Science and Technology in Human Societies: From Tool Making to Technology

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Chapter 44

TOOL MAKING

The adaptive strategies of all taxa belonging to the genus Homo included the use of stone tools, although the characteristics of the lithic carvings changed over time. The earliest and most primitive culture, Oldowan or Mode 1, appears in East African sediments around 2.4 Ma in the Early Paleolithic. Around 1.6 Ma appears a more advanced tradition, the Acheulean or Mode 2. The Mousterian culture or Mode 3 is the tool tradition that evolved from Acheulean culture during the Middle Paleolithic. Finally—for the limited purposes of this chapter—the Aurignacian culture, or Mode 4, appeared in the Upper Paleolithic. The original proposal of cultural modes by Grahame Clark (1969) included a Mode 5 by differentiating some technical details, allocating to Mode 4 the punch-struck blades from prismatic cores of the Upper Paleolithic, while the Mode 5 was reserved for the microliths and compound tools of the late Upper Paleolithic. We believe that this distinction is not necessary for the present chapter, whose aim is to relate cultural development to human evolution. A first approach attributes each cultural stage to a particular human taxon. Thus, the beginning of tool making, ie, Mode 1, is linked to Homo habilis, and “technology”—understood as the making of tools which require a modern mind necessary for Mode 4—to Homo sapiens. Although we will also examine the technical advances assigned to Mode 5 by Clark (1969), these are part of an evolution that does not involve a change of species. In fact, the “technology” may be adding new modes due to the multiple technological advances that the cultural evolution of Homo sapiens has achieved, starting with agriculture. It doesn’t make sense to suggest such a model, nor will we go into the later cultural developments that follow the evolution of the modern mind.

We should already express a methodological caveat before proceeding: the scheme Cultural Mode = species, is too general and incorrect. The assumption that a certain kind of hominin is the author of a specific set of tools is grounded on two complementary arguments: (1) the hominin specimens and lithic instruments were found at the same level of the same site; and (2) morphological interpretations attribute to those particular hominins the ability to manufacture the stone tools. The first kind of evidence is, obviously, circumstantial. Sites yield not only hominin remains, but those of a diverse fauna. The belief that our ancestors rather than other primates are responsible for the stone tools comes from the second type of argument, the capacity to manufacture. This consideration is perfectly characterized by the episode involving the discovery and proposal of the species H. habilis. As Louis et al. (1964) said, “When the skull of Australopithecus (Zinjanthropus) boisei was found [in Olduvai, Bed 1] no remains of any other type of hominid were known from the early part of the Oldowan sequence. It seemed reasonable, therefore, to assume that this skull represented the makers of the Oldowan culture. The subsequent discovery of H. habilis in association with the Oldowan culture at three other sites has considerably altered the position. While it is possible that Zinjanthropus and H. habilis both made stone tools, it is probable that the latter was the more advanced tool maker and that the Zinjanthropus skull represents an intruder (or a victim) on an H. habilis living site.” (Leakey et al., 1964).

Here we have a clear example of the argumentative sequence: First, a Paranthropus boisei cranium and
associated lithic instruments were discovered at the FLK I site, Olduvai. Later, hominins with a notably greater cranial capacity, included in the new species H. habilis, were discovered at the same place. Eventually, stone tools were attributed to H. habilis, morphologically more advanced in its planning capacities. Leakey et al. (1964) paper included a cautionary note. Even though it is less probable, it is conceivable that Zinjanthropus also made lithic tools.

However, the attribution of capacities that identify H. habilis as the author of Olduvai lithic carvings has some reservations. John Napier (1962) published an article on the evolution of the hand two years before, relating stone tools to the discovery of 15 hominin hand bones by Louis and Mary Leakey at the site where Zinjanthropus had been found. According to Napier, “Prior to the discovery of Zinjanthropus, the South African man-apes (Australopithecines) had been associated at least indirectly with fabricated tools. Observers were reluctant to credit man-apes with being toolmakers, however, on the ground that they lacked an adequate cranial capacity. Now that hands as well as skulls have been found at the same site with undoubted tools, one can begin to correlate the evolution of the hand with the stage of culture and the size of the brain” (Napier, 1962).

Napier’s (1962), and Leakey et al. (1964) interpretations of the Olduvai findings exemplifies the risks involved in the correlation of specimens and tools. Both the skull of Zinjanthropus (OH 5) as well as the OH 8 collection of hand and feet bones (with a clavicle), all of them found by the Leakey team in the same stratigraphic horizon, could be related to lithic making. Sites yielding tools and fossil samples of australopithecines and H. habilis require deciding which of those taxa made the tools. The widespread attribution of Mode 1 to H. habilis is based on a set of indicators among which are hand morphology and size, as well as brain lateralization—an expression of the control capabilities of either hand—(Ambrose, 2001; Panger et al., 2002).

PRECULTURAL USES OF TOOLS

Regarding the use of stones or other materials for obtaining food, one must distinguish between two different operations. One matter is to make use of pebbles, sticks, bones, or any available object to, for example, break nutsheells and access the fruit; another is to manufacture very deliberately tools with a specific shape to carry out a precise function. Although we are speaking in speculative terms, it is conceivable that the spontaneous use of objects as tools preceded stone carving.

By means of the comparative study of the behavior of African apes, ethology has provided some interesting interpretations about how chimpanzees use, and sometimes modify, stones and sticks to get food. Since the first evidence of such behaviors collected by Jane Goodall and Jordi Sabater Pi (Goodall, 1964; Sabater Pi, 1984), many cases of chimpanzee tool use that can be considered cultural have been brought to light. Very diverse cultural traditions have been documented, including up to 39 different behavioral patterns related with tool use by chimpanzees (Boesch and Tomasello, 1998; Vogel, 1999; Whiten et al., 1999). Some of these patterns include the use of different tools in sequence, as it is done by the Loango chimpanzees (Gabon) for obtaining honey (Boesch et al., 2009). It is, of course, true that the use of tools includes different patterns in the case of humans, who carry out operational planning tasks and, in particular, technical improvement processes (Davidson and McGrew, 2005). However, it is also true that chimpanzees are able to consider future uses of tools, which involves some planning (Mulcahy and Call, 2006). It has even been observed experimentally in these apes a conformity to cultural norms used by dominant individuals in the group, an attitude similar to human behaviors (Whiten et al., 2005).

One of the most interesting aspects of chimpanzee behavior, to understand the evolution of the lithic traditions, is the production, at the beginning unintentional, of flakes which resemble those produced by the first human cultures. This “spontaneous” production appears when chimpanzees accidentally shatter a stone while trying to crack nuts; the result can lead to sets of cores and flakes that are reminiscent of those in the oldest hominin sites containing tools (Mercader et al., 2002, 2007). It is reasonable to think that the hominins themselves would use, at least as much as chimpanzees, the spontaneous tools available (Panger et al., 2002). And they would do it for a considerable time before starting to produce tools explicitly. This idea was expressed by John Robinson (1962) when he said that the australopithecids did not produce the complex carved stone found in Sterkfontein; but, for this author, this does not mean they lacked culture. When seeking food they could have used rocks, sticks, bones, and any other tools that would be useful for their purposes. Eudald Carbonell et al. (2007) have referred to these usages prior to tool production as the “biofunctional stage” or “Mode 0.” Shannon McPheron et al. (2010) have identified at the site of Dikika (Ethiopia) stone tool—inflicted marks on bones whose age is more than 3.39 Ma. Even though McPheron et al. (2010) found no tools in Dikika, Sonia Harmand presented at the meeting of the Paleoanthropology Society in San Francisco on April 14, 2015, the finding at the site of Lomekwi (Lake Turkana, Kenya) of tools coming from sediments with an age of around 3.3 Ma (Callaway, 2015). There are, moreover, very heavy artifacts, some of them up to 33 lbs. Although at the time of writing this chapter the research on these tools has not been published, clues about the ancient use of stone tools are increasing.
It should be noted that suspicions about the existence of a distinct cultural level for australopiths were for a long time tied to evidence coming from Taung and Sterkfontein. The fractured bases of baboon skulls of Taung and other places, for example, indicated to Raymond Dart that they were cracked to consume their insides. Dart (1957) argued that the bones themselves had been used by australopiths as tools to strike, crush, and cut, giving rise to a tradition of using tools of “natural” origin, the osteodontokeratic culture prior to the use of stone tools.

Although the osteodontokeratic culture was eventually considered as a misinterpretation, and taphonomic studies would tend to argue that the identified bones were not actually tools, studies such as that of Francesco d’Errico and Lucinda Backwell (2003) on the uses of bones from Sterkfontein—members 1–3, between 1.8 and 1.0 Ma—have shown indications, in the form of wear marks, of their being used in milling tasks. In a later work, d’Errico and Backwell (2009) studied the different uses of bones. Once again, for the functions assigned to bones as tools, the use of sticks by chimpanzees in tasks such as digging, to extract termites or to separate the bark of trees, can serve as a model. Optical interferometer analysis of terminal areas of bones used as tools has revealed different wear patterns on specimens from Swartkrans and Drimolen. d’Errico and Backwell (2009) concluded that the differences found indicate diverse activities, as well as contacts with abrasive particles of various sizes, that would point to tasks similar to those that have been observed in chimpanzees.

The use of bones as tools extends to the African Middle Paleolithic, and even to the Upper Paleolithic, although with very different purposes to those inferred for tools of Swartkrans lower levels, as is evidenced, for example, by the small ivory points from Upper Semiliki Valley, Zaire (Brooks et al., 1995; Yellen et al., 1995). The markings found on the bones have been used as evidence of butchering activities. If appropriate taphonomic considerations are taken into account, the markings observed on carcasses are an irrefutable proof of the use of cutting tools on them. However, according to Sherwood Washburn (1957) the accumulation of remains in the breccias of South African caves is unrelated to hominin butchering tasks. There is a predominance of mandibular and cranial remains because they are the bones most difficult to break, so that they tend to accumulate in the lairs of predators and scavengers. Ancestral hyenas are likely responsible for the accumulation of remains that we now find fossilized, australopiths included. It has been suggested that the Taung child itself was the victim of a predator, probably an eagle (Berger and Clarke, 1996), though this hypothesis has been criticized (Hedenström, 1995).

Manipulated stones cannot be attributed to predators. Many lithic instruments have been found at the Sterkfontein Extension Site—hand axes, cores, flakes, and even a spheroid—which are unequivocal signs of the manipulation of raw materials to obtain tools designed to cut and crush (Robinson and Manson, 1957). However, there are doubts regarding the association between stone tools and their authors. The sites that have provided Australopithecus africanus, Sterkfontein, Makapansgat and Taung, are not the only ones that have provided samples of an early lithic culture. There is also a stone industry at Swartkrans (Brain, 1970; Clarke et al., 1970), though it was found a long time after Dart elaborated his idea of hominization. The interpretation of the possible stone artifacts found at Kromdraai is not easy (Brain, 1958). But even in Sterkfontein, the Extension Site belongs to Member 5, whereas Member 4, older than 5, has provided a great number of Au. africanus specimens although it has yielded no lithic tool whatsoever.

If the accumulation of bones at Sterkfontein Member 4 was due to scavengers, and if australopiths were the hunted and not the hunters, the question concerning the first tool-makers remains unanswered. The answer will depend on preconceptions regarding cognitive capacities and hominin adaptive strategies. New kinds of evidence have bearing on this issue: the paleoclimate to which different genera and species were adapted; the morphology of certain key elements required for the intentional manipulation of objects, such as hands and the brain; the diet and the taphonomic study of the relation at the sites of bones and tools.

TAPHONOMIC INDICATIONS OF CULTURE

Paleoclimatological conclusions regarding early hominin taxa suggest they were adapted to tropical forests. This is the case of Australopithecus anamensis (Leakey et al., 1995), Ardipithecus ramidus (WoldeGabriel et al., 1994), Australopithecus afarensis (Kingston et al., 1994) and Au. africanus (Rayner et al., 1993). This argues against Raymond Dart’s original hypothesis that related bipedalism, the expansion of open savannas, and the appearance of the first hominins. The first hominins would have emerged long before the expansion of the savanna in Africa and before any evidence of lithic tool use.

But in Dart’s time no Miocene hominins were known, so it was logical that he spoke of “the first humans,” referring to those who colonized the savanna during the Pliocene-Pleistocene. Which of them first began to use stone tools? Again, we are facing the necessity to associate fossil remains to the lithic tools found at the sites.

We said before that the attribution of a particular hominin taxon to the making of a specific culture type is based on finding the hominin specimens and lithic instruments at the same level of the same site. However, we must avoid falling into circularity. Especially, every precaution should be taken when attributing manipulation of ancient tools to hominins of different sympatric species. If
we find two taxa, T1 and T2, present at the same site and stratigraphic horizon—as happens with *H. habilis* and *P. boisei* at Olduvai—and if we claim that the authors of the carvings belong to one of them, let’s say to T1, because we assume that they have the ability to make tools, we will be falling into a circular argumentation. When finding the tools, we assume that those who carved them are precisely those individuals to whom we had previously attributed the possession of a cognitive level and manual capacity for manufacturing them.

