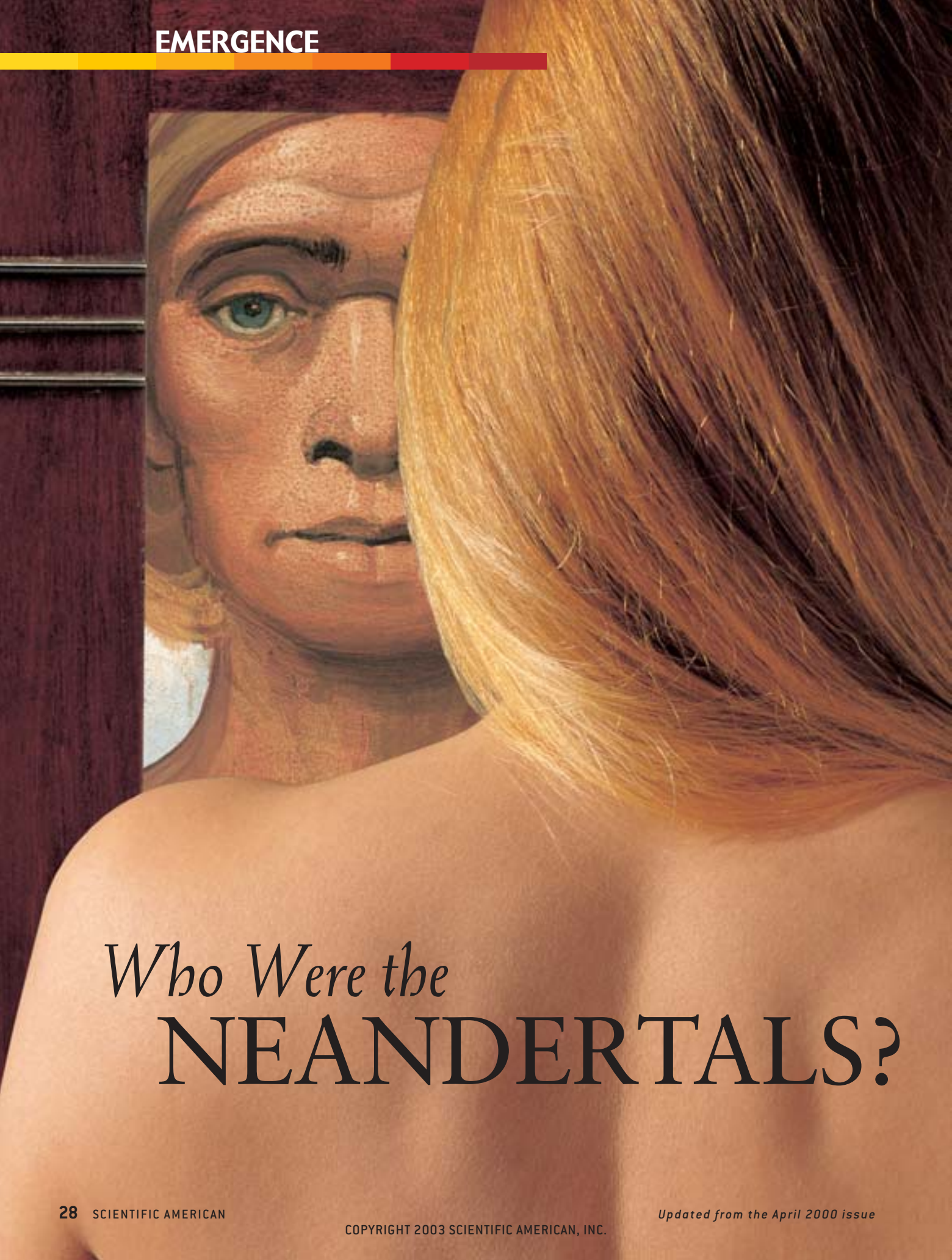

Who Were the NEANDERTALS?

Updated from the April 2000 issue

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Controversial evidence indicates that these hominids interbred with anatomically modern humans and sometimes behaved in surprisingly modern ways

By Kate Wong

REFLECTION OF THE PAST reveals a face that is at once familiar and foreign. The 130,000-year-old skull of an adult female from the Krapina rock-shelter in northwestern Croatia inspired this Neandertal reconstruction.

CROATIAN NATURAL HISTORY MUSEUM

It was such a neat and tidy story.

No match for the anatomically modern humans who swept in with a sophisticated culture and technology, the Neandertals—a separate species—were quickly driven to extinction by the invading moderns. But neat and tidy stories about the past have a way of unraveling, and the saga of the Neandertals, it appears, is no exception. For more than 200,000 years, these large-brained hominids occupied Europe and western Asia, battling the bitter cold of glacial maximums and the daily perils of prehistoric life. Today they no longer exist. Beyond these two facts, however, researchers fiercely debate who the Neandertals were, how they lived and exactly what happened to them.

The steadfast effort to resolve these elusive issues stems from a larger dispute over how modern humans evolved. Some researchers posit that our species arose recently (around 200,000 years ago) in Africa and subsequently replaced archaic hominids around the world, whereas others propose that these ancient populations contributed to the early modern human gene pool. As the best known of these archaic groups, Neandertals are critical to the origins controversy. Yet this is more than an academic argument over certain events of our primeval past, for in probing Neandertal biology and behavior, researchers must wrestle with the very notion of what it means to be fully human and determine what, if anything, makes us moderns unique. Indeed, spurred by recent discoveries, paleoanthropologists and archaeologists are increasingly asking, How much like us were they?

