TEN

WHO WERE THE NEANDERTHALS?

Homo neanderthalensis occupies a very special place in the hominid pantheon because it was the first extinct hominid species to be discovered and named, back in the mid-nineteenth century. Largely as a result of this accident of history, the Neanderthals have always loomed very large in considerations of our own evolution—although it has for long been evident that they were not direct human precursors as was suggested early on, and there is fairly general agreement by now that they deserve recognition as a distinctive hominid species in their own right. This distinctiveness is evident in the fact that there is surprisingly little disagreement in the normally contentious paleoanthropological fraternity over which particular fossils are Neanderthal.

A braincase from a site in the north of France known as Biache-St-Vaast represents the earliest distinctively Neanderthal fossil. It dates from at least 170 thousand years ago (MIS 6), and the accompanying fauna indicates that conditions then were moderately cold. If you want to push the oldest Neanderthal occurrence back a bit farther, you might include a somewhat less complete braincase from the German site of Reilingen that is uncertainly dated to MIS 8, perhaps 250 thousand years ago. This is about the presumed age of another, more complete specimen from

Steinheim, also in Germany, that possesses more Neanderthal features than the Sima hominids but that, like them, is not fully Neanderthal. These tantalizing observations hint that events in the hominid history of Europe around this time were more complex than has generally been assumed, and it also suggests that we are never likely to find full-fledged Neanderthal fossils at more than about a quarter of a million years ago. Nonetheless, it's obvious that the Neanderthal lineage must have been present in Europe between Sima and Reilingen times, and it's possible that we know so little about it due to the effects of repeated glaciation and deglaciation in the region.

One of the reasons why we have such a good hominid record in Europe is the extensive occurrence of limestone rocks offering caves and overhangs that hominids would have been eager to exploit for shelter. The occupation debris they left behind in such places would regularly have been washed out by the water that flooded across the landscape each time the ice sheets melted; but the record is good enough to tell us that *Homo heidelbergensis* also existed in Europe during the tenure of the Neanderthal lineage. This knowledge strongly supports the idea that a complex minuet among hominid species was unfolding in Europe during the Middle Pleistocene (the period between about 780 thousand and 126 thousand years ago). If so, the large-brained Neanderthals were the victors in this particular contest, since by Biache times, if not well before, they were in sole occupation of the subcontinent.

In their 200-thousand-year tenure, the Neanderthals spread widely in Europe, and far into western Asia. Their fossils have been found as far south as Gibraltar and Israel, and what is reasonably an early Neanderthal archaeological site, dating from a warm interlude, has been found as far north as Finland. A recent report even places these hominids (by tools they are assumed to have made, rather than by their fossils) at a site in northern Russia not far from the Arctic Circle, at some 31 to 34 thousand years ago when conditions were considerably colder. In the west, Neanderthal fossils are known from north Wales in the British Isles, and numerous others are scattered eastward as far as Uzbekistan. A nondescript bone bearing the characteristic Neanderthal genetic signature has even been discovered farther east yet, at a site in the Altai Mountains of southern Siberia.

Neanderthal sites are thus spread over a vast area of the Earth's surface, and occur at a huge variety of altitudes, topographies, and latitudes. It is, then, clear from its distribution alone that *Homo neanderthalensis* was a rugged and adaptive species, able to cope with a wide array of different environments. Still, Neanderthals notably tended to avoid areas that were uncomfortably close to the glacial fronts, and the total area within the enormous range that they were able to occupy at particular points in time must have varied widely amid the climatic vagaries of the Pleistocene. For example, during a cold snap during about 70 to 60 thousand years ago the Neanderthals seem to have been limited to Europe's Mediterranean fringes, while during the warmest parts of the following MIS 3 their traces are found far up into northern and central Europe.