Circularity can be broken if in sites where the alleged authors, such as T1, are found, of the carvings, tools are also found in a fairly widespread way, while that is not the case for T2 or any other taxon, which only sporadically are found associated with tools. In that case, it is reasonable to accept T1 as the toolmaker.

The systematic coincidence between a specimen of a particular morphology and lithic carvings of a specific cultural tradition is what has led us to consider the first species of the genus *Homo* as responsible for the oldest culture.

With regard to South Africa, the issue is uncertain. Sterkfontein Member 5 has yielded the Stw 53 cranium, which, as we saw, is considered as either *H. aff. habilis* or an *Australopithecus* of an unspecified species; and it was considered as the specimen-type of *Homo gautengensis* by Darren Curnoe (2010). Swartkrans has also provided some exemplars attributed to *H. habilis* and, regarding Taung, the most widespread opinion argues that the stone tools are much more recent and that they were made by more evolved hominins. The words “more evolved” obscure the circularity trap about which we spoke earlier. It makes us think that, as the carving of lithic tools imply high cognitive abilities, the presence of tools of that type leads us to conclude that their creators had reached a higher cognitive development. To accept that as a truth it is necessary to relate that “cognitive leap” with some other evidence aside from stone tools.

Taphonomic studies, which reconstruct the process of accumulation of available fossil evidence at a site, have increased our understanding of the behavior of early hominins. Different East African sites (Olduvai, Koobi Fora, Olorgesailie, Peninj) provide samples of hominin living sites with a direct association of hominin fossil remains and manipulated stones.

Although Olduvai gorge was not the first place in which early stone tools were found, it gave name to the earliest known lithic industry: Mode 1, also known as Oldowan culture. The excellent conditions of the Olduvai sites provided paleontologists and archaeologists with the chance to carry out taphonomic interpretations for reconstructing hominin habitats. Any lithic culture can be described as a set of diverse stones manipulated by hominins to obtain tools to cut, scrape, or hit. They are diverse tools obtained by hitting pebbles of different hard materials. Silex, quartz, flint, granite, and basalt are some of the materials used for tool making. In the Oldowan culture, the size of the round shaped cores is variable, but they usually fit comfortably in the hand; they are tennis ball—sized stones. Many tools belonging to different traditions fit within these generic characteristics. What specifically identifies Oldowan culture is that its tools are obtained with very few knocks, sometimes only one. The resultant tools are misleadingly crude. It is not easy to hit the stones with enough precision to obtain cutting edges and efficient flakes.

The Oldowan tools are usually classified by their shapes, with the understanding that differences in appearance imply different uses. Large tools include: (1) cobbles without cutting edge, but with obvious signs of being used to strike other stones, with the very appropriate name of hammerstones; (2) cobbles in which a cutting edge was obtained by striking, which served to break hard surfaces such as long bones (to reach the marrow, for example). They are called choppers; (3) flakes resulting from the blow to a core. Their edges are very sharp, as much as one of a metal tool, and their function is to cut skin, flesh, and the tendons of animals that need to be butchered. They can be retouched or not; (4) scrapers, retouched flakes with an edge which recall in some ways a serrated knife, and whose function would have been to scrape the skin into rawhide; (5) polyhedrons, spheroids, and discoids. Cores manipulated in various ways, as if flakes had been removed from their outer perimeter. Their function is uncertain; they may be nothing more than waste without particular utility.

**MODE 1: OLDOWAN CULTURE**

Taphonomic studies, aimed at reconstructing the process of accumulation of available fossil evidence at a site, have increased our understanding of the behavior of early hominins. Different East African sites (Olduvai, Koobi Fora, Olorgesailie, Peninj) provide evidence of hominin behavior benefited from the available opportunities to both scavenge and hunt.
It is not easy to arrive at definitive conclusions regarding the use of Oldowan tools. The idea we have of their function depends on the way we interpret the adaptation of hominins that used them, based on arguments that are often circular. Toolmakers can be seen, as Lewis Binford (1981) did, as a last stage in scavenging, when only large bones are available. If this were the case, the most important tools would be the hand axes that allow hitting a cranium or femur hard enough to break them. If, on the contrary, we understand that early hominins butchered almost whole animals, then flakes would be the essential tools. A functional explanation can be established between hand axes, manipulated with power grips, and flakes, which require handling them with the fingertips using a precision grip. It is not easy to go beyond this, but some authors, like Nicholas Toth (1985a,b), have carried out much more precise functional studies. Toth argued that flakes were enormously important for butchery tasks, even when they were unmodified, while he doubted the functional value of some polyhedrons and spheroids.

Several kinds of evidence have been used to resolve the question of how early hominins obtained animal proteins. One is the detailed analysis of the tools and their possible functionality. The microscopical examination of the edge of a lithic instrument allows inferring what it was used for—whether it served as a scraper to tan skin, or as a knife to cut meat, or as a hand axe to cut wood. This affords an explanation of behavior that goes beyond the possibilities of deducing a tool’s function from its shape. In certain instances lithic tools might have been used as woodworking tools. Indications of the use of wood instruments are not rare in the Late Pleistocene. In the Middle Pleistocene, the finding of plant microremains (phytoliths, fibers) on the edges of Peninj (Tanzania) Acheulean bifaces is the earliest proof of processing of wood with artifacts (Domínguez-Rodrigo et al., 2001).

The examination of the marks that tools leave on fossil bones provides direct evidence of their function. Taphonomic interpretations of cutmarks suggest hominins defleshed and broke the bones to obtain food. This butchery function related to meat intake portrays early hominins as scavengers capable of taking advantage of the carcasses of the prey of savanna predators (Blumenschine, 1987). But in some instances the evidence suggests other hypotheses. Travis Pickering et al. (2000) analyzed the cutmarks inflicted by a stone tool on a right maxilla from locality Stw 53 at Sterkfontein Member 5. The species to which the specimen belongs is unclear, but it is certainly a hominin. They noted that “[t]he location of the marks on the lateral aspect of the zygomatic process of the maxilla is consistent with that expected from slicing through the masseter muscle, presumably to remove the mandible from the cranium.” In other words, a hominin from Sterkfontein Member 5 dismembered the remains of another.

Are these marks indicative of cannibalistic practices, or are they signs of something like a ritual? The available evidence does not provide an answer to this question. It is not even possible to determine whether the hominint hat disarticulated the Stw 53 mandible and its owner belonged to the same species. But cannibalistic behaviors have been inferred from Middle Pleistocene cutmarks. This is how the cutmarks on the Atapuerca (Spain) ATD6-96 mandible have been interpreted (Carbonell et al., 2005). It has also been suggested regarding the Zhoukoudian sample (Rolland, 2004). Cannibalism seems to have been common among Neandertals and the first anatomically modern humans.

The Oldowan culture is not restricted to Olduvai. Stone tools have also been found at older Kenyan and Ethiopian sites, though in some occasions their style was slightly different. These findings have extended back the estimated time for the appearance of lithic industries (Table 44.1). For a list of Mode 1 main sites, see Plummer (2004).

Close to 3000 artifacts were found in 1997 at the Lokalalei 2C site (West Turkana, Kenya), with an estimated age of 2.34 Ma. They were concentrated in a small area, about 10 square meters, and included a large number of small elements (measuring less than a centimeter) (Roche et al., 1999). The tools were found in association with some faunal remains, but these show no signs of having been manipulated. Nearby sites, LA2A, LA2B and LA2D, and the more distant LA1 have also provided stone tools; LA1 and LA2C, with an age of 2.34 Ma, are the oldest sites with utensils in Kenya (Tiercelin et al., 2010).

The importance of the Lokalalei tools lies primarily in the presence of abundant debris, which allows establishing the sequence of tool making in situ. Helene Roche et al. (1999) have argued that the technique used by the makers of these tools required very careful preparation and use of the materials, previously unimaginable for such early hominins. This suggested that the cognitive capacities of those toolmakers were more developed than what is usually believed. One of the cores was hit up to 20 times to extract flakes, and the careful choice of the materials (mostly volcanic lavas like basalt) indicates that those who manipulated them knew their mechanical properties well.

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**TABLE 44.1 The Oldest Cultures**

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<thead>
<tr>
<th>Name</th>
<th>Localities</th>
<th>Age (Ma)</th>
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<tr>
<td>Lokalalei</td>
<td>West Turkana</td>
<td>2.34</td>
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<tr>
<td>Shungura</td>
<td>Omo</td>
<td>2.2–2.0</td>
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<tr>
<td>Hadar</td>
<td>Hadar</td>
<td>2.33</td>
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<tr>
<td>Gona</td>
<td>Middle Awash</td>
<td>2.5–2.6</td>
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Lokalalei findings indicate that hand control and, therefore, brain development, must have been already quite developed for nearly two and a half million years ago. The question of what species would have been responsible for manipulating these artifacts is a different matter, as we have repeatedly pointed out. James Steele (1999) raised the issue of the cognitive capacities and knowledge of the authors of the Lokalalei 2C tools. Steele admitted that the available evidence does not allow going beyond hypotheses similar to the one which attributed the Olduvai tools to *H. habilis* because of its larger cranial capacity compared with *P. boisei*. The Lokalalei findings indicate that almost two and a half million years ago the motor control of the hands, and thus the development of the brain, must have been considerable. The identity of the species responsible for manipulating those artifacts is a different issue, difficult to answer. In his commentary about Roche and colleagues' discovery, Steele (1999) refused to give a definitive answer. He simply argued that we still have similar doubts to those of the authors who, in 1964, associated the tools found at Olduvai with the species *H. habilis*.

The Middle Awash region includes many sites that have yielded Oldowan and Acheulean—a culture which replaced the Oldowan over time—tools, described for the first time by Maurice Taieb (1974) in his doctoral thesis. A *Homo* maxilla (AL 666-1) was found in association with Oldowan tools at Hadar (Ethiopia), to the north of Middle Awash. The sediments from the upper part of the Kada Hadar Member were estimated to 2.33 Ma; this was the earliest association between lithic industry and hominin remains (Kimbel et al., 1996). The 34 instruments found in the 1974 campaign (indicative of a low density of lithic remains) are typical of Oldowan culture: choppers and flakes. In addition, three primitive bifaces, known as end-choppers, appeared on the surface, but it is difficult to associate these tools with the excavated ones.

The earliest known instruments have been found at the Gona site (Ethiopia), within the Middle Awash area, in sediments dated to 2.6–2.5 Ma by correlation of the archaeological localities with sediments dated with the 40Ar/39Ar method and paleomagnetism (Semaw et al., 1997). Thus, they are about 200,000 years older than the Lokalalei tools.

Gona has provided numerous tools, up to 2970, including cores, flakes, and debris. Many of the tools were constructed in situ. No modified flakes have been found, but the industry appears very similar to the early samples from Olduvai. Sileshi Semaw et al. (1997) attributed the differences, such as the greater size of the Gona cores, to the distance between the site and the places where the raw materials (trachyte) were obtained; these are closer in Gona than in other instances. As hominins have not been found at the site, it is difficult to attribute the tools to any particular taxon. Semaw et al. (1997) believed it was unnecessary to suggest a “pre-Oldowan” industry. Rather, the Oldowan industry would have remained in stasis (presence without notable changes) for at least a million years. The precision of the Gona instruments led Sileshi Semaw’s team to assume that their authors were not novices, so even earlier lithic industries might be discovered in the future.

That future may have already arrived. *Nature* (Callaway, 2015) has reported the finding of stone cores and flakes, likely intentionally crafted, at the Lomekwi site, west of Kenya’s Lake Turkana. The sediments are dated 3.3 Ma, much older than *H. habilis*. Sonia Harmand of Stony Brook University in New York reported the findings at a meeting of the Paleoanthropology Society in San Francisco on April 14, 2015. Harmand’s team concluded that the tools represent a distinct culture, which they have named the Lomekwan culture. Harmand pointed out at the meeting of the Paleoanthropology Society that the cores are enormous, some weighing as much as 15 kg, which is surprising considering the small size of the australopithecines. How could they handle such large stones? And what were they used for?

Bernard Wood (1997) wondered about the authors of the tools found at the site. The great stasis of the Oldowan culture suggested by the tools raises a problem for the usual assignation of the Oldowan tradition to *H. habilis*. Given that the latest Oldowan tools are about 1.5-Ma old, this tradition spans close to a million years. This is why Wood (1997) noted that if Oldowan tools had to be attributed to a particular hominin, then the only species that was present during the whole interval was *P. boisei*. This is circumstantial evidence in favor of the notion that robust australopiths manufactured tools. But as we have mentioned several times in this book, there is no need for making a close identification between hominin species and lithic traditions, because cultural sharing must have been quite common. In any case, de Heinzelin et al. (1999) attributed the Gona utensils to the species *Australopithecus garhi*, whose specimens were found at Bouri, 96-km south of where the tools come from.