Comparisons of Neandertals and modern humans first captured the attention of researchers when a partial Neandertal skeleton turned up in Germany's Neander Valley in 1856. Those remains—a heavily built skull with the signature arched browridge and massive limb bones—were clearly different, and Neandertals were assigned to their own species, *Homo neanderthalensis* (although even then there was disagreement: several German scientists argued that these were the remains of a crippled Cossack horseman). But it was the French discovery of the famous "Old Man" of La Chapelle-aux-Saints some 50 years later that led to the characterization of Neandertals as primitive protohumans. Reconstructions showed them as stooped, lumbering, apelike brutes, in stark contrast to upright, graceful *Homo sapiens*. The Neandertal, it seemed, represented the ultimate "other," a dim-witted ogre lurking behind the evolutionary threshold of humanity.

Decades later reevaluation of the La Chapelle individual revealed that certain anatomical features had been misinterpreted. In fact, Neandertal posture and movement would have been the same as ours. Since then, paleoanthropologists have struggled to determine whether the morphological features that do characterize Neandertals as a group—such as the robustness of their skeletons, their short limbs and barrel chests, prominent browridges and low, sloping foreheads, protruding midfaces and chinless jaws—warrant designating them as a separate species. Researchers agree that some of these characteristics represent environmental adaptations. The Neandertals' stocky body proportions, for example, would have allowed them to retain heat more effectively in the extremely cold weather brought on by glacial cycles. But other traits, such as the form of the Neander-

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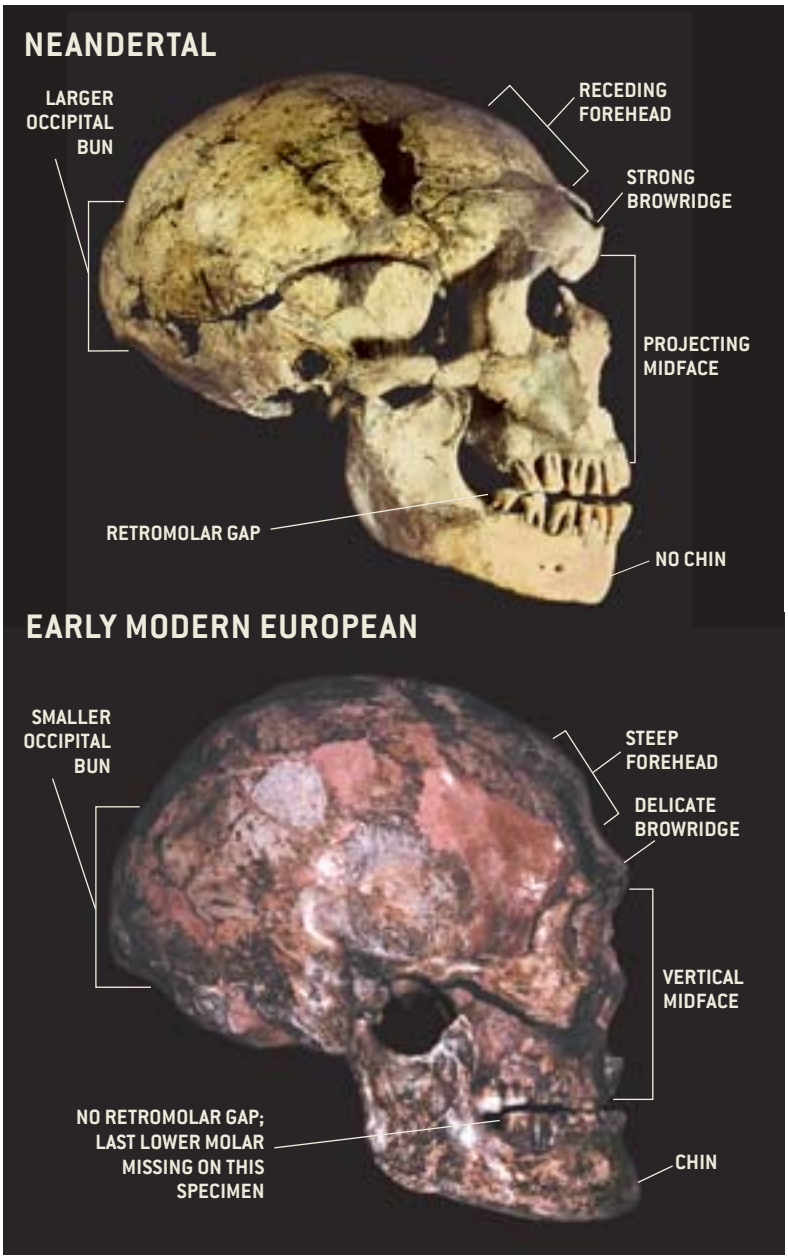

CHARACTERISTIC DIFFERENCES are shown between a Neandertal, represented by a French specimen, La Ferrassie 1, and an early modern, Dolní Věstonice 16, from the Czech Republic. Each aspect can be found in both groups, varying in degree and frequency, but they tend to appear as suites of features.

tal browridge, lack any clear functional significance and seem to reflect the genetic drift typical of isolated populations.

For those scholars who subscribe to the replacement model of modern human origins, the distinctive Neandertal morphology resulted from following an evolutionary trajectory separate from that of moderns. But for years, another faction of researchers has challenged this interpretation, arguing that many of the features that characterize Neandertals are also seen in the early modern Europeans that followed them. "They clearly have a suite of features that are, overall, different, but it's a frequency difference, not an absolute difference," contends David W. Frayer, a paleoanthropologist at the University of Kansas. "Virtually everything you can find in Neandertals you can find elsewhere."