This is particularly interesting since it has long been assumed, on the basis of their northerly Ice Age origins, that the Neanderthals were somehow "cold-adapted." In sharp contrast to the African-derived and "tropically adapted" *Homo sapiens,* they were seen as creatures of the ice and snow. In reality there is very little to suggest this, either in the peculiar form of the Neanderthal nasal region, often interpreted as a mechanism for warming and humidifying cold and dry incoming air before it hit the fragile lungs, or in their limb proportions. These were long taken as adapted for the Arctic, but they actually seem to resemble what is seen in intensive modern foragers of varying backgrounds. The reality is that, over their long tenure, the Neanderthals ranged throughout many diverse territories and climates, to which they must have accommodated culturally. Indeed, it would have been impossible for them to accommodate otherwise, since it's been calculated that, under the coldest conditions these hominids endured, a 180-pound Neanderthal would have required an extra 110 pounds of subcutaneous fat to compensate for a lack of clothing. Being built like a Sumo wrestler is hardly what you might view as the ideal adaptation to a hunting lifestyle; and it is far more likely that the Neanderthals were as lean as Arctic peoples tend to be today, and depended on clothing and other cultural accoutrements for insulation and warmth.

Interestingly, analysis of two Neanderthal DNA samples (more on Neanderthal DNA in a moment) suggested that they possessed an inactive

A reconstructed Neanderthal skeleton (left) compared with that of a modern human of similar stature. The comparison reveals two distinctly contrasting hominids. Apart from the cranial differences, note especially the very different shapes of the thoracic and pelvic regions. Photo by Ken Mowbray.

version of a gene affecting skin and hair color. Apparently, befitting their temperate origin, these individuals would have possessed pale skins and red hair. But, significantly, the gene variant in question is not one that is found among modern humans, even redheads. This one observation is by itself emblematic of the fact that we need to get away from seeing Neanderthals as a less successful version of ourselves, a hyper-adapted variety of modern human that put all of its eggs into the wrong basket.

Just as members of our species do, Neanderthals varied a bit in appearance from individual to individual, from place to place, and from time to time. Still, again like us, they all shared a distinctive common physical aspect. While Neanderthal braincases were capacious, they were also long and low, bulging at the sides and protruding at the back. (In contrast, our skulls are lightly built and globular, with a tiny face tucked underneath the front of a high, balloon-like braincase.) Neanderthal faces, hafted somewhat in front of the cranial vault, bore large noses (within which were some very unusual bony structures), and their cheekbones retreated rapidly at the sides. Below the neck the contrasts were equally striking. Compared to us the Neanderthals were heavily built, with thick-walled long bones bearing large, clunky joint surfaces at each end. Where our torsos are formed rather like barrels, tapering inward at top and bottom, theirs were funnel-shaped, tapering outward and down from a narrow top to match a broad, flaring pelvis below. This evidence of the skeleton thus joins other details in favoring the notion that Neanderthal gait was different from ours, stiffer and featuring greater rotation of the hips during striding. Beyond this, the general robustness of the Neanderthal skeleton also suggests great strength, and perhaps also high metabolic demands. Altogether, we are looking at a hominid that, although a fairly close relative, was anatomically distinct from *Homo sapiens* in numerous important details—although it seems to be us, not them, who have departed from the general hominid pattern in acquiring our unusual slender and gracile build. As far as we can tell from a less-than-perfect postcranial fossil record (though one that, significantly, contains the wonderful Sima sample) a broad pelvis and robust bone structure seem to have been characteristic of the entire Neanderthal lineage, and probably of all early *Homo* species.

We also differ from Neanderthals—and, as far as we know, from all other hominids—in the way in which we achieve our adult body form. We saw earlier that the Turkana Boy and other individuals of the *Homo ergaster/erectus* grade appeared to have developed much faster than *Homo sapiens* does, resulting in much shorter periods of both dependence and learning. And, despite its large brain, *Homo neanderthalensis* was no exception to this pattern. A recent study of Neanderthal dental development, using ultra-high-resolution techniques, has revealed that while the Neanderthal developmental period was indeed extended relative to earlier hominids, it was nonetheless shorter than our own. For example, the upper wisdom teeth (third molars) of one Neanderthal began developing at under six years of age, which is between three and four years earlier than in modern human children. Similarly, the first molars erupted substantially earlier in Neanderthals than in us. Translated into the overall developmental schedule, such data imply strongly that Neanderthals had a significantly shorter period of dependence on their parents than we do, and followed a faster path to sexual maturity. This conclusion coincides with analyses of the Neanderthal genome, which reveal that genes relating both to bodily and cognitive development differ from their equivalents in our own genomes.