The comparison between instruments from different sites has its limitations. As Glynn Isaac (1969) noted, it is not uncommon to find that the differences between the Oldowan techniques found at different locations of the same age are as large as those used to differentiate successive Oldowan stages, or even larger. This problem illustrates that the complexity of a lithic instrument is a function of its age, but also of the needs of the toolmaker.

**THE TRANSITION MODE 1 (OLDOWAN) TO MODE 2 (ACHEULEAN)**

Mode 2, or Acheulean culture, corresponds to a new carving procedure whose most characteristic element is the biface, “teardrop shaped in outline, biconvex in cross-section, and commonly manufactured on large (more than
10 cm) unifacially or bifacially flaked cobbles, flakes, and slabs” (Noll and Pettaglia, 2003). These tools, made with great care, were identified for the first time at the St. Acheul site (France), and are known as “Acheulean industrial complex” or “Acheulean culture” (Mode 2). Acheulean culture appeared in East Africa over 1.7 Ma, and extended to the rest of the Old World reaching Europe, where the oldest Acheulean tools received the local name of “Abbevillian industry.” The life of the Acheulean continued in Europe until about 50,000 years ago, although since 0.3 Ma more advanced utensils could be found from other cultural traditions, the Mousterian or Mode 3, which we will discuss later.

Mary Leakey (1975) described the transition observable at Olduvai from perfected Oldowan tools to a different and more advanced industry. The oldest instruments of Olduvai, which come from Bed I, were in a level dated by $^{40}\text{K}/^{40}\text{Ar}$ method at 1.7–1.76 Ma (Evernden and Curtiss, 1965). The first Acheulean tools are from Bed II. Between both beds there are tuffs, but the section that corresponds to the rest of the Old World reaching Europe, where the oldest Acheulean tools received the local name of “Abbevillian industry.” The life of the Acheulean continued in Europe until about 50,000 years ago, although since 0.3 Ma more advanced utensils could be found from other cultural traditions, the Mousterian or Mode 3, which we will discuss later.

Louis Leakey (1951) had previously considered the coexistence of cultures and the evolution of Oldowan instruments as evidence of gradual change. However, subsequent studies painted another scenario. Glynn Isaac (1969) argued that the improvement of the necessary techniques to go from the Oldowan to the Acheulean traditions could not have taken place gradually. A completely new type of manipulation would have appeared with Acheulean culture, a true change in the way of carrying out the operations involved in tool making. A similar argument has been made by Silesi Semaw et al. (2009) when interpreting the sequence of cultural change. Depending on the archaeological record of Gona (Ethiopia) and other African locations, Semaw et al. (2009) concluded that the Mode II would have arisen rather abruptly by a rapid transition from the Oldowan technique.

If so, it would be important to determine exactly when that jump forward occurred and to establish the temporal distribution of the different cultural traditions. Such detailed knowledge is not easy to achieve. The Olduvai site does not reveal precisely when the cultural change took place. The earliest instruments, from Bed I, are found in a level dated to 1.7–1.76 by the potassium/argon method (Evernden and Curtiss, 1965). The later Acheulean utensils appeared at the Kalambo Falls locality at Olduvai, in association with wood and coal materials. The age of these materials was estimated by the 14C method at 60,000 years (Vogel and Waterbolk, 1967). There are other volcanic tuffs between both points, but the 1.6 Ma interval between the most recent level and Kalambo Falls limits the precision of the chronometry. This period corresponds precisely to the time of the transition between both cultures (Isaac, 1969). If we take into account the evolution within Mode 1, with developed Oldowan tools that overlap in time with Acheulean ones, the difficulties involved in the description of the cultural change increase.

The technical evolution from Mode 1 to Mode 2 can also be studied at other places, such as the Humbo Formation from the Peninj site, to the west of Lake Natron (Tanzania). After the discovery made by the Leakys and Isaac in 1967, authors such as Amini Mturi (1987) or Kathy Schick and Nicholas Toth (1993) carried out research at the Natron area. Several Natron sites show a transition from Oldowan to Acheulean cultures close to 1.5 Ma (Schick and Toth, 1993). The correlation of the Peninj and Olduvai sediments allows the identification of the Oldowan/Acheulean transition with the upper strata of Bed II from Olduvai. But neither Olduvai nor the western area of Lake Natron allow a more precise estimate of the time of the change.

Another site excavated after the works at Olduvai and Peninj, Olorgesailie (Kenya), provided precise dating (by means of the $^{40}\text{K}/^{40}\text{Ar}$ method) for the Acheulean tools from Members 5 through 8 of that Formation, but they are recent sediments, estimated to between 0.70 and 0.75 Ma (Bye et al., 1987). The precise time of the substitution of Oldowan by Acheulean tools cannot be specified. Any group of hominins capable of using Acheulean techniques could have very well employed, on occasions,

### TABLE 44.2 Cultural Sequence at Olduvai

<table>
<thead>
<tr>
<th>Beds</th>
<th>Age in Ma</th>
<th>Number of Pieces</th>
<th>Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masek</td>
<td>0.2</td>
<td>187</td>
<td>Acheulean</td>
</tr>
<tr>
<td>IV</td>
<td>0.7–0.2</td>
<td>686</td>
<td>Acheulean</td>
</tr>
<tr>
<td>Middle part of III</td>
<td>1.5–0.7</td>
<td>99</td>
<td>Acheulean</td>
</tr>
<tr>
<td>Middle part of II</td>
<td>1.7–1.5</td>
<td>683</td>
<td>Developed Oldowan A</td>
</tr>
<tr>
<td>I and lower part of II</td>
<td>1.9–1.7</td>
<td>537</td>
<td>Oldowan</td>
</tr>
</tbody>
</table>

Established by Mary Leakey (1975, Modified)
simple tools to carry out tasks which did not require complex instruments.

An illustrative example is the large number of Acheulean artifacts found at Locality eight of the Gadeb site (Ethiopia) during the 1975 and 1977 campaigns. One thousand eight hundred forty-nine elements, including 251 hand axes and knives, were found at the 8A area, a very small excavation; whereas 20,267 artifacts appeared at 8E (Clark and Kurashina, 1979). The age estimates for the different Gadeb localities with lithic remains are imprecise: they range from 0.7 to 1.5 Ma. These localities contain, in addition to Acheulean tools, developed Oldowan utensils, which led J. Desmond Clark and Hiro Kurashina (1979) to conclude that two groups of hominins would have alternated at Gadeb, each with its own cultural tradition. But it is curious that the examination of the bones from Gadeb showed that the butchery activities had been carried out mostly with the more primitive hand axes, those belonging to developed Oldowan. This fact raises an alternative interpretation, namely, that tools obtained by advanced techniques are not necessary for defleshing tasks.

Konso-Gardula (Ethiopia), south of the River Awash and east of River Omo, has allowed the most precise dating of the beginning of the Acheulean culture. In addition, it has provided the oldest-known tools belonging to that culture. Since its discovery in 1991, Konso-Gardula has provided a great number of tools, which include rudimentary bifaces, trihedral-shaped burins, cores, and flakes, together with two hominin specimens, a molar and an almost complete left mandible (Asfaw et al., 1992). The sediments were dated by the $^{40}$Ar/$^{39}$Ar method to 1.34—1.38 Ma (Asfaw et al., 1992). Berhane Asfaw and colleagues (1992) associate the Konso-Gardula hominin specimens with the Homo ergaster specimens from Koobi Fora, especially with KNM-ER 992.

THE ACHEULEAN TECHNIQUE

To what extent can the Acheulean tradition be considered a continuation or a rupture regarding Oldowan? Was developed Oldowan a transition phase toward subsequent cultures? Mary Leakey (1966) believed that developed Oldowan was associated with the presence of primitive hand axes, protobifaces that anticipated Acheulean bifaces. However, protobifaces cannot be strictly considered as a transitional form between Oldowan and Acheulean techniques. Marcel Otte (2003) argued that natural constraints (eg, mechanical laws of the raw materials) forces the manufacture of similar forms, which thus may be considered successive stages of a single or very close elaboration sequence, although this may not always be the case.

The successive manipulation of a core, passing through several steps until the desired tool is obtained, is a task that Leroi-Gourhan (1964) named chaîne opératoire (“working sequence”). While a chopper and a protobiface respond to the same chaîne opératoire, the manufacture of Acheulean bifaces is the result of a completely different way of designing and producing stone tools. The main objective of Oldowan technique was to produce an edge, with little concern for its shape. However, Acheulean bifaces had a very precise outline, which evinces the presence of design from the very beginning. The existence of design has favored speculation about the intentions of the toolmakers.

In the tradition of Leroi-Gourhan, Nathan Schlanger (1994) suggested that the sequence of operations in the making of tools reflects an intention and a mental level of some complexity. One might, accordingly, distinguish between two types of “knowledge”:

- Practical knowledge, necessary for any carving operation. It is what psychologists call “procedural knowledge,” as it is needed to ride a bicycle without falling.
- Abstract knowledge, or posing problems and their solutions. This is closer to “declarative knowledge,” such as designing a route for cycling around town from one place to another with the least risk.

An easy way to distinguish between both is to understand that declarative knowledge can be transmitted through a spoken or written description, while the procedural knowledge cannot. However, as we will discuss, it is doubtful that the Acheulean culture involves accurate mental models of the tools that will be obtained, which brings into question the very chaîne opératoire of the Acheulean. The manufacture of accessories for transporting objects such as stones would be the real innovation of Mode 2 in that hypothesis.

Despite such doubts, the most common view holds that while a chopper and a protobiface belong to the same chaîne opératoire, obtaining Acheulean bifaces is the result of an entirely different approach when designing and producing a stone tool. The most conspicuous novelty is the diversity of Acheulean instruments. Sometimes it is difficult to assign a function to a stone tool. We have already seen that Oldowan chaîne opératoire and flakes have been interpreted both as simple debris and as valuable tools. However, Acheulean tools include knives, hammers, axes, and scrapers, whose function seems clear. The materials used to manufacture lithic instruments are also more varied within the new tradition. But the most notorious difference associated with the Acheulean culture is the tool we mentioned before: the hand axe.

The work of Glynn Isaac (1969, 1975, 1978, 1984) in Olorgesailie and Peninj (Tanzania) showed the main role of hand axes in the form of large flakes (Large Flake Acheulean, LFA) of more than 10 cm, in African Lower Paleolithic tool production. The study by Ignacio de la Torre et al. (2008) on the amount of raw material used for manufacturing various tools within two lithic sets found
in Peninj, RHS-Mugulud, and MHS-Bayasi, showed convincingly that the essential goal of hominins was to obtain large cutting tools, among which are the cleavers (without retouched edge), hand axes, and flakes, to use as knives. The carving technique used followed a characteristic pattern with a succession of steps not exclusive to Peninj carvings; it is the key to the Acheulean tradition:

1. The transformation of raw materials to be converted into cutting instruments involved, first, selecting suitable large stones to carve. The availability or lack of stone quarries with such raw materials may lead to significant differences between the cultural content of different sites.

2. Once the rock is selected, it is reduced by chipping off large flakes until obtaining still sizable blocks with a suitable form to begin careful carving.

3. The blocks are worked in chaîne opératoire, obtaining three different sizes of flake: small, medium, and large. The large flake, still of considerable size, is a hand axe in its basic shape which still needs a sharpened edge.

4. Larger flakes, which contrast with the intermediate ones by size, shape, and weight, are subjected to precision carving, with a number of successive blows to achieve its edge and final form: thus, an LFA appears. The number and accuracy of the blows contrast with the less systematic and manipulated of the protobifaces.

Peninj hand axes weighed, once finished, about 1 kg, so the waste materials from the large initial stones are abundant. In the intermediate stages of the Acheulean chaîne opératoire, flakes of different sizes are obtained, which can be in turn simultaneously used as tools for further carving. Smaller chips come from preparing the blocks or from shaping the hand axe. LFA production is complex and in most hand axes there are notches of 2–3 cm long, which show that fragments, or chips, were knocked off—similar to those obtained intentionally in the Oldowan tradition—but they are actually the result of percussion while retouching. Medium-size flakes from LFA carving were found both in Olduvai and Peninj, although they are larger in the latter location (de la Torre et al., 2008). They are large but very thin flakes, so that their volume and weight are modest. They could have served for carving tasks or used as blades, just in the same condition as we have found them.