He points to one of the earliest-known modern Europeans, a fossil from a site in southwestern Germany called Vogelherd, which combines the skull shape of moderns with features that are typically Neandertal, such as the distinct space between the last molar and the ascending part of the lower jaw known as a retromolar gap, and the form of the mandibular foramen—a nerve canal in the lower jaw. Additional evidence, according to Frayer and Milford H. Wolpoff of the University of Michigan at Ann Arbor, comes from a group of early moderns discovered in Moravia (Czech Republic) at a site called Mladeč. The Mladeč people, they say, exhibit characteristics on their skulls that other scientists have described as uniquely Neandertal traits.

Although such evidence was once used to argue that Neandertals could have independently evolved into modern Europeans, this view has shifted somewhat. "It's quite clear that people entered Europe as well, so the people that are there later in time are a mix of Neandertals and those populations coming into Europe," says Wolpoff, who believes the two groups differed only as much as living Europeans and aboriginal Australians do. Evidence for mixing also appears in later Neandertal fossils, according to Fred H. Smith, a paleoanthropologist at Loyola University of Chicago. Neandertal remains from Vindija cave in northwestern Croatia reflect "the assimilation of some early modern features," he says, referring to their more modern-shaped browridges and the slight presence of a chin on their mandibles.

Those who view Neandertals as a separate species, however, maintain that the Vindija fossils are too fragmentary to be diagnostic and that any similarities that do exist can be attributed to convergent evolution. These researchers likewise dismiss the mixing argument for the early moderns from Mladeč. "When I look at the morphology of these people, I see robustness, I don't see Neandertal," counters Christopher B. Stringer of the Natural History Museum in London.

Another reason to doubt these claims for interbreeding, some scientists say, is that they contradict the conclusions reached by Svante Pääbo, now at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, and his colleagues, who in July 1997 announced that they had retrieved and analyzed mitochondrial DNA (mtDNA) from a Neandertal fossil. The cover of the journal *Cell,* which contained their report, was unequivocal: "Neandertals Were Not Our Ancestors." From the short stretch of mtDNA they sequenced, the researchers determined that the difference between the Neandertal mtDNA and living moderns' mtDNA was considerably greater than the differences found among living human populations. But though it seemed on the surface that the species question had been answered, undercurrents of doubt have persisted [see "Ancestral Quandary," by

ERIK TRINKAUS/MUSÉE DE L'HOMME (*top*); ARCHEOLOGICKÝ ÚSTAV AVČR (*bottom*)

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Kate Wong, News and Analysis, January 1998]. Since then, mtDNA from three more specimens has been retrieved and analyzed, with similarly inconclusive results.

Recent fossil evidence from western Europe has intensified interest in whether Neandertals and moderns mixed. In January 1999 researchers announced the discovery in central Portugal's Lapedo Valley of a largely complete skeleton from a four-year-old child buried 24,500 years ago in the Gravettian style known from other early modern Europeans. According to Erik Trinkaus of Washington University, Cidália Duarte of the Portuguese Institute of Archaeology in Lisbon and their colleagues, the specimen, known as Lagar Velho 1, bears a combination of Neandertal and modern human traits that could only have resulted from extensive interbreeding between the two populations [see "The Hybrid Child from Portugal," on the next page].

If the mixed-ancestry interpretation for Lagar Velho 1 holds up after further scrutiny, the notion of Neandertals as a variant of our species will gain new strength. Advocates of the

GUIDE TO TERMINOLOGY

Neandertal can also be spelled Neanderthal. Around 1900 German orthography changed, and the silent "h" in certain words, such as "thal" (meaning "valley"), was dropped. The designation *Homo neanderthalensis* remains the same, but the common name can be spelled either way.