Neanderthals also attained their characteristic cranial form through developmental trajectories that were not only faster than ours, but distinctly different. Sophisticated imaging and modeling techniques have shown that many of the characteristics that differentiate our faces from those of Neanderthals not only follow distinctive pathways of development postnatally, but also are well established at the time of birth. We cannot regard those many differences as superficial. Yet the actual shape of the brain is not among those features that are distinctive early on. Like Neanderthals, humans are born with longish skulls, which turns out to be a requisite of getting the neonate successfully through the birth canal; and we achieve our globular braincases in the first year of life, in the very rapid developmental spurt that propels the brain toward its unique external form. This dramatic early alteration in external form of the modern human brain and braincase is very unusual; and it is only possible once the constraints of the birth process are relaxed. The scientists who discovered it speculate that it may in some way be related to the internal reorganization of the brain that makes symbolic cognition possible.

NEANDERTHAL GENES

In 1997 *Homo neanderthalensis* became the first extinct hominid species to have its DNA characterized. In that year, a German team ingeniously extracted a length of mitochondrial DNA (mtDNA) from

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the original Neanderthal specimen that had been found in Germany's Neander Valley in 1856. Mitochondrial DNA is a short ring of DNA that resides in tiny organelles that supply energy to each of our cells. These contain their DNA independently of the much greater quantities of the stuff in the cells' nuclei—and this is a huge advantage for scientists trying to compare the mutations that have accumulated over evolutionary time. The advantage arises from the fact that mtDNA is inherited uniquely through the mother and, unlike nuclear DNA, doesn't get jumbled up in each generation as the egg and sperm of the parents combine. The historical message it contains is thus much simpler to sort out. Among modern humans, mtDNA has turned out to be an amazingly useful marker for characterizing various populations and tracing their spread; and the Neanderthal mtDNA turned out to fall well outside the envelope of variation that describes all human populations today. To be precise, while the German researchers found an average of eight differences in the relevant part of the mitochondrial genome between pairs of modern human populations, and about 55 between humans and chimpanzees, the number for Neanderthals was 26. What's more, the Neanderthals lay equidistant from all the modern human populations tested.

Since 1997 mtDNA has been obtained from numerous Neanderthal specimens originating in all parts of the species' range, always with the same result. As expected, the Neanderthals differed somewhat among themselves, though a relatively low diversity has suggested to researchers that Neanderthal populations were typically small, something that archaeologists had also guessed from the low relative abundance of the occupation sites they left behind. All the Neanderthals still clustered together, in contradistinction to *Homo sapiens,* and in numerous studies researchers have been unable to detect any Neanderthal contribution to the DNA of an extensive sample of modern Europeans.

These findings reinforced the notion derived from anatomical studies that *Homo neanderthalensis* was its own species, an effectively individuated entity with its own history and its own fate. However, nature is an untidy place, and species can be leaky vessels—especially where they are very closely related as well as actors in a fast-moving evolutionary drama, as hominids during the Pleistocene most assuredly were. In 2010, the German group announced another first—a draft version of a complete Neanderthal nuclear genome (taken from three samples of bone from the Croatian cave of Vindija, dated to about 40 thousand years ago). These samples provided a vast data base. There are more than three billion individual "nucleotides"—basically, data points—in a human genome; and interpreting this Neanderthal genome meant massaging all of those data points through some very hefty computer algorithms. But after all the necessary manipulations (with which not everyone is entirely happy), the researchers reported that "Neandertals shared more genetic variants with present-day humans in Eurasia than with present-day humans in sub-Saharan Africa, suggesting that gene flows from Neandertals into the ancestors of non-Africans occurred before the divergence of Eurasian groups from each other." Actually, on closer examination the apparent gene flow (i.e., gene transfer due to interbreeding) turned out to be in the order of 1 to 4 percent: hardly vast and, oddly, only one way: from Neanderthals into modern humans.