The most advanced Acheulean technique, with symmetrical bifaces and carefully carved edges, required a soft-hammer technique. This method consists in striking the stone core obtained in step 3 with a hammer of lesser hardness, such as of wood or bone. The blows delivered with such a tool allow a more precise control but requires, of course, much more labor. A detailed description of the process was provided by Schick and Toth (1993). The manipulation of large stones (mostly basalt and quartzite) for making hand axes seems to have been the turning point for the development of the Acheulean culture. Incidentally, it would also create a significant risk to those who had to manipulate stones of large size (Schick and Toth, 1993).

Schick and Toth (1993) noted that bifaces can also be obtained, in the absence of sufficiently large raw material, from smaller cores similar to those that served as a starting point for the manufacture of Oldowan choppers. But the manipulation of large blocks of material (mostly lava and quartzite) to produce long flakes seems to have been the turning point for the development of the Acheulean culture. It would also have involved risk for those who had to manipulate stones of large size (Schick and Toth, 1993).

The oldest Acheulean tool presence documented corresponds to the Kokiselei 4 site of Nachukui formation, West Turkana (Kenya). By radiometry of nearby volcanic tuffs ($^{40}$Ar/$^{39}$Ar), stratigraphic equivalence with Koobi Fora and paleomagnetism, Christopher Lepre et al. (2011) assigned to the terrain of Kokiselei 4 an age of 1.76 Ma. The site has the added advantage of also containing Oldowan utensils, which supports the idea that Mode 1 and Mode 2 technologies were not mutually exclusive. Lepre et al. (2011) argued as alternative hypotheses for the presence of Acheulean tools at Kokiselei 4, that they were either brought there from another location—unidentified yet—or carved by the same hominins of the site which produced Oldowan tools.

The last Acheulean utensils of East Africa, that is, the most recent, are from Kalambo Falls location (Tanzania), associated with coal and wood materials. The age of these materials was fixed by $^{14}$C method at 60,000 years (Vogel and Waterbolk, 1967). With regard to South Africa, tools attributed to the Late Acheulian appear in various sites—Cape Hangklip, Canteen Kopje (stratum 2A), Montagu cave, Wonderwerk cave, Rooidam, Duinefontein 2, for example—with an age of $\sim$0.2 Ma (Kuman, 2007).

**CULTURE AND DISPERAL**

The occasional presence of Oldowan tools is not proof indicating that a certain group had a primitive cultural condition. It is possible to find simple carvings in epochs and places that correspond to a more advanced industry. There is no reason to manufacture a biface by a long and complex process if what is needed at a given time is a simple flake. But the argument does not work in reverse. The presence of Mode 2 clearly indicates a technological development.

As we have seen, Oldowan culture is generally attributed to *H. habilis*. However, the identification of the Acheulean culture with the African *Homo erectus* is also very common. The strength of the bond of Acheulean/erectus led Louis Leakey to consider the emergence of Acheulean tools at Olduvai as the result of an invasion by
*H. erectus* from other localities (Isaac, 1969). Fossils of the taxon *H. habilis* are African, but numerous exemplars which can be attributed to *H. erectus* have appeared out of Africa. In fact, the taxon was named by Eugène Dubois (1894) from fossils found in Trinil, Java. Asians and African specimens had remarkable similarities, but also some differences, a fact that has led to the proposal of the species *H. ergaster* for the African *erectus* (Groves and Mazák, 1975). Although there is no general consensus on the need for that distinct taxon, those who deny the validity of *H. ergaster* commonly refer to Asian *erectus* as *H. erectus* sensus stricto, and to the African as *H. erectus* sensu lato.

Why is it necessary to propose two different species, or two degrees of the same species, when referring to *H. erectus*? One of the main reasons for the need to distinguish two groups of populations has to do with the culture. The oldest *H. erectus* of Java and China, unlike their coeval in Africa, did not exhibit Mode 2 culture.

Obviously, the occupation of Asia began with one or more African hominin dispersals. The natural way out of Africa is the Levantine corridor—Middle and Near East—a path that is widely understood as the one used by hominins during their various departures from the African continent. Located between the Black Sea and the Caspian Sea, Georgia is part of the transit area between Africa, Asia, and Europe. A site in Georgia, Dmanisi, has provided the best evidence of the first hominin exit from their continent of origin. Since the initial discovery of a jaw, D211 (Gabunia and Vekua, 1995) in Dmanisi, other cranial specimens have appeared, such as D2280 and D2282 (Gabunia et al., 2000), of modest volume—775 and 650 cm$^3$ respectively. In 2002 the existence of another cranium of the same age, D2700, was reported (Vekua et al., 2002) that had an even smaller volume: 600 cm$^3$. We offer these details to contextualize the problem of attributing to which species these fossils belong. After hesitating to attribute them to *H. habilis* or *H. ergaster*, Léo Gabunia et al. (2002) proposed for Dmanisi hominins a new species: *Homo georgicus*. Two more exemplars, a cranium D3444 and its associated jaw D3900, were discovered in 2002–2004 campaigns (Lordkipanidze et al., 2005, 2006). New postcranial specimens from Dmanisi, belonging to an adolescent and three adults, one of large size and two smaller, were described in 2007 (Lordkipanidze et al., 2007). Although the authors did not ascribe the remains to any particular species, they indicated that the Dmanisi set lack those derived features characteristic of *H. erectus*.

Besides these fossils, from Dmanisi also come stone artifacts and animal bones with cutting and percussion marks. More than 8000—some choppers and scrapers, and abundant flakes—have been found in the two stratigraphic units, A and B, of the site. Reid Ferring et al. (2011) maintained that the stratigraphic study of the Dmanisi set of lithic utensils indicates that this place was repeatedly occupied during the last segment of the Olduvai subchron, i.e., between the range of 1.85—1.78 Ma. In the authors’ opinion, such an antiquity implies that the Georgia specimens precede the African *H. erectus* or *H. ergaster* emergence.

But Dmanisi is not the only site providing us with evidence of the migration out of the African continent. In the Yiron site, to the North of Israel near the valley of the Jordan River, instruments were found in 1981 consisting of flakes of a very primitive appearance, adding to other more modern tools previously found. The primitive artifacts were found in the stratigraphic horizon below the basaltic volcanic intrusion dated by radiometry at 2.4 Ma, thus the age of Yiron tools was considered comparable to the oldest culture of Mode 1 from the Rift (Ronen, 2006).

At least four other sites in Israel have provided old lithic utensils. Chronologically, Yiron is followed by the Erk-el-Ahmar formation, a few kilometers south of Ubeidiya, also in the Jordan Valley, where cores and silex flakes were found (Tchernov, 1999). After a few failures to date it by paleomagnetism, the magnetostratigraphy of the Erk-el-Ahmar formation made by Hagai Ron and Shaul Levi (2001) correlated the normal events of the area with the Olduvai subchron, attributing it thus an age of 1.96—1.78 Ma. However, the tools appeared at 1.5 km from the collected samples. Ron and Levi (Ron and Levi, 2001) accepted an age for the silex utensils of 1.7—2.0 Ma, a date supported by fauna studies (Tchernov, 1987), and that, by the way, is coincident with that of Dmanisi. Ubeidiya (Israel) is a locality between Yiron and Erk-el-Ahmar. Between 1959 and 1999, numerous lithic instruments were found, similar in age and appearance to those at the Oldowan—Acheulean transition of Olduvai Bed II, along with cranial fragments, a molar, and an incisor attributed *Homo* sp. indet (Tobias, 1966), or to *Homo* cf. *erectus* (Tchernov, 1986). An additional incisor was described in 2002 (Belmaker et al., 2002). The horizon with hominin remains was dated by fauna comparisons and stratigraphic study at $\approx 1.4$ Ma, on the basis of the deposits age and tooth similarities with KNM-ER 15000 and the Dmanisi specimens. Miriam Belmaker et al. (2002) maintained that the last incisor found in Ubeidiya, UB 335, could be tentatively identified as *H. ergaster*. The utensils from Gesher Benot Ya’aqov are 0.8 Ma of age, dated by paleomagnetism. Finally, utensils found in Bizat Ruhama are younger than Gesher Benot Ya’aqov, which belongs to the lower part of the Matuyama chron (in both cases the information comes from Ronen, 2006).

All the tools found in these sites, which indicate the first dispersals out of Africa, are of Mode 1. Around 1.7—1.6 Ma hominins undertook various successful dispersals throughout Asia, reaching the Southeast—Java (Indonesia)—and the Far East—China. This means that vast zones of the Asian continent were occupied without
Acheulean utensils. However, later migrations brought Mode 2 out of Africa as well.

Acheulean instruments have a geographical eastern limit in the Indian subcontinent. With a detailed compilation of all the available evidence at that time, Hallam Movius (1948) established two areas: the first in Africa, West Asia, and West Europe, and the second ranging from the Far East to Southeast Asia. During the Middle Pleistocene, both had lithic industries, corresponding to different technical levels: choppers—ie, Mode 1—in the East, and bifaces—Mode 2—in the West. This is known as the “Movius line,” the virtual limit that separates these two vast areas.

The Movius line was not a permanent obstacle for a long period of time. Truman Simanjuntak et al. (2010) claimed that around 0.8 Ma a noticeable change occurred in Java, when tools emerged which have been classified as Acheulean by these authors. Ngembung cleavers are the oldest indication, followed by the three human occupations of Song Terus cave (Punung, East Java), among which the “Terus period,” of 0.3 to c. 0.1 Ma, is the oldest (Simanjuntak et al., 2010). Other Southeast Asian locations which also contain ancient lithic utensils are the island of Flores (Mata Menge site), with an age of 0.88 Ma obtained by the 40Ar/39Ar method (Zhang et al., 2010), Bukit Bunuh (Malaysia), Ogan (Sumatra), Sembiran (Bali), Nulbaki (West Timor), Wallanae (Sulawesi) and Arubo (Luzon, Philippines) (Simanjuntak et al., 2010), as sufficient examples of a Mode 2 late dispersal. The overview of the various described industries of Southeast Asia led Sheila Mishra et al. (2010) to draw several somewhat controversial conclusions with regard to cultural dispersion. First, that Mode 2 reached Java and other Asian areas. Second, an indicative sequence of an initial period with an absence of large hand axes does not actually exist in India; all occupations of Southeast Asia would have had the set H. erectus/LFA as a protagonist. Third, a more bold assumption, India might have been both the origin of Mode 2 and of H. erectus, as well as the source of what later would become their African counterparts (H. ergaster and the Acheulean technique) by a reverse dispersal from Asia to Africa.

Regarding China, the oldest tools come from the basins of Yuanmou and Nihewan. Majuangou, the eastern border of the Nihewan basin has four stratigraphic horizons in which Mode 1 utensils have appeared, which are, from top to bottom, Banshan, MJG-I, MJG-II, and MJG-III (Table 44.3).

In accordance with paleomagnetic studies, the four beds with tools of Majuangou are distributed over 340,000 years, between Olduvai and Cobb Mountain subchrons. Fossils of mollusk shells and aquatic plants indicate a lacustrine environment. The lower bed is of 1.66 Ma (Zhu et al., 2004).

In the Yangtze riverbed, Sichuan province, is Longgupo site, with Mode 1 instruments of an uncertain age. They could be 1.9—1.7 Ma, in accordance to paleomagnetism (Wanpo et al., 1995), but electron spin resonance analysis on the cave specimens’ dental enamel have indicated a much later date.

Cultural indications of very ancient human presence exist at Yuanmou, with four members, which are, from the oldest to the youngest, M1 (lacustrine and fluviolacustrine deposits), M2 (fluvi), M3 (fluvi), and M4 (fluvi and alluvial) (Zhu et al., 2008). The Member M4 in Niujiangbao has provided hominin remains and four stone tools which were found in 1973: a scraper, a small biface core, and two flakes of Mode 1 with evidence of laborious production (Yuan et al., 1984).

All the utensils of the described Chinese sites belong to Mode 1 (Oldowan). However, it has been claimed that tools from more modern locations correspond to Mode 2. Thus, Yamei et al. (2000) pointed out the presence at various sites in Bose basin, Guanxi province in Southern China, of more advanced tools. Although two-thirds of the basin contain only monoface tools, from the western area of Bose—in which the adequate raw material exists—come large cutting tools bifaces of 803,000 ± 3000 years of age, described by Yamei et al. (2000). According to that presence, Yamei et al. (2000) affirm that “Acheulean-like tools in the middle-Pleistocene of South China imply that Mode 2 technical advances were manifested in East Asia contemporaneously with handaxe technology in Africa and western Eurasia.”