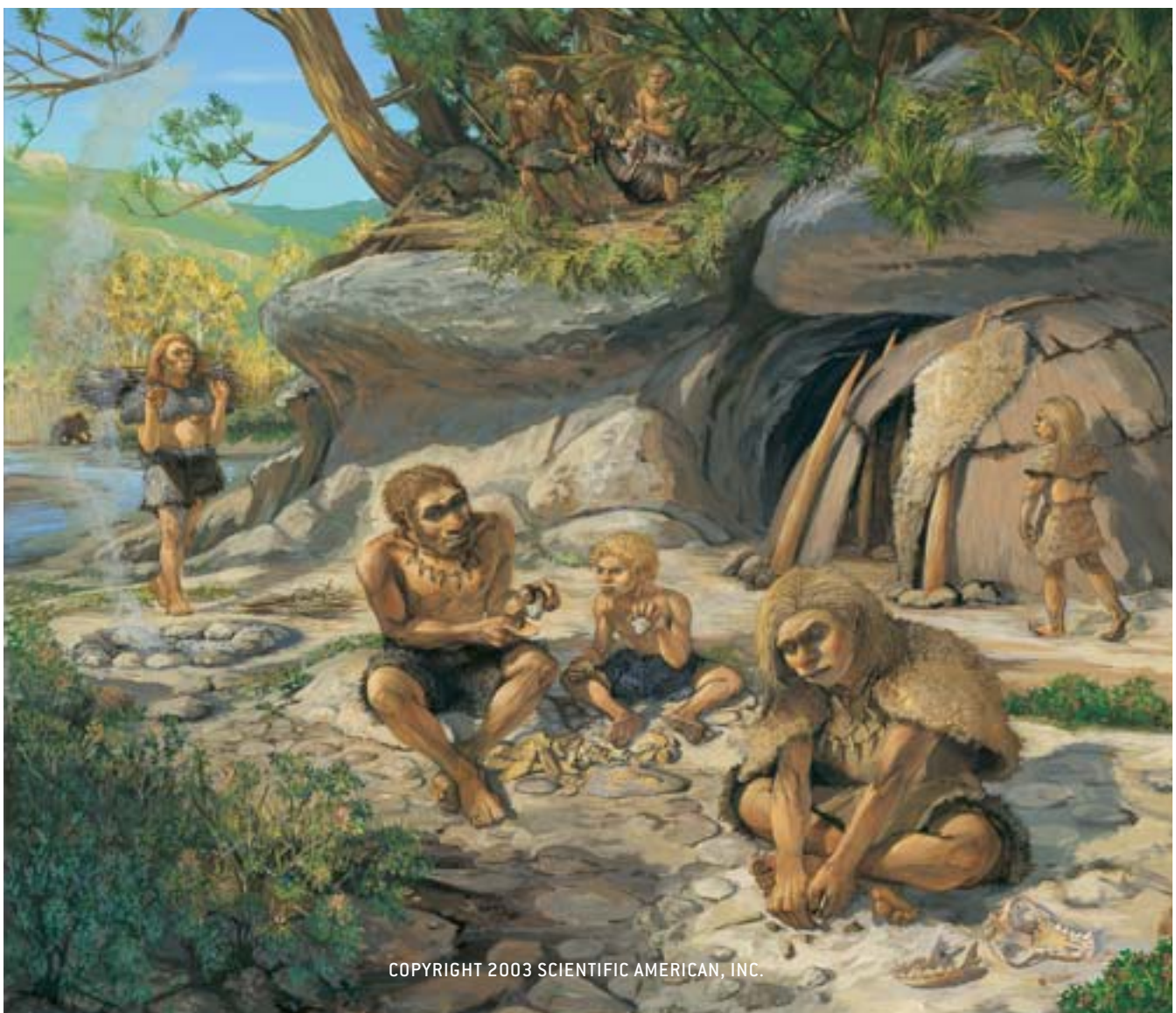
Paleolithic, or Old Stone Age, is the period ranging from the beginning of culture to the end of the last glaciation. It is subdivided into Lower, Middle and Upper stages.

Mousterian is a Middle Paleolithic stone tool–based cultural tradition associated with Neandertals and with early moderns in the Near East.

Aurignacian is an Upper Paleolithic cultural tradition associated with moderns that includes advanced tools and art objects.

Châtelperronian is an Upper Paleolithic cultural tradition associated with Neandertals. It resembles both the Mousterian and the Aurignacian.

DAY IN THE LIFE of Neandertals at the Grotte du Renne in France is imagined here. The Châtelperronian stratigraphic levels have yielded a trove of pendants and advanced bone and stone tools. Such items, along with evidence of huts and hearths, were once linked to modern humans alone, but the Grotte du Renne remains suggest that some Neandertals were similarly industrious.



MICHAEL ROTHMAN

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THE HYBRID CHILD FROM PORTUGAL

BY ERIK TRINKAUS AND CIDÁLIA DUARTE

ON A CHILLY AFTERNOON in late November 1998, while inspecting the Abrigo do Lagar Velho rock-shelter in central Portugal's Lapedo Valley, two archaeology scouts spotted loose sediment in a rodent hole along the shelter's back wall. Knowing that burrowing animals often bring deeper materials to the surface, one of the scouts reached in to see what might have been unearthed. When he withdrew his hand, he held in it something extraordinary: bones of a human child buried nearly 25,000 years ago.

Subsequent excavation of the burial, led by one of us (Duarte), revealed that the four-year-old had been ceremonially interred—covered with red ocher and laid on a bed of burnt vegetation, along with pierced deer teeth and a marine shell—in the Gravettian style known from modern humans of that time across Europe. Based on the abrupt cultural transition seen in archaeological remains from the Iberian Peninsula, it seemed likely that when moderns moved into the area after 30,000 years ago, they rapidly replaced the native Neandertals. So it stood to reason that this specimen, called Lagar Velho 1, represented an early modern child. In fact, it didn't occur to us at first that it could be anything else.

This wonderfully complete skeleton does have a suite of features that align it predominantly with early modern Europeans. These include a prominent chin and other details of the mandible (lower jaw), small front teeth, a short face, the nose shape, minimal brow development, muscle markings on the thumb bone, the narrowness of the front of the pelvis, and several aspects of the shoulder blade and forearm bones.

Yet intriguingly, a number of features also suggest certain Neandertal affinities. Specifically, the front of the mandible slopes backward despite the chin, there is a porous depression above the neck muscles, the pectoral muscles are strongly developed, and the lower legs are short and stout. Thus, the Lagar Velho child exhibits a complex mosaic of Neandertal and early modern human features.

This anatomical amalgam is not the result of any abnormalities. Taking normal human growth patterns into consideration, our analysis indicates that except for a bruised forearm, a couple of lines on the bones indicating times when growth was trivially arrested (by sickness or lack of food) and the fact that it died as a child, Lagar Velho 1 developed normally. The combination can only have resulted from a mixed ancestry—something that had not been previously documented for western Europe. We therefore conclude that Lagar Velho 1 resulted from interbreeding between indigenous Iberian Neandertals and early modern humans dispersing throughout Iberia sometime after 30,000 years ago. Because the child lived several millennia after Neandertals are thought to have disappeared, its anatomy probably reflects a true mixing of these populations during the period when they coexisted and not a rare chance mating between a Neandertal and an early modern human.

Fieldwork conducted in 1999 yielded major pieces of the skull and most of the remaining teeth. An international team then assembled to fully interpret this remarkable specimen. Aside from detailed comparative analyses of individual portions of the skeleton, all the remains were CT scanned and a virtual, computer-assisted reconstruction of the skull was undertaken.