Even odder is a result reported by the same group shortly thereafter. These industrious researchers had already found that a morphologically uncategorizable finger bone from the southern Siberian cave of Denisova, only some 30 thousand years old, yielded a DNA fingerprint that distinguished it from both modern humans and Neanderthals, although it seemed to be somehow related to the latter. A complete genome was then obtained from this specimen, and is said to share a small proportion of its genes with modern-day Melanesians (and nobody else), suggesting—if true—that the ancestral Melanesians might have picked up these genetic variants on their way out of Africa and across Asia to the Pacific. A molar from Denisova produced basically the same genetic signature; but this tooth is both extremely large and morphologically dissimilar to any other hominid teeth known from so late in time, emphasizing that morphological and genetic evidence may sometimes be apparently at odds. However these findings are eventually interpreted, they suggest that events in later hominid evolution may have been very complex, and that the historically and functionally individuated entities that we recognize as hominid species may nonetheless have occasionally exchanged genetic material.

Perhaps such an exchange has even been an important source of genetic innovation in the human past. Not long ago, a group of molecular biologists in Chicago reported that a rapidly spreading variant of the microcephalin gene, important in regulating brain size, appeared to have been imported into the *Homo sapiens* genome only some 37 thousand years before the present. Their calculations suggested that it might have been introduced into our species from a relative that had separated from our lineage a little over a million years ago; and the Neanderthals seemed to them to fit the bill, though in fact any other hominid "donor" species might have been involved. At this point it's probably too early to know quite what to make of observations such as these (and 37 thousand years ago is too late to have made a material difference in the emergence of our own species); but it is not out of the question that minor gene exchange among closely related hominid species at an earlier time may have had a significant role in furnishing the ancestors of *Homo sapiens* with new genetic material.

This in itself is nothing remarkable. It has long been known that genes are occasionally exchanged between well-differentiated mammals. Indeed, there is a pair of ligers—huge hybrid beasts with lion and tiger parents—resident in an animal park in South Carolina right now. These are fearsome creatures indeed; and especially in view of their vigor you might be surprised to learn that lions and tigers are not even each other's recently diverged closest relatives. Lions are actually more closely related to jaguars, and tigers to snow leopards; and the last common ancestor of lions and tigers lived around four million years ago. But in spite of these impressive hybrids, nobody is out there arguing that lions and tigers are not fully individuated entities, each one with its own independent history and evolutionary trajectory. Despite that little genetic romp, there is no reasonable likelihood whatever that the two big cats will ever merge into a blended unit combining the characteristics of both parental populations. Closer to hominid home, the same thing seems to go for closely related primates that intermix. In Ethiopia, hybridization regularly occurs in a specific zone between hamadryas and gelada baboons, two closely related monkeys that are strikingly different to the eye. But even there, we see no indication that either broader parental species is losing its distinctive physical identity.

To put all this in context, the difference in skull structure between *Homo neanderthalensis* and *Homo sapiens* is far greater than what we see between hamadryas and geladas—and also greater than the one between lions and tigers. And whether or not acts of mating may occasionally have occurred between members of the two hominid species, the probability is negligible that there was any evolutionarily significant genetic interchange between them. In other words, nothing seems to have occurred that might have influenced the future fate of either, and the populations never integrated to any significant extent. Claimed "hybrids" such as the very late skeleton discovered at the Abrigo do Lagar Velho in Portugal, or the odd early *Homo sapiens* skull from the Peştera cu Oase in Romania, turn out on closer inspection to be somewhat unusual modern humans. What's more, and very significantly, the archaeological record is in parallel sending us a more or less identical signal of inconsequential or nonexistent cultural intermixing. From every line of evidence we have, it seems that *Homo sapiens* and *Homo neanderthalensis* were differentiated entities, each with its own history and way of doing business. Even if the odds may be reasonable that there was occasionally a bit of Pleistocene hanky-panky, swapping the odd stretch of DNA didn't change that functional reality.

NEANDERTHAL DIETS

As we've seen, the genetic evidence hints that Neanderthals were always thin on the ground, and this is probably also reflected in the typically small size of the sites they left behind, as well as their low density. In both warmer periods and cooler ones, Neanderthals lived in seasonal environments that would not have been enormously productive of the kinds of plant foods necessary to sustain hominids; and at all times they would likely have been quite heavily dependent on animal fats and proteins to get by. Just how dependent clearly varied, though, and this variation seems to have been largely a function of time and circumstances, for Neanderthals were flexible foragers who knew how to exploit whatever the environment offered.