In the same Bose basin, but in its northern zone—Fengshudao site—were found an industry set with an abundance of hand axes, although smaller in size, of an age of 0.8 Ma, obtained by the 30Ar/39Ar method (Zhang et al., 2010). Pu Zhang et al. (2010) attributed these

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**TABLE 44.3 Stratigraphic Horizons With Lithic Tools of Majuangou (Zhu et al., 2004)**

<table>
<thead>
<tr>
<th>Bed</th>
<th>Location</th>
<th>Area (m²) × Depth (in cm) of the Excavation</th>
<th>Year</th>
<th>Number of Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banshan</td>
<td>44.3–45 m</td>
<td>2 × 70</td>
<td>1990</td>
<td>95</td>
</tr>
<tr>
<td>MJG-I</td>
<td>65.0–65.5</td>
<td>20 × 50</td>
<td>1993</td>
<td>111</td>
</tr>
<tr>
<td>MJG-II</td>
<td>73.2–73.56</td>
<td>40 × 36</td>
<td>2001–2002</td>
<td>226</td>
</tr>
<tr>
<td>MJG-III</td>
<td>75.0–75.5</td>
<td>85 × 50</td>
<td>2001–2002</td>
<td>443</td>
</tr>
</tbody>
</table>
characteristics to Fengshudao industry and, in particular, the absence of cleavers due to the lack of adequate raw material (big blocks). In their view, the tools correspond to the variability of the Acheulean, with its own particularities, such as unidirectional carving.

AN ANCIENT MODE 2 IN ASIA?

The cultural dispersal hypotheses, as the one by Sheila Mishra et al. (2010) mentioned before, or any other argument in favor of an ancient Mode 2 in the Far East (Java and China), such as that of Hou Yamei et al. (2000), stumble upon the idea of Asia colonization, which is widely accepted as the most probable and based on the Movius model. In fact, the controversy between the idea of an ancient presence of LFA in Java and the Movius line is more substantial. Mishra et al., in a paper of 2010 as well as in other previous works, denied the presence of different chaînes opératoires characteristics of Mode 1 and Mode 2, which is tantamount to denying the distinction between these two techniques. If it is the same industry with a higher or lesser development encompassing the entire ancient world, then the Movius line lacks meaning. However, in spite of the limitations of a simple geographic scheme, the common view accepts the Movius line, although its meaning has been much debated and there are still details to be explained, such as the absence of bifaces in Eastern Europe.

A cultural dispersal synthesis of the Middle Paleolithic highlights the following points indicated by Ofer Bar-Yosef and Miriam Belmaker (2011):

- absence of Acheulean culture in Southeast Asia
- presence in numerous locations of Mode 2 in Western Asia—Near East—decreasing abundance of bifaces as we approach the East—Caucasus and Anatolia
- discontinuity between the two areas with evident presence of Mode 2, the Levant, and India
- absence of Mode 2 in China, with the exception of Bose basin

The best explanation for cultural dispersal patterns of that kind requires that migrations from and to the west were discontinuous, in subsequent waves. But the evidence in relation to Java indicated by Sheila Mishra et al. (2010) cannot be thus justified. Critiques, like that of Parth Chauhan (2010), point to an incorrect age estimation due to inherent dating problems of the $^{230}\text{Th}^{234}\text{U}$ technique. Although it is possible that the Acheulean arrived in Southeast Asia as early as the Brunhes-Matuyama limit, ie, 0.78 Ma, additional evidence is required.

Naturally, the problem of cultural dispersal doesn’t end with the absence or presence of Mode 2 in the Far East. Indeed, local particularities lead to the need to make more precise distinctions to account for what was an evolution subject to large population movements. As Marcel Otte (2010) has said, the Movius line exists, rather, as a frontier, it is like a veil which moves as time passes by the hand of ethnic traditions. Neither these should be confused with carving techniques, nor is it possible to identify a biface or hand axe with an Acheulean utensil. In the strictest sense, Mode 2 refers to a specific chaîne opératoire which never is the first to appear in a site, nor is it required to be exclusive, because it can coexist with simpler carvings. Otte (2010) recognized that, exceptionally, bifaces are present in the Middle Paleolithic of China, but a close look at Bose hand axes led him to argue that they cannot be considered Mode 2 at all. They would be the result of a discovery: from cores of adequate origin, bifaces could be obtained with not much manipulation. The procedure is the opposite of Olorgesailie or Peninj technique, in which a huge block is flaked to obtain LFA. In an unfortunate expression, Marcel Otte (2010) qualified the Chinese Acheulean as a “research artifact.” In the best of cases, it could be considered as cultural parallelism.

THE TRANSITION MODE 2 (ACHEULEAN) TO MODE 3 (MOUSTERIAN)

Mode 3, or Mousterian culture, is the lithic tool tradition that evolved in Europe from Acheulean culture during the Middle Paleolithic. The name comes from the Le Moustier site (Dordogne, France), and was given by the prehistorian Gabriel de Mortillet in the 19th century, when he divided the Stone Age known at the time in different periods according to the technologies he had identified (Mortillet, 1897). Mortillet introduced the terms Mousterian, Aurignacian, and Magdalenian, in order of increasing complexity, to designate the tools from the French sites of Le Moustier, Aurignac, and La Magdalene. However, as we said earlier, almost all the sites belonging to the Würm glacial period mentioned in the previous chapter contain Mousterian tools. In many instances, their lower archaeological levels also show the transition of Acheulean to Mousterian tools, and even from the latter to Aurignacian ones. The archaeological richness and sedimentary breadth of some of these sites, like La Ferrassie, La Quina, and Combe-Grenal, grants them a special interest for studying the interaction between cultural utensils and adaptive responses. Most European sites belonging to the Würm glacial period contain Mousterian tools. Similar utensils have appeared in the Near East, at Tabun, Skuhl, and Qafzeh.

Mousterian techniques changed in time. Geoffrey Clark’s (1997) study of the Middle and Upper Paleolithic cultural stages convincingly demonstrated how wrong it is to speak about “Mousterian” as a closed tradition, with precise limits, or as a unit with precise temporal boundaries. Even so, we will talk about a Mousterian style, as Clark
himself did, which becomes apparent when compared with the Upper Paleolithic technical and artistic innovations which constitute Mode 4. However, to understand the magnitude of Mode 3, we must extend the consideration of “Mousterian culture” from lithic tools to other products and techniques that appear at Mousterian sites. In a broad sense, Mode 3 culture includes controversial features, such as objects created with a decorative intention and indications of funerary practices.

Let us begin with the Mousterian tool-making techniques. They were used to produce tools that were much more specialized than Acheulean ones. The most typical Mousterian tools found in Europe and the Near East are flakes produced by means of the Levallois technique, which were subsequently modified to produce diverse and sharper edges. Objects made from bone are less frequent, but up to 60 types of flakes and stone foils can be identified, which served different functions (Bordes, 1979).

The Levallois technique appeared during the Acheulean period, and was used ever since. The oldest Levallois carvings are probably c. 400 ka and come from the Lake Baringo region (Kenya) (Tryon, 2006). Its pinnacle was reached during the Mousterian culture. The purpose of this technique is to produce flakes or foils with a very precise shape from stone cores that serve as raw material. The cores must first be carefully prepared by trimming their edges to remove small flakes until the core has the correct shape. Thereafter, with the last blow, the desired flake—a Levallois point, for instance—is obtained. The final results of the process, which include points, scrapers, and other instruments, are subsequently modified to sharpen their edges. The amazing care with which the material was worked constitutes, according to Bordes (1953), evidence that these tools were intended to last for a long time in a permanent living location.

Tools obtained by means of the Levallois technique are, as we said earlier, typical of European and Near East Mousterian sites. Bifaces, on the contrary—so abundant in Acheulean sites—are scarce. The difference has to do mostly with the manipulation of the tools; scrapers were already produced using Acheulean, and even Oldowan, techniques. The novelty lies in the abundance and the careful tool retouching.

NEANDERTALS AND MOUSTERIAN CULTURE

Both in spatial and temporal terms, the Mousterian culture coincides with Neandertals. This identification between the Mousterian culture and Homo neanderthalensis has been considered so consistent that, repeatedly, European sites yielding no human specimens, or with scarce and fragmented remains, were attributed to Neandertals on the sole basis of the presence of Mousterian utensils. Despite the difficulties inherent in associating a given species with a cultural tradition, it was beyond doubt that Mousterian culture was part of the Neandertal identity. Exclusively?

This perception changed with the reinterpretation of the Near East sites (Bar-Yosef and Vandermeersch, 1993). Scrapers and Levallois points, which were very similar to the typical European ones, turned up there. Neandertals also existed there, of course, but in contrast with European sites a distinction could not be drawn between localities that had housed Neandertals and anatomically modern humans solely on the grounds of the cultural traditions. The more or less systematic distinction between Neandertal—Mousterian and Cro-Magnon—Aurignacian helped to clarify the situation in Europe. But it could not be transferred to the Near East, where sites occupied by Neandertals and those inhabited by anatomically modern humans, proto-Cro-Magnons, yielded the same Mousterian tradition utensils.

This coincidence implies several things. First, that cultural sharing was common during the Middle Paleolithic, at least in Levant sites. Second, that during the initial stages of their occupation of the eastern shore of the Mediterranean, anatomically modern humans made use of the same utensils as Neandertals. Hence, it seems that at the time Skuhl and Qafzeh were inhabited, there was no technical superiority of modern humans over Neandertals. The third and most important implication has to do with the inferences that can be made because Neandertals and H. sapiens shared identical tool-making techniques. As we have already seen, the interpretation of the mental processes involved in the production of tools suggests that complex mental capabilities are required to produce stone tools. We are now presented with solid proof that Neandertals and modern humans shared techniques. Does this mean that Neandertal cognitive abilities to produce tools were as complex as those currently characteristic of our own species? Many authors, headed by Trinkaus, Howells, and Zilhão, believe so. But some authors arguing in favor of high cognitive capacities in Neandertals went beyond lithic culture shared at the Near East. They presented other kinds of items which, in their opinion, were indications of Neandertal aesthetic, religious, symbolic, and even maybe linguistic, capacities.

The possibility that Neandertals buried their dead is the best basis to attribute transcendental thought to them. Voluntary burial is indicative of respect and appreciation, as well as a way to hide the body from scavengers. This may also imply concern about death, about what lies beyond death, and the meaning of existence. The argument for religiousness is convincing when burial is accompanied by some sort of ritual.

Neandertal burials have been located in four areas: Southern France, Northern Balkan, the Near East (Israel and Syria), and Central Asia (Iraq, Caucasus, and Uzbekistan). In most cases these burials seem to be deliberate.
Hence, the “old man” from La-Chapelle aux Saints appeared in a rectangular hole dug in the ground of a cave that could not be attributed to natural processes (Bouysssonie et al., 1908). In regard to La Ferrassie and Shanidar, the possible evidence of the existence of tombs led Michael Day (1986) to remark, in a technical and unspeculative treatise, that these exemplify the first intentional Neandertal burial that has been reliably determined. Eric Trinkaus’ (1983) taphonomic considerations point in the same direction. The abundance and excellent state of Neandertal remains at those sites, together with the presence of infantile remains, are proof that the bodies were out of the reach of scavengers. Given that there is no way natural forces could produce those burials, Trinkaus believes the most reasonable option is to accept that the remains were intentionally deposited in tombs. However, William Noble and Ian Davidson (1996) argued that, at least in the case of Shanidar (Iraq), it is probable that the cave’s ceiling collapsed while its inhabitants were sleeping.

Some of the aforementioned remains are not only buried intentionally, but they are accompanied by evidence of rituals. This is the case of the Kebara skeleton (Israel), which, despite being excellently preserved—it even includes the hyoid bone—is lacking the cranium. Everything suggests that the absence of the cranium is due to deliberate action carried out many months after the individual died (Bar-Yosef and Vandermeersch, 1993). It is difficult to imagine a different taphonomic explanation. Bar-Yosef and Vandermeersch (1993) wondered about the reasons for such an action, suggesting that the answer might lie in a religious ritual.

A Neandertal tomb with an infantile specimen was found in the Dederiyeh cave (Syria), 400-km north of Damascus. Takuru Akazawa et al. (1995) interpreted the burial as an indication of the existence of a ritual. The reason behind this argument is the posture in which the specimen was deposited in the tomb. The excellently preserved skeleton was found with extended arms and flexed legs. Mousterian lithic industry also turned up in the cave, which Akazawa et al. (1995) associated with that from Kebara and Tabun B, though there were few tools at the burial level. An almost rectangular limestone rock was placed on the skeleton’s cranium, and a small triangular piece of flint appeared where the heart had once been. Although Akazawa et al. (1995) did not elaborate an interpretation of these findings, they implicitly suggest that these objects had ritual significance.