Such rigorous technological study is

MORPHOLOGICAL MOSAIC found on this 24,500-year-old skeleton from Portugal indicates that Neandertals and modern humans are members of the same species who interbred freely. The child—called Lagar Velho 1—is modern overall but bears some Neandertal traits, such as short lower-limb bones and a backward-sloping mandible.

replacement model do allow for isolated instances of interbreeding between moderns and the archaic species, because some other closely related mammal species interbreed on occasion. But unlike central and eastern European specimens that are said to show a combination of features, the Portuguese child dates to a time when Neandertals are no longer thought to have existed. For Neandertal features to have persisted thousands of years after those people disappeared, Trinkaus and Duarte say, coexisting populations of Neandertals and moderns must have mixed significantly.

Their interpretation has not gone unchallenged. In a commentary accompanying the team's report in the *Proceedings of the National Academy of Sciences USA* in June 1999, paleoanthropologists Ian Tattersall of the American Museum of Natural History in New York City and Jeffrey H. Schwartz of the University of Pittsburgh argued that Lagar Velho 1 is most likely "a chunky Gravettian child." The robust body proportions that Trinkaus and his colleagues view as evidence for Neandertal ancestry, Stringer says, might reflect adaptation to Portugal's then cold climate. But this interpretation is problematic, according to Jean-Jacques Hublin of France's CNRS, who points out that although some cold-adapted moderns exhibit such proportions, none are known from that period in Europe. For his part, Hublin is troubled that Lagar Velho 1 represents a child, noting that "we do not know anything about the variation in children of a given age in this range of time."

Survival Skills

TAXONOMIC ISSUES ASIDE, much research has focused on Neandertal behavior, which remained largely misunderstood until relatively recently. Neandertals were often portrayed as incapable of hunting or planning ahead, recalls archaeologist John J. Shea of the State University of New York at Stony Brook. "We've got reconstructions of Neandertals as people who couldn't survive a single winter, let alone a quarter of a million years in the worst environments in which humans ever lived," he observes. Analysis of animal remains from the Croatian site of Krapina, however, indicates that Neandertals were

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necessary because the discovery of an individual with such a mosaic of features has profound implications. First, it rejects the extreme Out of Africa model of modern human emergence, which proposes that early moderns originating in Africa subsequently displaced all archaic humans in other regions. Instead the Lagar Velho child's anatomy supports a scenario that combines a dispersal of anatomically modern humans out of Africa with mixing between that population and the archaic populations it encountered. (For example, the African ancestry of early modern Europeans is reflected in their relatively long lower-leg bones, a tropical adaptation. Lagar Velho 1, however, has the short shins of the cold-adapted Neandertals.)

Lagar Velho 1 also provides insights into the behavioral similarities of Neandertals and early modern humans. Despite the paleontological evidence indicating anatomical differences between these two groups, their overall adaptive patterns, social behaviors and means of communication (including language) cannot have contrasted greatly. To their contemporaries, the Neandertals were just another group of Pleistocene hunter-gatherers, fully as human as themselves.

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CIDÁLIA DUARTE is a researcher at the Portuguese Institute of Archaeology in Lisbon.

skilled hunters capable of killing even large animals such as rhinoceroses, according to University of Cambridge archaeologist Preston T. Miracle. And Shea's studies suggest that some Neandertals employed sophisticated stone-tipped spears to conquer their quarry—a finding supported in 1999, when researchers reported the discovery in Syria of a Neandertal-made stone point lodged in a neckbone of a prehistoric wild ass. Moreover, additional research conducted by Shea and investigations carried out by University of Arizona archaeologists Mary C. Stiner and Steven L. Kuhn have shown that Neandertal subsistence strategies varied widely with the environment and the changing seasons.

Such demonstrations refute the notion that Neandertals perished because they could not adapt. But it may be that moderns were better at it. One popular theory posits that modern humans held some cognitive advantage over Neandertals, perhaps a capacity for the most human trait of all: symbolic thought, including language. Explanations such as this one arose from observations that after 40,000 years ago, whereas Neandertal culture remained relatively static, that of modern Europeans boasted a bevy of new features, many of them symbolic. It appeared that only moderns performed elaborate burials, expressed themselves through body ornaments, figurines and cave paintings, and crafted complex bone and antler tools—an industry broadly referred to as Upper Paleolithic. Neandertal assemblages, in contrast, contained only Middle Paleolithic stone tools made in the Mousterian style.

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A CASE FOR NEANDERTAL CULTURE

BY JOÃO ZILHÃO AND FRANCESCO D'ERRICO

EVER SINCE THE DISCOVERY nearly 150 years ago of the specimen that defined the Neandertals, researchers have tended to deny Neandertals the behavioral capabilities of modern humans, such as the use of symbols or of complex techniques for tool manufacture. Instead Neandertals were characterized as subhuman, stuck in primitive technical traditions impervious to innovation. And when sophisticated cultural remains were linked to late Neandertals at several sites in western Europe, the evidence was explained away. The most spectacular of these sites, a cave in north-central France named Grotte du Renne (one in a string of sites collectively known as the Arcy-sur-Cure caves), yielded a wealth of complex bone and stone tools, body ornaments and decorated objects, found in association with Neandertal remains. Other sites in France and along the Cantabrian and Pyrenean mountain ranges bore similar artifacts made in this tradition, called the Châtelperronian.