One study of adjacent occupation sites in western Italy was eloquent in this regard. About 120 thousand years ago, during a warm period (MIS 5e), Neanderthal occupations were brief, and the animal remains associated with them consisted mainly of the cranial remains of older individuals. The researchers concluded that the hominids at the site had scavenged the remains of animals that had died of natural causes: the heads were the last bits available when large carnivores had had their fill. In contrast, at 50 thousand years ago, when (coincidentally or not) conditions were much colder, the animal remains were those of individuals in the prime of life, and consisted of parts from all over the body. Together with greater densities of stone tools this suggested not only more sustained site occupation, but that the Neanderthals were using sophisticated ambush-hunting techniques to obtain carcasses that were brought back whole to be butchered at the home site. Archaeological evidence of this kind almost always gives an incomplete impression of the lives of the ancient hominids who left it behind, and it is never easy to interpret. Nonetheless, the contrast between the earlier and later occupations is striking; and at the very least it indicates not only that Neanderthal techniques of obtaining animal foods varied greatly, but also that their occupation habits did, too. These hominids were certainly not stereotyped in their subsistence strategies.

Flexible they may have been, but a powerful consensus is growing among archaeologists that under appropriate circumstances Neanderthals were top predators. Not only were animal products the main if not the only potential hominid mainstay at cooler times, but evidence is also accumulating that they routinely went after large-bodied mammals, some of them the most fearsome of all the creatures on the landscape. The most provocative such evidence comes from the study of stable isotope ratios preserved in Neanderthal teeth and bones. We've seen that carbon isotopes have been very informative about diet among the australopiths; in the case of the Neanderthals, an equivalent role has been filled by stable isotopes of nitrogen. It turns out that the ratio between the two isotopes ^{15}N and ^{14}N increases slightly in your tissues with every step you take up the food chain: the higher the ratio, the more meat there is in your diet. Starting in the early 1990s, scientists discovered that the bones of Neanderthals invariably showed higher $^{15}N/^{14}N$ ratios than were found in the fossil bones of herbivores from the same place;

indeed, they were right up there with the ratios recovered from wolves, lions, and hyenas—if not higher yet.

This observation fit well with the abundance of butchered herbivore remains typically found at Neanderthal sites. But the ultimate observation came in 2005, when a French team found an extremely high $^{15}N/^{14}N$ ratio in the bones of a very late Neanderthal from a place called St.-Césaire. Since this value was well above what they had found even in hyenas from the same site, the scientists suggested that the only way in which Neanderthals could possibly have achieved such a high ratio was by specializing in the consumption of herbivores that were themselves enriched in ^{15}N. And the only putative victims were among the most intimidating of the many large beasts roaming the landscape: namely, mammoths and wooly rhinoceroses. What is more, the French scientists suggested that it would not have been possible for the St.-Césaire Neanderthals to have scavenged all the mammoth and rhino carcasses that would have been necessary to sustain the high nitrogen isotope ratios they had found in the hominids' bones. In their view, the hominids must have actively hunted the huge mammals, presumably as an important component of a long-standing dietary tradition. The case seems pretty strong, then, that Neanderthals were redoubtable hunters who, even at low population densities, were able to tackle some of the most formidable prey around. At their living sites they routinely controlled fire in hearths; and these fires doubtless provided a focus of their social activities, besides furnishing a means for cooking all that meat and for discouraging unwanted predators.

Still, it's important not to forget that plant foods must have played a significant role in the Neanderthals' diets in most places and at most times. This aspect of their food intake has been predictably neglected because plant remains rot rapidly, and rarely preserve in the archaeological record. However, scientific ingenuity is beginning to open up some amazing new avenues for investigation. For example, a recent report describes plant microfossils (both starch grains and phytoliths, tiny rigid bodies that occur in plant roots, leaves, and stems, and differ according to plant species) that were recovered from the plaque coating Neanderthal teeth from two famous sites. A dentist's nightmare had become a treasure trove for paleoanthropologists. One of the sites in question is the cave of Shanidar in northern Iraq, and the specimen examined dates from about 46 thousand years ago. Shanidar is, by the way, the site that has famously yielded the skeleton of an aged male Neanderthal with a withered arm. This appendage must have been useless to its possessor for most of his long life, and his survival has elicited speculation that he enjoyed the sustained support of his social group. The other site is the Belgian cave of Spy which, at about ten thousand years younger, falls very late in Neanderthal history.