The Shanidar IV specimen is one of the most frequent references in relation to ritual behaviors. The discovery of substantial amounts of pollen at the tomb was interpreted as evidence of an intentional floral offering (Leroi-Gourhan, 1975). If this were the case, it would represent the beginning of a custom that lasts today. It must not be forgotten either that two of the Shanidar crania, I and V, show a deformation that was attributed to aesthetic or cultural motives. However, Chris Stringer and Eric Trinkaus (1981) indicated that the specimens had been reconstructed incorrectly and that the shape of the first one was due to pathological circumstances. In his study of the Shanidar IV burial, Ralph Solecki (1975) argued that there is no evidence of an intentional deposit of flowers at the burial. The pollen must have been deposited there in a natural way by the wind. Supporting the notion of an unintentional presence, Robert Gargett (1989) suggested that the pollen could have been introduced simply by the boots of the workers at the cave’s excavation. Paul Mellars (1996) believes that the accidental presence of objects at French burial sites, such as La Ferrassie or Le Moustier, is inevitable: the tombs were opened at places in which faunal remains and Mousterian utensils were abundant.

The Teshik-Tash site (Uzbekistan), located on high and precipitous terrain, contains an infantile burial associated with wild goat crania. According to Hallam Movius (1953), the horns formed a circle around the tomb. This would support a symbolic purpose and a ritual content associated with the burial. Currently, however, even those who favor Neandertals as individuals with remarkable cognitive capacities are quite skeptical about the presumed intentional arrangement of the crania (Trinkaus and Shipman, 1993; Akazawa et al., 1995; Mellars, 1996).

Neandertal burials can be interpreted as a functional response to the need of disposing of the bodies, even if only for hygienic reasons. But they could also be understood as the reflection of transcendent thinking, beyond the simple human motivation of preserving the bodies of deceased loved ones. According to Mellars (1996), “we must assume that the act of deliberate burial implies the existence of some kind of strong social or emotional bonds within Neandertal societies.” However, Mellars believes that there is no evidence of rituals or other symbolic elements in those tombs. The appearance of such evidence would demonstrate that Neandertals were capable of religious thinking. Similarly, Gargett (1989) argued that the evidence of Neandertal burials is much more solid than the evidence of offering or rituals. Julien Riel-Salvatore and Geoffrey A. Clark (2001) have noted that applying Gargett’s criterion to the Early Upper Paleolithic would also lead to doubting the intentionality of the first modern human burials. They believe that there is a continuity, regarding the tombs, between the Middle and Early Upper Paleolithic archaeological records. True differences do not appear until the Late phase of the Upper Paleolithic (20–10 ka).

However, Neandertal burials contrast sharply with the burials made by modern humans, living approximately at the same time. The differences are especially illustrative in the Near East. The only intentional, and potentially symbolic, funerary Middle Paleolithic objects are the bovid and pig remains found in burials at Qafzeh and Skuhl.
(Mellars, 1996). Both appeared in modern human sites. Taking into account that humans and Neandertals living at those sites shared the same Mousterian tradition, this is a significant difference. It not only has to do with the manufacture of objects, but with much more subtle aspects, which are associated with mental processes like symbolism, aesthetics, or religious beliefs.

William Noble and Ian Davidson (1996) stressed that Neandertal burials have not been found outside caves. In contrast, there are examples of very early human tombs in open terrains at places such as Lake Mungo (Australia). Around these dates more developed technocomplexes appeared in Europe. Industries called “transitional,” to contrast them with the “real” Mode 4, a set of cultural traditions of the Upper Paleolithic, coincided with the entry of the first modern humans, the Cro-Magnon, into Europe between 40 and 28 ka. Traditions of the Upper Paleolithic include not only tools that are more precise and sophisticated than those from the earlier Mousterian culture but also abundant representations of real objects in the form of engravings, paintings, and sculptures, realistic representations that display significant differences in favor of the development of Mode 4. A good example is the large mammal paintings of the Chauvet cave, dated by radiocarbon calibration (14C) at c. 36 ka (von Petzinger and Nowell, 2014). Such a realistic intensity of the polychromes of the Upper Paleolithic have led to the argument that modern humans achieved an artistic revolution explainable only by a corresponding cognitive revolution attaining what we call the “modern mind.” Does this cognitive revolution appear suddenly and exclusively in our species?

As McBrearty and Brooks (2000) pointed out, the proposal of a cognitive revolution repeats a scenario introduced in the 19th century with the Age of the Reindeer (Lartet and Christy, 1865–1875). Around the 1920s the Upper Paleolithic was generally characterized by the presence of sculptures, paintings, and bone utensils. But according to McBrearty and Brooks (2000), the evidence used to determine the changes between the Lower, Middle, and Upper Paleolithic was always taken from the Western Europe archaeological record. During the last glacial period, the human occupation of that area was irregular, as F. Clark Howell (1952) pointed out, with populations periodically reduced, or even extinguished. McBrearty and Brooks (2000) argued that the “revolutionary” nature of the European Upper Paleolithic is mainly due to the discontinuity in the archaeological record, rather than to cultural, cognitive, and biological transformations, as suggested by advocates of the “human revolution.” Instead, McBrearty and Brooks (2000) hold that there was a long process that gradually led to the European Aurignacian richness.

Was the transition to the European Aurignacian gradual or sudden? To analyze the process of change from Mode 4 to Mode 5, which is the same as specifying the time and mode of the emergence of the modern mind, we need to clarify a number of interrelated processes:

- the appearance of *H. sapiens*
- its dispersal from the place of origin
- cultural development leading to the industries of the European Upper Paleolithic

The first step to clarify the origin of the modern mind raises the issue of identification of the oldest members of our species. The name Cro-Magnon corresponds to fossils discovered in 1868 near Eyzies-de-Tayac (Dordogne), of c. 30 ka of age, obtained by comparison with 14C date of the Aurignacian levels of the Pataud rock shelter (Dordogne) (Henry-Gambier, 2002), but applied in general to the first modern humans which entered Europe. The first entry could have been around ≈45 ka (Paul Mellars, 2005) (we will come back later to this issue). However, the age of *H. sapiens* would be considerably older. The numbers obtained by molecular methods have a remarkably broad range: 290–140 ka (Cann et al., 1987); 249–166 ka (Vigilant et al., 1991) obtained by coalescence of mtDNA. But, the paleontological record contains exemplars tentatively attributed to *H. sapiens* of much older age. The 640 ka old specimens from Bodo (Clark et al., 1994), if the “Bodo man” is thought to be a modern human, would make the origin of *H. sapiens* much older. The origin of our species would go even further back if the Danakil specimen, with almost a million years of age (Abbate et al., 1998), is included. All these fossils, besides their dubious ascription, are of a very different age than that indicated by molecular methods.

If we merely consider those specimens whose attribution to our species is most likely, various cranial materials from Aduma region (Middle Awash) should be mentioned, including the partial skull ADU-VP-1/3. Found on the surface, their age was attributed by morphological comparisons. When Yohannes Haile-Selassie et al. introduced them, they claimed that these crania “are similar in preserved parts to specimens from the Middle East, and from...
northern and eastern Africa, between 100 and 300 ka. Specifically, the most complete Aduma cranium is most similar to crania thought to belong to the younger part of that range. This Middle Stone Age cranium, in most of its characters, is indistinguishable from other anatomically modern human crania” (Haile-Selassie et al., 2004). From the same formation, found on the surface, is the parietal BOU-VP-5/1, also attributed to H. sapiens (Haile-Selassie et al., 2004). In the Herto Member of the Bouri formation appear fossils, such as the cranium BOU-VP-16/1 (White et al., 2003), which were classified as H. sapiens by Tim White et al. The age of Herto specimens, obtained by 40Ar/39Ar method, is of 160–154 ka (Clark et al., 2003). From Singa (Sudan) came a calvarium found in 1924 and ascribed to H. sapiens (Rightmire, 1984) whose dating by mass-spectrometric U-Th is of 133 ± 2 ka (McDermott et al., 1996). Günther Bräuer et al. (1997) proposed that the oldest modern humans evidences would be a cranium (KNM-ER 3884) and a femur (KNM-ER 999) from Koobi Fora (Kenya), dated by uranium series, respectively, at 270 and 300 ka. Nevertheless, the most interesting fossils are the South African.

Along with its role in documenting cultural evolution—which we will see soon—South Africa has also provided evidence on the origin and dispersals of the first H. sapiens. Various sites from the most southerly part of South Africa, near Cape Town, such as Border cave (de Villiers, 1973), Klasies River Mouth (Singer and Wymer, 1982), Equus cave (Grine and Klein, 1985), Die Kelders cave, Blombos cave (Henshilwood et al., 2001), Sibudu (Backwell et al., 2008), Hofmeyr (Grine et al., 2007) and Hoedjiespunt (Berger and Parkington, 1995), among others, have provided the most important samples of the emergence of modern humans. The fossils from these sites are normally of lesser significance and of dubious dating. But the importance of the association between fossil specimens and archaeological remains in South Africa lies in the fact that the Khoe-San hunter-gatherers, the oldest living identified ethnicity, are found there. Their separation from the rest of human populations occurred at least 100,000 years ago (Schlebusch et al., 2012); thus, the age of our species should be older than that.

The evidence of an earlier division of H. sapiens populations reveals that the transit from Mode 3 to Mode 4 could not be deduced by comparison between the technological level of Neandertals and Cro-Magnon in the range of ≈40 ka. It must be found in the cultural development of H. sapiens in Africa, which took place at a time (100–200 ka) when the appearance and early evolution of our species occurred. A review of African cultural evolution of that period reveals the meaning of the proposed model of gradual change by McBrearty and Brooks (2000) to which we referred earlier.

THE AFRICAN MIDDLE STONE AGE

The traditional consideration of the African archaeological record was influenced by the scheme used to create the European sequence of Lower, Middle, and Upper Paleolithic stages. The cultural phases of Africa were consistently grouped into Early, Middle, and Late Stone Age (ESA, MSA, and LSA, respectively). ESA encompasses not only Mode 1 but also Mode 2, so that the difference between the cultural level of ESA and MSA comes from innovations that go beyond the tools of the Acheulean culture. If ESA is linked especially with large bifaces (LFA hand axes), the MSA has been traditionally characterized by the absence of large bifaces, an emphasis on Levallois technology, and the presence of points (Goodwin and Van Riet Lowe, 1929).

Both East Africa as well as South Africa contain evidence of an ancient presence of MSA technocomplexes. In addition to the findings on the surface, whose age is imprecise, about 60 sites in East Africa susceptible to dating which contain MSA utensils (Basell, 2008) have been described. According to the review by Laura Basell (2008), their ages range from <200 ka to about 40 ka. The beginning of MSA could be even much older. Jayne Wilkins (2013) indicated that there are MSA utensils at Kathu Pan 1 site (Northern Cape, South Africa) of an age of up to ≈500 ka.

In principle, ESA and MSA could be distinguished simply by the presence of hand axes or points. But, as clarified by Sally McBrearty and Christian Tryon (2006), the sites normally lack tools capable of leading to a formal classification. The problem is that “formal tools are vastly outnumbered at nearly all sites by flakes, cores, and expedient tools, and the basic flake and core artifact inventories [of the Acheulean and MSA], are in many cases indistinguishable” (McBrearty and Tryon, 2006). In the absence of reliable dating, we face the fact that the method of direct percussion is not an accurate chronological marker. However, MSA can also be associated with “blade and microlithic technology, bone tools, increased geographic range, specialized hunting, the use of aquatic resources, long distance trade, systematic processing and use of pigment, and art and decoration” (McBrearty and Brooks, 2000). And among the innovations related to hunting are procedures and resources that were attributed initially to Mode 4 of European Cro-Magnon, as is the use of hafting adhesives, identified in the South African MSA (Charrié-Duhamel et al., 2013).

Considering the novelty of compound-adhesive manufacture, the age of the emergence of the oldest MSA is fixed at ≈300 ka (Henshilwood and Dubreuil, 2012; Wadley, 2010). Dates of that range are similar to those of the lower horizon of Gademotta formation (Ethiopia), 276 ± 4 ka (Morgan and Renne, 2008) and the Bedded Tuff Member
of Kapthurin formation (Kenya), 284 ± 24 ka (Deino and McBrearty, 2002), obtained both by ⁴⁰Ar/³⁹Ar. However, as argued by Robert Foley et al. (2013) “The majority of MSA sites postdate 130 Ka, and it is from the beginning of MIS 5 (≈ 130–74 Ka) and during MIS 4 (74–60 Ka) that the classic African MSA becomes widespread and abundant.”

South African sites have allowed the study in greater detail of the development of MSA, especially in its final stages, and the transition to LSA.