Because early modern Europeans had a comparable industry known as Aurignacian—which often appears at the same sites that contain Châtelperronian materials—some researchers have suggested that the archaeological layers were disrupted, mixing Aurignacian artifacts into the Neandertal-associated levels. Other scholars have interpreted this to mean that Neandertals picked up these ideas from moderns, either collecting or trading for items manufactured by moderns or imitating the newcomers' practices without really grasping the underlying symbolic nature of some of the objects.

Our reassessment of the evidence from the Grotte du Renne shows that the Neandertal-associated ornaments and tools found there did not result from a mixing of the strata, as demonstrated by the presence of finished objects and the by-products of their manufacture in the same stratigraphic level. Moreover, the Châtelperronian artifacts recovered at the Grotte du Renne and other sites, such as Quinçay, in the Poitou-Charentes region of France, were created using techniques different from those favored by Aurignacians. With regard, for example, to the pendants—modified bear, wolf and deer teeth, among others—Neandertals carved a furrow around the tooth root so that a string of some sort could be tied around it for suspension, whereas Aurignacians pierced their pendants. As archaeologist François Lévêque and a colleague have described, even when, as they did on occasion, Neandertals put a hole through a tooth, they took an unusual approach, puncturing the tooth. Moderns preferred to scrape the tooth thin and then pierce it.

Similarly, the new knapping techniques and tool types that appear among late Neandertals at other sites in France, Italy and Spain fail to show any influence from the Aurignacian. Instead they maintain affinities with the preceding local traditions, of which they seem to represent an autonomous development.

If the Neandertals' Châtelperronian culture was an outcome of contact with moderns, then the Aurignacian should predate the Châtelperronian. Yet our reanalysis of the radiometric dates for the archaeological sequences reveals that apart from a few debatable instances of mixture, wherever both cultures are

Yet hints that Neandertals thought symbolically had popped up. Neandertal burials, for example, are well known across Europe, and several, it has been argued, contain grave goods. (Other researchers maintain that for Neandertals, interment merely constituted a way of concealing the decomposing body, which might have attracted unwelcome predators. They view the purported grave goods as miscellaneous objects that happened to be swept into the grave.) Evidence for art, in the form of isolated pierced teeth and engraved bone fragments, and red and yellow ocher, has been reported from a few sites, too, but given their relative rarity, researchers tend to assign alternative explanations to these items.

The possibility that Neandertals might have engaged in modern practices was taken more seriously in 1980, when researchers reported a Neandertal from the Saint-Césaire rock-shelter in Charente-Maritime, France, found along with stone tools manufactured according to a cultural tradition known as the Châtelperronian, which was assumed to have been the handiwork of moderns. Then, in 1996, Hublin and his co-workers made a startling announcement. Excavations that began in the 1940s at the Grotte du Renne at Arcy-sur-Cure near Auxerre, France, had yielded numerous blades, body ornaments and bone tools and revealed evidence of huts and hearths—all hallmarks of the Upper Paleolithic. The scant human remains found amid the artifacts were impossible to identify initially, but using computed tomography to examine the hidden inner-ear region preserved inside an otherwise uninformative skull fragment, Hublin's team identified the specimen as Neandertal.

In response, a number of scientists suggested that Neandertals had acquired the modern-looking items by stealing them, collecting artifacts discarded by moderns or perhaps trading for them. But this view has come under fire, most recently from archaeologists Francesco d'Errico of the University of Bordeaux and João Zilhão of the University of Lisbon, who argue that the

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represented at the same site, the Châtelperronian always underlies the Aurignacian, suggesting its priority. Furthermore, consideration of the hundreds of datings available from this period in Europe and the Near East shows that wherever the context of the dated samples is well known, the earliest occurrences of the Aurignacian are apparently from no earlier than around 36,500 years ago. The same radiometric data, however, indicate that by then Neandertals were already moving toward modernity on their own. In other words, the Châtelperronian and other late Neandertal cultures, such as the Uluzzian of Italy, emerged in Europe around 40,000 years ago, long before any moderns established themselves in those areas.

That this autonomous development included the manufacture and use of symbolic objects created for visual display on the body, as are often observed in traditional societies, reflects various social roles within Neandertal cultures. Thus, "modern" behavior seems to have emerged in different regions and among different groups of humans, as would happen later in history with the invention of agriculture, writing and state society.

An alternative explanation, taking into account the broadly simultaneous appearance of personal ornaments in many parts of the Old World, is that contacts between modern and archaic humans challenged each group's personal, social and biological identities, igniting an explosion of production of symbolic objects by all those involved. On the strength of the available data, however, we favor the hypothesis of independent invention.

Regardless of which is eventually proved correct, the behavioral barrier that seemed to separate moderns from Neandertals and gave us the impression of being a unique and particularly gifted human type—the ability to produce symbolic cultures—has definitively collapsed.

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FRANCESCO D'ERRICO is a CNRS researcher at the Institute of Prehistory and Quaternary Geology, University of Bordeaux, in France.

PENDANTS, BONE TOOLS AND KNIVES from the Grotte du Renne site seem to be the handiwork of Neandertals. That the advanced items underlie early modern human cultural remains from the same site and are manufactured according to methods different from those favored by the moderns suggests that some Neandertals independently developed a modern culture.

COURTESY OF DOMINIQUE BAFFIER (*left and right panels*), FROM "LES DERNIERS NÉANDERTALIENS," LA MAISON DES ROCHES, 1999; FRANCESCO D'ERRICO (*center panel*)

Châtelperronian artifacts at the Grotte du Renne and elsewhere, though superficially similar to those from the Aurignacian, reflect an older, different method of manufacture [see "A Case for Neandertal Culture," above].