Though far apart in time and space, and representing environments ranging from Mediterranean to cool temperate, the two caves tell similar stories. In both places the Neanderthals consumed a wide variety of plant foods that reflected the range of resources available in the local environment. There was no indication of specialization on particular plants, but in both places many of the foods would have required some preparation prior to consumption, and some starchy plant parts had indeed been cooked to render them more edible. There is, by the way, no contradiction between extensive consumption of starches and the nitrogen isotope record, because the isotopes only register the consumption of meat and of plant foods that are high in protein. At Shanidar the foods indicated by the microfossils include dates, barley, and legumes—items that would have been ready for harvesting at different times of year, thus indicating that foraging for plant foods was a year-round activity. All in all, this new study shows us that the essentials of the modern hunting-gathering style of subsistence had been established by the time the Neanderthals had entered the picture. Like *Homo sapiens* today, *Homo neanderthalensis* was an opportunistic omnivore, reminding us that despite our secondary adoption of a predatory lifestyle, we have never entirely put behind us our ancient vegetarian heritage.

NEANDERTHAL LIFESTYLES

Apart from being small, we didn't know until very recently what those Neanderthal groups that sat around the fire cooking their food were actually like. All we had as a basis to speculate on the subject were stone artifacts and broken bones, and the ways in which these were scattered around living sites. This scattering was typically (though not invariably) random, with little suggestion that the living space was divided into areas for specific activities such as butchery, stone knapping, sleeping, eating, and so forth. We routinely find such division of space at sites left by fully symbolic modern humans, so there is already some suggestion of different approaches to domestic life by the two species. But until recently, there hasn't been much to tell us how Neanderthal groups were organized. Now a team of Spanish researchers, working at the 50-thousand year-old Neanderthal site of El Sidrón, has come up with some intriguing suggestions based on both physical and molecular evidence.

The El Sidrón site itself is a long and complex warren of tunnels produced in the surrounding limestone by an ancient underground river system, and it has a complex history. Most notably, an extensive assemblage of Neanderthal bones was deposited in a single event on the bottom of one arm of the cave, when the ground surface above (or, just possibly, the floor of a higher tunnel) collapsed into the cavity below. Large numbers of knapped stones were intermixed with fossil bones and other debris. Many of the fragments could be refitted into complete cobbles, suggesting that the spot where the collapse occurred was a place where stone tools were made. The 1,800 fossil fragments found in the debris represent the broken-up remains of twelve Neanderthal individuals: six adults, three adolescents, two juveniles, and an infant. All appear to have already been dead when the collapse occurred, not long after their decease. More remarkably, not only had these Neanderthals been dead, but the researchers conclude that they had been the victims of a massacre, since many of the bones show marks of cutting and percussion consistent with defleshing, and probably cannibalism.

Evidence of defleshing is not uncommon on Neanderthal (and even *Homo heidelbergensis*) bones, and many scientists have argued that removal of flesh from corpses after death is not necessarily proof of cannibalism; but the case made that the hominid bones at El Sidrón were broken for consumption is a compelling one, and the probability seems to be growing that this behavior was indeed part of the Neanderthal repertoire. Interestingly, the El Sidrón researchers think that, in contrast to the "gastronomic cannibalism" seen at the Gran Dolina (i.e., cannibalism occasioned by habit, rather than by necessity), the El Sidrón

Neanderthals were the victims of "survival cannibalism." In support of this they point to the fact that the fossil remains bear clear signs of environmental stress, mainly in the form of an abundance of those defects in dental enamel formation that were notably rare at the Sima de los Huesos. If dietary stress was indeed a significant issue for these hominids, then it is likely that competition among contiguous Neanderthal groups for available resources was strong. Putting the various lines of evidence together, the researchers conclude that the twelve El Sidrón Neanderthals all belonged to a single social group that had been ambushed, killed, and consumed by another.

Two further observations support the notion that an entire Neanderthal group had perished in the El Sidrón event. One of these is that a group size of twelve, with a few adults of each sex and children of all ages, is pretty much in line with what you might expect. Specific estimates of Neanderthal group sizes are few and far between, but one recent study at the 55-thousand-year-old Spanish Neanderthal site of Abric Romaní concluded that groups occupying the rock shelter had varied in size from eight to ten individuals. If the Abric Romaní inhabitants were typical, and the estimates of their group sizes are accurate, it's even possible that the twelve individuals from El Sidrón belonged to a largish social unit by Neanderthal standards.