There are several concurrent processes at the temporal range of 80–60 ka: the expansion of modern human populations, their exit from Africa, and the emergence of technological and symbolic innovations associated with the modern mind. Naturally, the possibility of specifying dates, in particular for new tools, becomes the key to relate all those events. The final stages of cultural evolution within the MSA correspond in South Africa to the traditions of Still Bay (SB) and Howiesons Poort (HP), widespread in the southern cone of Africa. The study of Zenobia Jacobs et al. (2008) characterizes SB as flake-based technology, which includes finely shaped, bifacially worked, lanceolate points that were probably parts of spearheads. On the other hand, HP is described as “blade-rich … associated with backed (blunted) tools that most likely served as composite weapons, made of multiple stone artifacts.” However, both traditions share “associated bone points and tools, engraved ochres and ostrich eggshells, and shell beads.” Four South African sites are particularly useful to detail the scope of SB and HP phases: Diepkloof, Sibudu, Blombos, and Klasies River. The first two because they have tools of both traditions. Blombos, because the abundance of engravings, pigments, and perforated beads. Klasies River, because the fossil remains led to clarification of which hominins were responsible for the transition from MSA to LSA. This is something of special interest because both SB and HP already show different innovations which previously were associated only with the most advanced culture of the Upper Paleolithic.

Sibudu cave, located in KwaZulu-Natal North coasts, near Durban (South Africa), include a remarkable sequence of MSA occupations extending over a short timeframe. The first MSA tools which appeared in the Marine Isotope Stage (MIS) 4, ie, are older than ≈ 61 ka. From that point, phases follow one after another: pre-SB, SB, HP, post-HP, and late and final MSA phases directly overlain by Iron Age occupation (Backwell et al., 2008). The final phases, post-HP, of Sibudu have been studied by Manuel Will et al. (2014), attributing to MIS 3 around 58 ka. This proliferation of different traditions over a short period may have been related to both climate change as well as the tendencies of hunter-gatherers in regard to their use of local resources.

Diepkloof Rock Shelter shows a similar succession. It is located on the west coast of South Africa (Western Cape Province), 14 km from the Atlantic at the Table Mountain Group, very close to various sites with MSA industry. The excavation completed up to 2013 reveals the following sequence: MSA (type “Mike”); Pre-SB-SB-Early HP-MSA (type “Jack”); Interim. HP-Late HP-Post-HP (Porraz et al., 2013b). The change from SB-HP in Diepkloof is abrupt and that rapid shift has been interpreted in three ways: a population replacement, a discontinuity in the archaeological record, and/or a fast innovation, with a new way of hafting (and using) tools (Igreja and Porraz, 2013). However, Porraz et al. (2013b) disagree with the hypothesis connecting the appearance of the SB and the HP to the arrival of new populations. Instead, the authors support a scenario based on local evolution with distinct technological traditions that coexisted in South Africa during MIS 5. As argued by Porraz et al. (2013a), during MIS 5 there was “the coexistence of multiple, distinct technological traditions. We argue that the formation of regional identities in southern Africa would have favored and increased cultural interactions between groups at a local scale, providing a favorable context for the development and diffusion of innovations …” The southern African data suggest that the history of modern humans has been characterized by multiple and independent evolutionary trajectories and that different paths and scenarios existed toward the adoption of ‘modern’ hunter-gatherer lifestyles.” Within that independent evolution SB and HP traditions appear and disappear at the sites in very short periods. But on the whole these technocomplexes “are neither of short duration in time, nor homogeneous across space” (Porraz et al., 2013b). Consequently, for Porraz et al. (2013b), the traditions SB and HP cannot be considered as horizon markers.

**THE PROTAGONISTS OF THE SOUTH AFRICAN MSA**

Jayne Wilkins (2013) pointed out the general characteristics of the human evolution related to the development of MSA in South Africa. For this author the earlier MSA is “generally attributed to a group of hominins that are variably described as late archaic H. sapiens, or H. helmei [meanwhile] by ∼195–150 ka, anatomically modern human fossils are known from East Africa … and modern H. sapiens are responsible for the later MSA” (Wilkins, 2013).

In a review article that overviews how the South African Pleistocene Homo fossil record correlates with the Stone Age sequence, Gerrit Dusseldorp et al. (2013) have argued about the basic problem to establish the correlation between fossils and tools: few South African hominin fossils can be placed between ≈200 ka and 110 ka, ie, during the probable dates of transformation from
Mid-Pleistocene Homo to modern H. sapiens in the region. With an age ranging between \( \approx 110 \) and \( 40 \) ka, specimens appeared at Klasies River, such as jaws KRM 41,815 and 16,424 and the cranial fragments KRM 27,070 attributed to H. sapiens. From Border cave site came the jaw BC 5, with an accurate dating of \( 74 \pm 5 \) ka, obtained by electronic spin resonance from a tooth fragment (Grün et al., 2003). In such a manner, \( 74,000 \) years would be the minimum age for the presence of H. sapiens in South Africa (a complete list of Early, Middle Pleistocene, and Modern Homo of South Africa is given in Dusseldorp et al., 2013, Supplementary material).

The set of South African fossils, associated with MSA technocomplexes mainly belong to MIS 5 and MIS 4, and can be called “transitional.” Its morphology is modern, but the process of gracilization, leading to the form and dimensions of contemporary populations, was not yet completed (Dusseldorp et al., 2013). As Dusseldorp et al. (2013) said: “On the whole, the fossil record from this period suggests that South Africa was occupied by populations showing a wide range of anatomical variation.”

Between the end of MSA and the beginning of LSA, two complete fossils of modern morphology are available in South Africa: the Hofmeyr skull and the jaw of Bushman Rock Shelter. Both specimens are attributed to MIS 3, with an age for the child’s jaw of Bushman Rock Shelter—assigned tentatively to site levels 16 or 17—of \( \approx 29.5 \) ka (Protsch and de Villiers, 1974). The Hofmeyr skull has been dated at \( 36.2 \pm 3.3 \) ka by thermoluminescence and uranium series. The phenetic affinities of the Hofmeyr skull were studied by Frederick Grine et al. (2007) using a multivariate analysis of linear measurements, as well as the coordinates of 19 three-dimensional points in comparison with those of modern humans from North Africa (Meso-lithic), sub-Saharan Africa, West Eurasia, Oceania, and East Asia/New World, along with two Neandertals, four Upper Paleolithic modern humans, and one modern human from the Levant, also of Upper Paleolithic. The result of the analysis indicates that the anatomy of the Hofmeyr skull is closer to that of modern human populations from Eurasia of the Upper Pleistocene than to the current Khoe-San (Grine et al., 2007). This result supports, according to Grine et al. (2007), the hypothesis that early modern humans, which migrated to Eurasia, came from South Africa.

This anatomical connection, the presence of an advanced technology of tool making and the evidence of the emergence of what could be called modern behavior, in cognitive terms which go beyond the technological level, make South Africa a site of great value to understand the last steps of human evolution. In this respect Blombos site becomes important. Its human remains provide only a little information; during 1997—1998 campaigns, four teeth were found in Blombos cave, two of them deciduous teeth, some of which, with respect to the crown diameter, belong to the modern human range. But the peculiarity of Blombos is linked to the presence of ocher pieces.

The presence of red ocher—hematite (iron oxide)—is very common in all South African sites of the Late MSA, and stones with signs of use have striations which are attributed widely to the acquirement of powder for pigment making. In the absence of polychrome on the walls of caves, it is possible to infer that the use of the pigment is related to other symbolic behavior. As argued by Christopher Henshilwood et al. (2001), one intuitive conclusion, shared by most archaeologists, is that MSA ocher was used for body-paint/cosmetic and possibly the decoration of organic artifacts. But, in the absence of empirical evidence, that hypothesis is entirely speculative. Blombos’ value lies in the contribution of evidence linking ocher and symbolism.

Blombos cave is located near the Indian Ocean, 25 -km west of SB town and 300 -km east of Cape Town. The site is located 100 m from the coast and at an elevation of 34.5 m above sea level. In Blombos MSA levels more than 8000 pieces of ocher have been found, many with signs of use (Henshilwood et al., 2002), among which the most outstanding are the geometric engravings, present in the three sedimentary phases of Blombos, thus, over nearly 100 ka (Henshilwood et al., 2009). As Henshilwood et al. (2009) pointed out, “The fact that they were created, that most of them are deliberate and were made with representational intent, strongly suggests they functioned as artefacts within a society where behavior was mediated by symbols.” In other words, we find an empirical example of the “new mind.” Blombos documents undoubtedly the presence of Mode 4.

THE WAY OUT OF AFRICA FOR HOMO SAPIENS

The process leading to modern humans, from their emergence and development of Mode 4 in Africa, to their entry into Europe, and to the “artistic explosion” that appears in the caves of Southern France and Northern Spain, is controversial. To clarify the ancestral genetic blueprint of current humans, Toomas Kivisild et al. (2006) conducted an analysis of the whole mtDNA of 277 individuals from five African haplogroups, L0 to L5. The most parsimonious cladogram obtained shows that the L0d, corresponding to Khoe-San people, is the ancestral subhaplogroup with respect to the rest of Africans. Recent analysis of single nucleotide polymorphisms (SNPs) in the nuclear DNA, supported the sub-Saharan origin of modern humans (Jakobsson et al., 2008; Li et al., 2008). The details of Khoe-San genetic variation have been offered by Carina Schlebusch et al. (2012) by genotyping \( \approx 2.3 \) million SNPs in 220 South Africans. The results of the study indicated
that the divergence between the Khoe-San and other modern African humans took place more than 100,000 years ago—that is to say, near the very beginning of the emergence of H. sapiens—although the genetic distribution of the modern day Khoe-San goes back only about 35,000 years.

Paul Mellars (2006b) has proposed a model for the origin and dispersal of modern humans, which could be summarized in the following events:

- genetic evidence:
  - MIS 5 (130−80 ka)
    - Presence of H. sapiens in the Near East
    - Evolutionary changes in South Africa
  - MIS 4 (71−60)
    - Expansion to Africa
    - Dispersal to Eurasia
- Archaeological evidence
  - MIS 5
    - Emergence of the “modern mind” in South Africa
    - Dispersal to North Africa and the Near East
  - MIS 4
    - Dispersal of the “modern mind” into Eurasia

A key element of this model is formed by the episode of \( \approx 65 \) ka ago, with a coastal dispersal of H. sapiens populations which took advantage of high-productivity areas of resources to expand into Asia until they reached the Wallacea and Sahul regions (Mellars et al., 2013). As Jane Balme et al. (2009) indicated, the occupation of diverse ecosystems with hostile environments and depressed fauna, could only have occurred with the use of complex systems of exchange and communication, including language. Although it is difficult to verify this hypothesis, what these authors argue is equivalent to an acceptance that Southeast Asian settlers in that time range possessed the modern mind.

Cultural evolution in Asia associates H. sapiens as the only species to which the cognitive traits of the modern mind can be attributed; however, the European case is different. If the southern and coastal dispersals of modern humans into Asia took place c. 65−60 ka ago, the dispersal permitting the occupation of Europe by the Cro-Magnon is later: 47−41 ka, according to data calibrated by radiocarbon (Mellars, 2006a). Cultural traditions commonly attributed to modern humans entering Europe are, cited in order of antiquity, the industries Aurignacian, Gravettian, Solutrean, and Magdalenian.

The Aurignacian culture was defined by Edouard Lartet (1860) in accordance with the tools found at the site of Aurignac (French Pyrenees), but is also assigned to similar industry sets from large parts of Eastern, Western, and Central Europe, and also to some of the existing technocomplexes in parts of the Middle East (Mellars, 2006a). The technological level of Aurignacian contrasts with the Mousterian Mode 3 of Neandertals. The most obvious difference is the use of microbladelet technology, representing a major difference from the most advanced tools up to that time. If Châtelperroian points, as well as bladelets, fulfill the same purpose, to serve as projectiles, the Aurignacian microliths are “serially, laterally hafted along the shaft of projectiles, not mounted at their extremities” (Bon, 2006).

The need to compare the technocomplexes of Mode 3 and Aurignacian led to distinguish the latter as belonging to a homogeneous tradition, following the initial descriptions such as those by Abbe Breuil (1913). However, technological analysis determined the presence of different forms of tool production in the Aurignacian. For the initial carvings, in contrast with Mode 3, several different names were proposed—“Classic Aurignacian,” “Aurignacian I,” “Proto-Aurignacian,” “Early Aurignacian,” “Pre-Aurignacian,” “Archaic Aurignacian,” “Initial Aurignacian”—and applied to techniques that in some instances are quite similar. Some authors have even suggested that between the initial carvings of Mode 4 and the most advanced Aurignacian there are very few differences (Nejman, 2008). However, François Bon (2006) has argued that, from a technological point of view, two different systems can be distinguished, which the author called “Archaic (or Proto) Aurignacian” and “Early Aurignacian.” The difference consists in that only one chaîne opératoire is required to obtain Archaic Aurignacian tools, meanwhile two distinct chaînes opératoires are required to obtain blades and bladelets of the Early Aurignacian (Bon, 2006). As William Banks et al. (2013) stated, “For the Proto-Aurignacian, blades and bladelets were produced from unidirectional prismatic cores within a single, continuous reduction sequence ... During the Early Aurignacian, blades and bladelets were produced via two distinct core reduction strategies. Blades continued to be produced from prismatic cores, were robust, and were typically heavily retouched on their lateral edges. Carinated ‘scrapers’ served as specialized cores whose reduction yielded short, straight, or curved bladelets that were typically left unretouched. The Early Aurignacian is also characterized by the appearance of split-based bone points.” (Banks et al., 2013).