Most researchers are now convinced that Neandertals manufactured the Châtelperronian tools and ornaments, but what prompted this change after hundreds of thousands of years is unclear. Cast in this light, "it's more economical to see that as a result of imitation or acculturation from modern humans than to assume that Neandertals invented it for themselves," reasons Cambridge archaeologist Paul A. Mellars. "It would be an extraordinary coincidence if they invented all these things shortly before the modern humans doing the same things arrived." Furthermore, Mellars disagrees with d'Errico and Zilhão's proposed order of events. "The dating evidence proves to me that [Neandertals] only started to do these things after the modern humans had arrived in western Europe or at least in northern Spain," he asserts. Unfortunately, because scientists have been unable to date these sites with sufficient precision, researchers can interpret the data differently.

From his own work on the Grotte du Renne body ornaments, New York University archaeologist Randall White argues that these artifacts reflect manufacturing methods known—albeit at lower frequencies—from Aurignacian ornaments. Given the complicated stratigraphy of the Grotte du Renne site, the modern-looking items might have come from overlying Aurignacian levels. But more important, according to White, the Châtelperronian does not exist outside of France, Belgium, Italy and northern Spain. Once you look at the Upper Paleolithic from a pan-European perspective, he says, "the Châtelperronian becomes post-Aurignacian by a long shot."

Still, post-Aurignacian does not necessarily mean after contact with moderns. The earliest Aurignacian sites do not in-

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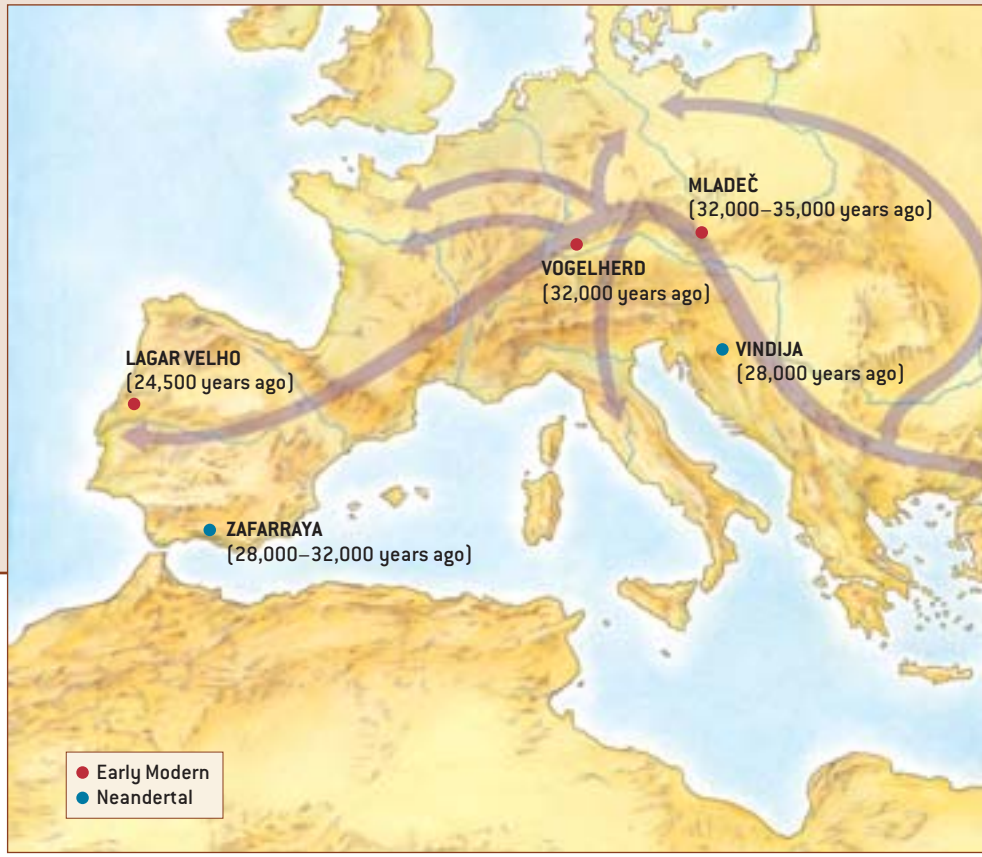
THE FATE OF THE NEANDERTALS

BY FRED H. SMITH

STRONG EVIDENCE has accumulated in recent years that the emergence of modern humans in Europe resulted largely from the immigration of peoples into the continent, probably from the Near East, starting sometime between 40,000 and 30,000 years ago. Most researchers envisioned these early modern populations as having moved into Anatolia and the Balkans, then up through the plains and valleys of central Europe, and finally into northern and western Europe. Meanwhile the indigenous Neandertals, it was thought, were systematically pushed into more peripheral and undesirable parts of the landscape by these expanding populations of moderns. The Neandertals' last bastion appeared to have been the Iberian Peninsula, where fossils from a Spanish site called Zafarraya have been dated to 32,000 years ago and tools attributed to Neandertals have been dated to around 28,000 years ago. A number of scholars argued that after this time no traces of Neandertals remained in Europe and that the Neandertals did not make any biological contributions to early modern humans. It seemed that the Neandertals were sent into complete extinction by a superior human species—us.

Evidence from an important site in northwestern Croatia calls aspects of this conventional wisdom into question. By performing accelerator mass spectrometry dating directly on two Neandertal specimens from Vindija cave, my colleagues and I have demonstrated that Neandertals were living in some of the most desirable real estate in central Europe as late as 28,000 years ago. These dates, the most recent known for Neandertal fossils, show that these humans were not quickly relegated to the periphery; they competed quite well with intruding modern populations for a long time.