Still, wherever this band stood in the size spectrum, the notion that it constituted a single social unit was supported by analysis of its members' mtDNA, which had been excellently preserved in the cool conditions within the cave. For a start, diversity among the El Sidrón mtDNA genomes was very low, consistent with a family group. But most revealing was the finding that the three El Sidrón adult males had all belonged to the same mtDNA lineage, while each of the females had belonged to a different one. And here, for the first time, is a potential (though not definitive) message about the social organization of Neanderthals: that the El Sidrón males had remained in their birth group, while the females had married out of theirs, being dispatched at or soon after puberty to join a neighboring band. As one scientific colleague was quoted by the *New York Times* as saying, "I cannot help but suppose that Neanderthal girls wept as bitterly as modern girls, faced by the prospect of leaving close family on their 'wedding' day." This may be anthropomorphizing a bit—and it is certainly true that impassive female transfer is not that uncommon among primates—but it is difficult not to respond to the sentiment.

The inferences made by the El Sidrón researchers about Neanderthal society do not stop there. They note that a five- to six-year-old child and a three- to four-year-old were probably offspring of the same adult female. This suggests a birth interval of around three years, consistent with what was historically seen among hunter-gathering peoples. This in turn implies that Neanderthals achieved prolonged inhibition of ovulation, most plausibly through the expedient of protracted breastfeeding. An imaginative further conjecture comes from the material from which the El Sidrón stone tools were made: the nearest place at which it could be obtained was several miles away. Perhaps, the researchers speculated, the El Sidrón Neanderthals had incurred the wrath of the neighboring group into whose territory they had forayed to obtain it, and paid a heavy price in a reprisal raid.

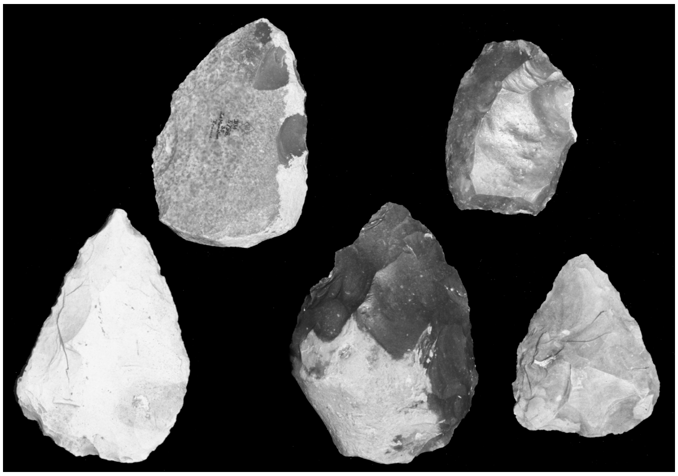
Taken together, all of this tantalizing evidence from El Sidrón is helping create a more visceral picture of the Neanderthals than we ever had before. Knowing from high-tech laboratory analyses that tiny numbers of Neanderthals heroically hunted mammoths out on the tundra certainly evokes our admiration of these hardy and resourceful hominids. But this kind of information is profoundly different from contemplating the historical vignette of Neanderthal life—and death—with which El Sidrón presents us. The vision of a peacefully stone-knapping extended family of Neanderthals being raided, murdered, butchered, and eaten by a marauding group of their fellows is an unsettling one in the extreme; but then again, it is possibly not so different from what every modern watcher of crime-scene television is by now inured to.

On the more humane side, one of the reasons we have such a good sampling of reasonably intact Neanderthal remains is that these hominids at least occasionally buried their dead. And while it has been argued both that the presumed burials never occurred, and that they not only occurred but sometimes contained grave goods, the truth seems to lie somewhere in between. Yes, the Neanderthals did invent the practice of burial; and no, there is no really convincing evidence that they ever did so with the ritual that typically accompanies modern human burials. Much as we want to see echoes of ourselves in this practice (which Neanderthals apparently invented before our ancestors did), it is impossible to know whether or not Neanderthal burials were overlarded with all of the symbolic baggage with which ours are. That they imply some sort of deep empathetic feeling seems close to certain; but in the broader context of what we know about Neanderthals, it is far less probable that they imply belief in an afterlife—something that would indeed demand symbolic cognitive abilities.

