culture was long thought to be the work of modern humans making the transition from Mousterian to Aurigna-



Making their points. Neandertal stone tools (*above*) are distinct from the hafted points of modern humans.

CREDITS: (HORSE) A. MARSHACK; (RING AND ORNAMENTS) J.-J. HUBLIN; (POINTS) O. BAR-YOSEF/HARVARD UNIVERSITY

cian. Then in 1979, Neandertal bones were found in a layer with Châtelperronian tools. Now, says Hublin, it seems Neandertal artisans made Châtelperronian artifacts just about the time that Cro-Magnon people invaded the region. There is fierce debate over whether Neandertals imitated the nearby modern humans or invented this culture independently (*Science*, 20 November 1998, p. 1451). Regardless, the timing implies contact: "It was clear that Neandertals in some spots survived the arrival of modern humans," says Hublin. "They were the makers of some of these transitional industries, not the modern humans."

And some archaeologists now argue that the Châtelperronian is not unique. Other sites in Italy, Greece, and central Europe, where the most complete archaeological trail exists for this time, indicate that Neandertals were not just copycats but were experimenting with more modern tools and behavior. "Everyone believed in the sequence of Mousterian, Châtelperronian, Aurignacian," says archaeologist Janusz Kozlowski of Jagellonian University in Cracow, Poland. "Now we know the transitional technologies are much more rich."

More than 20 different technologies, for example, have been identified in archaeological sites in central Europe. No one knows who made these tools 45,000 to 30,000 years ago, because no diagnostic human remains are associated with them. But Kozlowski argues that at least two of the cultures, the Bohunician and the Szeletian, may have been made by Neandertals. The Bohunician is early—45,000 years ago in Moravia—and the blades, although modern, retain many of the steps from a late Mousterian style of producing flakes from a stone core, combining old methods with new blade production. These ancient people were experimenters: A bit later, they used methods more like those of the Upper Paleolithic to haft blades. "This means these people were able to produce tools according to different sequences of movement," says Kozlowski. "This flexibility shows more complex cognitive abilities."

The other technology with possible Neandertal ties, the Szeletian, was found with a Neandertal mandible in the Szeleta Cave in Hungary. Although that is not proof that Szeletians were Neandertals, the Szeletian may well have been the work of some of the last Neandertals, says Northern Illinois's Smith. And these toolmakers apparently had contact with the Aurignacians. Szeletian tools have been found at Aurignacian sites in Slovakia, and Aurignacian bone points have been found at Szeletian sites, although there is no evidence as to whether the contact was friendly, hostile, or direct.

Retreating south

There are also signs that Neandertals were aware of modern humans' presence in Italy, where three distinct traditions coexisted between 40,000 and 30,000 years ago. The early Aurignacian (characterized by many little bladelets, rather than large blades) appeared in northern Italy almost 37,000 years ago. At that time, the late Mousterian tools began to include more blades, and the Mousterian people—the Neandertals—moved out of northern Italy, says Arizona's Kuhn, who has worked at Italian sites. And another new transitional technology, known as the Uluzzian, appeared in central and southern Italy. There are no diagnostic human remains linked with this culture, but the Uluzzian is completely different from the Aurignacian and at some sites predates it; thus, Kuhn thinks it is the handiwork of Neandertals.

This pattern, of extended coexistence and slow movement south into refuges by the Neandertals, is best documented in Iberia by a trail of Mousterian and Aurignacian tools. The Aurignacian tools appeared

Anthropologists Duel Over Modern Human Origins

LONDON—Chris Stringer carefully lays the wooden box on a long table cluttered with scientific journals. He unfastens the latch, opens the top, and gingerly lifts out a human skull that is perhaps 400,000 years old. As Stringer gently turns the cranium in his hands, its appearance is startling. The flat, nearly vertical midface and large brain cavity could almost be mistaken for those of a modern human. Yet above the eyes, heavy browridges and a sharply receding forehead distinctly recall *Homo erectus*, a long-extinct early human. "It's modern, and yet not modern," Stringer tells a visitor to his office at London's Natural History Museum.