This overlap of Neandertal and early modern peoples for several millennia in the heart of Europe allowed considerable



clude any human remains. Researchers have assumed that they belonged to moderns because moderns are known from younger Aurignacian sites. But "who the Aurignacians were biologically between 40,000 and 35,000 years ago remains very much an unanswered question," White notes.

He adds that if you look at the Near East around 90,000 years ago, anatomically modern humans and Neandertals were both making Mousterian stone tools, which, though arguably less elaborate than Aurignacian tools, actually require a considerable amount of know-how. "I cannot imagine that Neandertals were producing these kinds of technologically complex tools and passing that on from generation to generation without talking about it," White declares. "I've seen a lot of people do this stuff, and I can't stand over somebody's shoulder and learn how to do it without a lot of verbal hints." Thus, White and others do not buy the argument that moderns were somehow cognitively superior, especially if Neandertals' inferiority meant that they lacked language. Instead it seems that moderns invented a culture that relied more heavily on material symbols.

Researchers have also looked to brain morphology for clues to cognitive ability. According to Ralph L. Holloway of Columbia University, all the brain asymmetries that characterize modern humans are found in Neandertals. "To be able to discriminate between the two," he remarks, "is, at the moment, impossible." As to whether Neandertal anatomy permitted speech, studies of the base of the skull conducted by Jeffrey T. Laitman of the Mount Sinai School of Medicine suggest that if they talked, Neandertals had a limited vocal repertoire. The significance of such physical constraints, however, is unclear.

Fading Away

IF NEANDERTALS POSSESSED basically the same cognitive ability as moderns, it makes their disappearance additionally puzzling. But the recent redating of Neandertal remains from Vindija cave in Croatia emphasizes that this did not happen overnight. Loyola's Smith and his colleagues have demonstrated

SUSAN CARLSON

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opportunity for various interactions, and Vindija may reflect some of them. Work by my Croatian colleagues Ivor Karavanić of the University of Zagreb and Jakov Radovčić of the Croatian Natural History Museum has revealed a combination of Mousterian and Aurignacian tools in the same stratigraphic level as the dated Neandertal fossils, indicating that Neandertals either made advanced implements or traded with moderns for them. Morphologically, the Vindija Neandertals look more modern than do most other Neandertals, which suggests that their ancestors interbred with early moderns.

The likelihood of gene flow between the groups is also supported by evidence that Neandertals left their mark on early modern Europeans. Fossils representing early modern adults from central European sites such as Vogelherd in southwestern Germany and Mladeč in Moravia (Czech Republic) have features that are difficult to explain unless they have some Neandertal contribution to their ancestry.

For example, Neandertals and early modern Europeans virtually all exhibit a projection of the back of the skull called an occipital bun (aspects of the shape and position of the buns differ between them because the overall skull shapes are not the same). Yet fossils from the Near Eastern sites of Skhūl and Qafzeh, which presumably represent the ancestors of early modern Europeans, do not have this morphology. It is hard to explain how the growth phenomenon responsible for this bunning could reappear independently and ubiquitously in early modern Europeans. Instead it is far more logical to recognize this morphology as a link to the Neandertals. The Portuguese child discovered late in 1998 in the Lapedo Valley offers more intriguing clues [see "The Hybrid Child from Portugal," on page 32].

I believe the evidence shows that the behavioral and biological interactions between Neandertal and early modern human populations were very complex—too complex for the origins of modern humans in Europe to have involved a simple, complete biological replacement of the Neandertals. Neandertals as organisms no longer exist, and Neandertal genes may not have persisted to the present day, but those genes were there in the beginnings of modern European biological history.

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MOVEMENT OF MODERNS (*purple*) into Europe did not displace the Neandertals, who were still living in central and western Europe 28,000 years ago. A number of the early modern European specimens bear some Neandertal features, which suggests that during the long period of overlap the two populations mixed.

that Neandertals still lived in central Europe 28,000 years ago, thousands of years after moderns had moved in [see "The Fate of the Neandertals," above]. Taking this into consideration, Stringer imagines that moderns, whom he views as a new species, replaced Neandertals in a long, slow process. "Gradually the Neandertals lost out because moderns were a bit more innovative, a bit better able to cope with rapid environmental change quickly, and they probably had bigger social networks," he supposes.

On the other hand, if Neandertals were an equally capable variant of our own species, as Smith and Wolpoff believe, long-term overlap of Neandertals and the new population moving into Europe would have left plenty of time for mingling, hence the mixed morphology that these scholars see in late Neandertals and early moderns in Europe. And if these groups were exchanging genes, they were probably exchanging cultural ideas, which might account for some of the similarity between, say, the Châtelperronian and the Aurignacian. Neandertals as entities disappeared, Wolpoff says, because they were outnumbered by the newcomers. Thousands of years of interbreeding between the small Neandertal population and the larger modern human population, he surmises, diluted the distinctive Neandertal features, which ultimately faded away.

"If we look at Australians a thousand years from now, we will see that the European features have predominated [over those of native Australians] by virtue of many more Europeans," Wolpoff asserts. "Not by virtue of better adaptation, not by virtue of different culture, not by virtue of anything except many more Europeans. And I really think that's what describes what we see in Europe—we see the predominance of more people."

From the morass of opinions in this contentious field, one consensus emerges: researchers have retired the vision of the shuffling, cultureless Neandertal. But whether these ancient hominids were among the ancestors of living people or a closely related species that competed with our own for the Eurasian territory and lost remains to be seen. In either case, the details will be extraordinarily complicated. "The more we learn, the more questions arise, the knottier it gets," muses archaeologist Lawrence G. Straus of the University of New Mexico. "That's why simple explanations just don't cut it." SA

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