NEANDERTHALS AND MATERIALS

By the time diagnostic Neanderthal remains are known in Europe, the stone-working tradition known as the "Mousterian," using variants of the prepared-core technique, had become entrenched. Indeed, in Europe the Mousterian is virtually synonymous with *Homo neanderthalensis,* although a very similar toolkit was also produced by other hominids in North Africa and the Levant. The most characteristic implements of the Mousterian are modestly sized sharp points and convex-sided scrapers, or even small teardrop handaxes made on flakes; but the number of variations is endless. This may not, however, have been through the toolmakers' specific intention. For while more than 50 distinct Mousterian tool forms were defined by mid-twentieth-century archaeologists, more recent researchers have recognized that there is in fact more of a continuum of form. This is due to a complex and discontinuous sequence of actions, as flakes made from superior materials were continually resharpened to maintain their functionality. Indeed, it was cleanly and predictably fracturing rocks themselves that were the key to making the best Mousterian tools. Good materials were evidently highly prized and regularly sought far afield, showing how valuable they were. Not infrequently, the nearest source of the rock used to make at least some of the tools found at Mousterian sites was many miles away—hence the speculation over the fate of those unfortunate Neanderthals at El Sidrón.

The need for good materials was occasioned by the Mousterians' sheer skill, for they were gifted stoneworkers who disdained poor materials, only making crude implements out of them when—as was frequently the case—there was no alternative. The Neanderthals instinctively knew



Mousterian flint tools made by Neanderthals at various sites in France. These skillfully shaped tools include two small handaxes, two scrapers, and a point, all made on stone flakes using the prepared-core approach. Photo by Ian Tattersall.

stone, as a modern cabinetmaker instinctively knows wood. And while a piece of silicified limestone might be good enough for producing a simple flake meant to be used only until its edge went blunt, the Mousterians carefully fashioned a good piece of flint or chert, then gave it a new edge over and over again until it was too small to be of further use. The discovery of scraping tools or points bearing traces of resin confirms that Neanderthals often set such tools into wooden handles, or used them as spear tips, binding them in position with leather thongs or sinews. The Mousterian toolkit was clearly the product of intelligent and dexterous beings.

Yet perhaps not beings just like us. Despite their frequent beauty, and for all the skill that went into making them, Mousterian tools showed a certain monotony over all the vast area that the Neanderthals inhabited. Several varieties of the Mousterian have been named, and are still recognized. But uniformity in concept was the rule of the day, and it's likely that the minor variations we do see in Neanderthal toolkits broadly reflect local differences in activity due to differential availability of resources, or occasionally to some refinement over time, rather than to the experimentation with different ways of doing things you'd expect to find among geographically scattered modern people. What's more, while they hafted stone tools into wood, Neanderthals rarely seem to have made tools of other soft materials. Bone and antler are plentiful at Neanderthal sites, and were abundantly fashioned into artifacts by later Europeans. But the Mousterian toolmakers rarely took advantage of these materials—although one of the rare examples of a Mousterian bone tool, from the 50-thousand-year-old site of La Quina and evidently used for the purpose of retouching stone tools, appears to have been made from a piece of hominid cranium. In this case and in others, the Mousterians bashed bones as though they were stones, with none of the sensitivity to the special mechanical properties of soft materials shown by their successors. In short, spectacular as it was, Neanderthal craftsmanship was pretty stereotyped.

The upshot of all of this is that we find nothing in the technological record of the Neanderthals to suggest that they were symbolic thinkers. Skillful, yes; complex, certainly. But not in the way that we are. As a species, *Homo neanderthalensis* seems to have fully participated in the hominid trend over time toward more challenging behaviors, and toward more subtle and intricate relationships with the environment. It certainly participated in the hominid trend toward bigger brains, possibly taking this tendency to its most extreme expression. But behaviorally there was no qualitative break with the past; the Neanderthals were simply doing what their predecessors had done, if apparently better. In other words, they were like their ancestors, only more so. We are not. We are symbolic.