The paradox of fossils like this one from Broken Hill, Zambia, with its mixture of ancient and modern traits, has sparked one of the most bitter and longest running battles in paleoanthropology. Stringer is a leading proponent of what many consider the dominant theory—that humans with such transitional features belonged to transitional species, in this case one often called *Homo heidelbergensis*. According to how Stringer reads the fossil record, an unbroken evolutionary chain in Africa may link this species to modern humans, who then swept around the globe, replacing already-settled human populations such as the Neandertals in Europe (see main text) and perhaps even *H. erectus* in Asia.

But although this "Out of Africa" scenario is established in many media and textbook accounts, a staunch band of skeptics, led by paleoanthropologist Milford Wolpoff of the University of Michigan, Ann Arbor, holds to an opposing theory called multiregional evolution. In this view, the evolution of modern humans has been occurring across the globe since early humans left Africa nearly 2 million years ago. Thanks to continuous exchanges of genes among populations in different regions, humans have always belonged to one species and have evolved together into today's modern form. For Wolpoff, there is no such thing as "*H. heidelbergensis*": Such a mix of modern and ancient features reflects normal variation within a species. Nor does Wolpoff concede that his view is in the minority. "I think paleoanthropologists are split right down the middle on this," he says.

Close kin? Milford Wolpoff thinks that the ancestors of modern humans included European Neandertals like his reconstructed companion.

CREDIT: PAUL JARONSKI/UM PHOTO SERVICES

As leaders of two irreconcilable scientific camps, Stringer, 53, and Wolpoff, 58, have come to personify this bitter debate. And indeed, the argument has often become personal. "Milford and I have had some nasty exchanges," Stringer admits. In one 1989 article, Wolpoff ridiculed the idea that modern humans had replaced Neandertals as a "scientific rendering of the story of Cain," adding that this scenario's "violent" implications were "not pleasant." And Stringer, in his 1996 book *African Exodus*, co-written with Robin McKie of the London-based *Observer* newspaper, countered that "attention to inconvenient details has never been part of the Wolpoff style of rhetoric." The last straw, Wolpoff says, was a 1997 opinion piece in *The New York Times* cosigned by Stringer and McKie. The article contended that a

at about 36,500 years ago and coexisted with Mousterian artifacts for some time. But the Mousterian tools persisted in Iberia—and are even associated with Neandertal remains in Columbeira and Figueira Brava near Lisbon—until 30,000 to 28,000 years ago, making Iberia one of the last Neandertal holdouts, says archaeologist Joao Zilhão of the Portuguese Institute of Archaeology in Lisbon.

The record from these far-flung sites taken together suggests that the replacement of the Neandertals was slow (see map on p. 1725). At first, they remained entrenched in their homelands, but eventually they moved into southern Italy and Iberia and into the Balkan and Caucasus mountains. Something—either modern humans coming from the north or a climatic cooling during this time—prompted them to give up their "home field advantage," says Kuhn. "When the new people got there and started eating the same foods, life became a little more uncertain; there was a little competition for who got the game first." And he thinks that competition for resources—not necessarily direct contact—could have spurred the Neandertals, who had been living the same way for millennia, to make changes: "I think that when times got hard, Neandertals came up with better tools. It shows what they were capable of when you pushed them."

This competition, says Kuhn, may have inspired changes in "the other guys, too"—modern humans. "Suddenly, they ran into these really intransigent locals. It would have affected them, too," says Kuhn. He notes that the most complex Paleolithic art and culture appeared only in Europe, although modern humans emerged earlier in Africa, the Middle East, and Australia. He speculates that this flowering of culture was in part a reaction to competition with another kind of human.

Eventually, the Neandertals disappeared, perhaps because they were unable to rebound when the climate turned frigid starting 28,000 years ago and competition for prime land became harsher, speculates Bordeaux's Hublin. Moderns had some subtle advantage—perhaps slightly better language or abstract reasoning skills, or even a shorter interval between births of babies—that meant the difference between survival and extinction, say Pilbeam and Bar-Yosef.