The oldest documented presence of Archaic or Proto-Aurignacian is found before the cold Heinrich Event 4 (HE4) (=40 ka) in Northern Spain (El Castillo, Cantabria, level 18, 41−38 ka; l’Arbreda, Catalonia, level 11, 41−39 ka) and Northern Italy (Paina 38.6−37.9; Fumane 36.8−32.1) (Kozlowski and Otte, 2000), Southern France (Istaritz 37.18 ± 4.2 ka (Szmidt et al., 2010)), and Moravia (Brno-Bohunice, =48 ka (Hoffecker, 2009)). The oldest evidence of the Early Aurignacian would be of almost 34 ka in France (Castanet Lower, Combe Saunière VIII,
The biggest obstacle to give meaning to the Archaic and Early Aurignacian cultures is the absence of associated fossils. Therefore, as stated by João Zilhão (2006), these industries can be attributed to both Neandertals and modern humans. We have, then, a problem for the identification of the “modern mind.” If we associate it to the technological level of cultures immediately preceding the advanced Aurignacian, Neandertals could also have had that cognitive capacity. But, if we relate the modern mind with realistic representations of figurative cave art, these only appear at the end of the Aurignacian. Early modern humans would then have lacked such a capacity.

**TRANSITIONAL INDUSTRIES**

The meaning of the emergence of the modern mind in both technological and symbolic terms becomes clearer by analyzing the transitional industries. According to Ivor Jankovic et al. (2006), these “include the Châtelperronian of France and northern Spain, Szeletian and Jankovichian of central and parts of eastern Europe, Uluzzian of Italy (Tuscany, Calabria, southern Adriatic part, Uluzzo Bay, etc.), Streletskian of eastern Europe, Jerzmanowician of eastern Germany and Poland, Althmulian of southern Germany, Bohunician of Czech Republic, Brynzeny and Kostenki Szeletian of Russia and several other unnamed or site-specific assemblages from Poland, Slovakia, Czech Republic, Romania, etc.” They are called “transitional” because they contain elements of the Middle Paleolithic (Mousterian, Micoquian), absent in the Early Aurignacian, such as curved-backed points and foliate points (Kozlowski and Otte, 2000), but also tools that are considered characteristic of the Upper Paleolithic, such as carinated scrapers or bone points. David Brose and Milford Wolpoff (1971, Table 44.1) provide a long list of Upper Paleolithic utensils found in Middle Paleolithic contexts.

The problem of the transitional industries appears when we need to assign them to a species. As was indicated by Jankovic et al. (2011), “even if we accept the earliest Aurignacian as an industrial complex that has its origins outside this area . . . (which is far from proven) and attribute it to anatomically modern newcomers (for which there are no known hominin/industrial associations) we are left with the problem of who is responsible for these Initial Upper Paleolithic assemblages.” The absence of fossil remains associated with almost every transitional technocomplex generally prevents the association of hominin/industry, and of confirming who were the architects of this cultural change. However, two sites with Châtelperronian culture, Saint-Césaire (c. 36 ka) (Lévêque and Vandermeersch, 1980; Mercier et al., 1991) and Arcy-sur-Cure (c. 34 ka) (Hublin et al., 1996), contain in the same stratigraphical level fossils of *H. neanderthalensis* (questioned by Bar-Yosef and Bordes, 2010; Higham et al., 2010). This coincidence has been at times enough to attribute all transitional industries to Neandertals (Allsworth-Jones, 1986; Mellars, 1996; Stringer and Gamble, 1993); a consideration sustained in some revisions of specialists (Churchill and Smith, 2000; Francesco d’Errico, 2003).

The general assignment of transitional industries to the Neandertals encounters the problem of the morphology of fossil specimens found at Uluzzian levels. In the Grotta di Fumane (Lessini Mountains, North Italy) several human teeth have been found: Fumane, 1, 4, 5, deciduous; Fumane 6, adult. Stefano Benazzi et al. (2014) classified Fumane 1 as clearly Neandertal, and Fumane 5 as supporting Neandertal affinity. Both specimens come from the Mousterian levels of Fumane. At the same time, Fumane 6, of the Uluzzian levels, does not show morphological features useful for taxonomic discrimination (Benazzi et al., 2014). Fumane fossil specimens, therefore, do not contradict the general attribution of Uluzzian to Neandertals. However, a new analysis by Stefano Benazzi et al. (2011) of two deciduous molars from the Uluzzian levels (EIII) of the Grotta del Cavallo (Apulia, Southern Italy), one initially classified as a Neandertal, leads to different conclusions. By means of morphometric methods based on microtomographic data, Benazzi et al. (2011) stated that the Cavallo specimens can be attributed to modern humans. In addition, in the EIII level of the Grotta del Cavallo appeared several marine shells (*Dentalium* sp., *Nuculana* sp., and *Cyclope neritea*) snapped or pierced to be transformed into beads.

If the Uluzzian technocomplex, very ancient, is the production of modern humans, we find ourselves with the possibility to establish plausible dates for the entry into Europe of *H. sapiens*. The Grotta di Fumane (Lessini Mountains, North Italy) contains levels of the late Mousterian (A11, A5), Uluzzian (A4, A3), and Proto-Aurignacian (A2, A1 up to D3) technocomplex (Benazzi et al., 2014). Fumane Mousterian levels were dated by calibrated radiocarbon between 45.4 and 41.7 (A11) and 38.875 ± 1.497 ka (A5), while the Uluzzian level (A4) received 37.8–36.9 ka (Peresani et al., 2008). Applying a development of radiocarbon dating (acid-base-oxidation-stepped combustion—ABOX-SC—and acid-base-acid—ABA—pretreatments for removing contaminants, then accelerator mass spectrometry—AMS), Thomas Higham et al. (2009) increased the age of the fossils of Cavallo. The age of the Proto-Aurignacian A2 level would be
41.20–40.45 ka, ie, prior to the Campanian Ignimbrite eruption. The latest Mousterian occupation (A5) would be 43.58–42.98 ka, and the Uluzzian levels should be found between that date and 41.20–40.45 ka. The analysis by Katerina Douka et al. (2014) pushed back even further the age of the Uluzzian. By an integrated synthesis of new radiocarbon results and a Bayesian statistical approach from four stratified Uluzzian cave sequences in Italy and Greece (Cavallo, Fumane, Castelcivita, and Klissoura 1), Douka et al. (2014) concluded that the Uluzzian arrived in Italy and Greece shortly before 45 ka. Its final stages are \( \approx 39.5 \) ka, coinciding with the Campanian Ignimbrite eruption. Fumane dates agree with that of the Grotta del Cavallo. Benazzi et al. (2011) dated the Cavallo shells by AMS radiocarbon at an age of 45.01–43.38 ka.

The latest scenario presents, therefore, the arrival of Uluzzian technocomplexes—ie, of modern humans—in Italy and Greece, with the modern mind necessary to use personal ornaments (beads), shortly before 45 ka, a date old enough to match the Châtelperronian levels of Neandertals in France and northern Spain. Additionally, beads and ochre pigments also appear at the Châtelperronian sites. The Grotte du Renne, Arcy-sur-Cure (France), a site inhabited by Neandertals (Hublin et al., 1996), in addition to Châtelperronian tools constructed in situ has yielded a series of up to 36 objects such as carved ivory pieces and perforated bones, the sole purpose of which must have been decorative. In addition to Châtelperronian tools constructed in situ, the Grotte du Renne (Arcy-sur-Cure, France) has yielded a series of up to 36 objects such as carved ivory pieces and perforated bones, the sole purpose of which must have been decorative (Hublin et al., 1996). Since 1949 Leroi-Gourhan carried out studies that revealed important differences between the engraving techniques used to produce the Arcy-sur-Cure Châtelperronian artifacts and the latest Aurignacian utensils that were found in the most modern strata of the same cave (Leroi-Gourhan, 1958, 1961). Hence, the Châtelperronian (Neandertal) and Aurignacian (modern human) cultures were different. But the decorative objects from the Grotte du Renne raised doubts about these differences existing between modern humans and Neandertals. Thus, Hublin et al. (1996) interpreted the Arcy-sur-Cure Châtelperronian artifacts as the result of trading process rather than the result of technical imitation of modern human technology. Francesco d’Errico et al. (1998) arrived at a different conclusion: those objects were the result of an independent and characteristically Neandertal cultural development, which had managed to cross the threshold of the symbolism inherent in decorative objects. There is no reason to assume that the biological differences between Neandertals and modern humans necessarily translated into differences between their intellectual capacities. Paul Bahn (1998) also believed the Arcy-sur-Cure objects merited attributing Neandertals a sophisticated and modern symbolic behavior.

Randall White (2001) has offered an alternative interpretation of the decorative objects from the Grotte du Renné: “It seems implausible that … Neandertals and Cro-Magnons independently and simultaneously invented personal ornaments manufactured from the same raw materials and using precisely the same techniques.” Consequently, he argues that the Châtelperronian ornaments from the Grotte du Renné are Aurignacian and were produced by modern humans. The question whether the authors of the Châtelperronian culture were Neandertals, modern humans, or both, has sparked numerous discussions. The evidence from Saint-Césaire (France), with both Middle and Upper Paleolithic strata, allowed in situ studies of the association of specimens and tools, as well as the cultural transition (Mercier et al., 1991). Norbert Mercier et al. (1991) used thermoluminescence to estimate the age of the Neandertal specimens found in levels with Châtelperronian industry. Their results suggest they were 36,300 ± 2700 years old. Mercier et al. (1991) argued that there was contact between Neandertals from Western Europe and the first modern humans that arrived there. They also noted something we have said on several occasions: the straightforward identification of cultures with taxa is not possible.

Arcy-sur-Cure suggests Neandertals were possibly capable of producing decorative objects; other sites provide evidences of cultural sharing. Ivor Karavanic and Fred Smith (1998) documented the presence of two contemporary sites at Hrvatsko Zagorje (Croatia) which are close to each other. The Vindija cave has yielded Neandertals, while Velika Pčina has only produced remains of anatomically modern humans. The authors believed that the coincidences exhibited by the tools from both sites are due to imitation or even commercial exchange. These Croatian sites do not include ornaments, but they provide remarkable indications of cultural exchange. This is corroborated beyond a doubt by H. neanderthalensis and H. sapiens coincident at Palestine caves. Although the shared Near East Mousterian culture could be interpreted as the maximum horizon Neandertals could reach, the Arcy-sur-Cure objects, assuming they were constructed or used by Neandertals, suggest this was not the case. They seem to support the notion that Neandertals appreciated pendants enough to identify them as “beautiful objects.” At least in this sense, they would have achieved the “modern mind.”

The hypothesis that Neandertal decorative elements found in the Châtelperronian deposits are imitations of Aurignacian objects made by modern humans implies that both cultures were contemporary or that the Aurignacian culture was older. João Zilhão et al. (2006) have investigated the sequence of sediments and the archaeological association of the Grotte des Fées at Châtelperron (France) and reject the Châtelperronian-Aurignacian
contemporaneity: They assert that “its stratification is poor and uncertain, the bone assemblage is carnivore accumulated, the putative interstratified Aurignacian lens in level B4 is made up for the most part of Châtelperronian material, the upper part of the sequence is entirely disturbed, and the few Aurignacian items in levels B4–5 represent isolated intrusions into otherwise in situ Châtelperronian deposits” (Zilhão et al., 2006). Their conclusion is that “as elsewhere in southwestern Europe, this evidence confirms that the Aurignacian postdates the Châtelperronian and that the latter’s cultural innovations are better explained as the Neandertals’ independent development of behavioral modernity” (Zilhão et al., 2006). This hypothesis deserves attention, but to be accepted similar studies should be carried out at places other than the Grotte des Fées.

Any chronological table of the cultural sequences reveals the difficulties we are encountering. Direct correspondences are usually drawn between cultural manifestations and species, associating Mousterian with Neandertals and Aurignacian with modern humans. Hence, it seems clear that attributing or not to Neandertals sufficient cognitive capacities for aesthetic experience is heavily influenced by a given author’s point of view about the Mousterian evidence. Those who argue that Neandertals and H. sapiens belong to different species tend to reject the presence of the “modern mind” in the former’s contrivances, and vice versa.

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