But not everyone is buying the idea of a long coexistence, with Neandertals as resourceful experimenters. Stanford archaeologist Richard Klein, for example, says that most Neandertals simply couldn't match the symbolic sophistication of the moderns. He considers the Châtelperronian "the only compelling indication of overlap" between moderns and Neandertals. And he warns that many of the sites of the "transitional technologies" and of the latest persistence of Neandertals have dating problems. The period from 60,000 to 30,000 years ago is at the limits of radiocarbon dating, so the resulting dates can easily be skewed by tiny amounts of recent carbon contamination and cause errors spanning 5000 to 40,000 years—enough to make it seem that Neandertals and moderns coexisted far longer than they really did.

Bar-Yosef responds that dates from dozens of sites show "a clear geographic pattern" indicating long periods of overlap. "If you go one by one, you can find problems with individual dates, but the general trend isn't going to change," he says. Nonetheless, he agrees that an international effort to redate key sites is needed to nail down precisely when this last transition from one type of human to another took place. "What happened with these two populations happened over and over again," notes Pilbeam. "It's just that this interaction was recent enough that we are able to detect it."

–ANN GIBBONS

recent African origin implies that racial differences are superficial and that "we are indeed all Africans under the skin." On the other hand, it concluded, "some scientists and those with narrow political agendas have put forward arguments to sustain the idea that races exist with fundamental biological differences." Wolpoff believes the article implied that his views make him a racist and says he has "not been on speaking terms with Stringer" ever since. (Stringer says the article was aimed at right-wing organizations, not Wolpoff.)

Yet despite their acrimonious disagreements, there are interesting parallels in the routes the men took to opposite conclusions. Both trace their interest in fossils to early childhood. As a youngster, Stringer often visited London's Natural History Museum, and Wolpoff says he was "astounded" to learn in college that "there was actually a profession" devoted to this hobby. While a graduate student at the University of Bristol in the early 1970s, Stringer spent 4 months traveling through Europe in an old Morris Minor, examining fossil skulls in museums across the continent. The data he gathered, including measurements of a nearly modern skull from North Africa, led him to question then-popular notions that Neandertals were our ancestors. Meanwhile, after receiving his Ph.D. from the University of Illinois, Urbana-Champaign, in 1969, Wolpoff took off on his own series of fossil tours, visiting Africa, Asia, and Australia. He began to develop his ideas about multiregional evolution, he says, when he realized that humans from Asia and Australia had retained some traits over several hundred thousand years, even as other features changed. "Asian features are found at all time periods," he says. For example, skulls from China always have small, forward-facing cheeks, flat noses, and very little facial projection, whereas ancient skulls from Australia are "robust and prognathic" with "huge cheeks" that he says are reflected in the features of some living Australian Aborigines.

African advocate. Chris Stringer argues that modern humans descended from Africans like this fossil hominid from Zambia.

CREDIT: KAMPFNER PHOTOGRAPHY/KAMPFNER.COM

Despite the sometimes heated argument, admirers of both Stringer and Wolpoff insist that each man bases his views on science. Stringer "has always tried to convince by scientific results," says paleoanthropologist Günter Bräuer of the University of Hamburg in Germany, an early proponent of the Out of Africa theory. And biological anthropologist John Relethford of the State University of New York College at Oneonta, who has often questioned the Out of Africa camp's genetic evidence, says that Wolpoff "has studied virtually every [fossil]. ... He has a keen sense of variation across time and space."

Yet it seems unlikely that either side will convince the other anytime soon. Two months ago, the multiregionalists mustered both genetic and fossil evidence that they say bolsters the case for continuous evolution (*Science*, 12 January, pp. 230 and 231). Wolpoff says he thinks the argument will go on until he, Stringer, and other members of the opposing camps retire. "Then you will know how the debate turned out, by seeing what the new generation thinks." As for why the debate has become so emotional, Stringer says: "Scientists show the same frailties as the rest of the human species, especially when talking about our own origins."

–MICHAEL BALTER