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Neanderthal Acculturation in Western Europe?

A Critical Review of the Evidence and Its Interpretation[1]

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The presence of bone tools, personal ornaments, and apparently "modern" stone tools in European late Middle Paleolithic or pre-Aurignacian Paleolithic contexts is generally interpreted as the result of the acculturation of final Neanderthal populations by anatomically modern humans. Analysis of the stratigraphic, chronological, and archaeological data from the key site of Grotte du Renne (Arcy-sur-Cure, France) shows that the notion of acculturation, as commonly understood, is inconsistent with the evidence. It is argued here that this site is not an exceptional case and is best explained by models of independent development that are supported by a reevaluation of Châtelperronian technology and by the patterns of chronological and geographical distribution of Aurignacian, Châtelperronian, Uluzzian, and late Mousterian settlements.

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Biological and cultural interactions between Neanderthals and anatomically modern humans in Europe during the so-called Middle-to-Upper-Paleolithic transition have long been the object of intense debate (e.g., Gilman 1984, Mellars and Stringer 1989, Farizy 1990*a*, Mellars 1990, Graves 1991, Bräuer and Smith 1992, Cabrera Valdés 1993, Knecht, Pike-Tay, and White 1993, Byers 1994, Nitecki and Nitecki 1994, Carbonell and Vaquero 1996). The limited quantity of human remains associated with archaeological material dated to this period has represented a major problem for testing hypotheses regarding the nature, extent, and chronology of possible relationships between the two human types. All the skeletal evidence available from both France and other regions of Europe suggests that the Aurignacian is the product of anatomically modern populations (Stringer, Hublin, and Vandermeersch 1984; Gambier 1989, 1993; Stringer 1990, 1994). For 15 years the Neanderthal skeleton found at Saint-Césaire in association with a Châ-

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telperronian stone industry (Lévêque and Vandermeersch 1980) has been the only element suggesting that the Châtelperronian was manufactured by Neanderthals.

Other human fossils discovered in Western Europe before the Saint-Césaire skeleton were often considered too fragmentary or not sufficiently diagnostic to demonstrate the association between human and cultural remains. This was the case with the human teeth from the Châtelperronian layers of the Grotte du Renne, at Arcy-sur-Cure (Yonne, France), and those from the Uluzzian layers of the Grotta del Cavallo, attributed respectively by Leroi-Gourhan (1959) and by Messeri (Palma di Cesnola and Messeri 1967, Messeri and Palma di Cesnola 1976) to Neanderthals. A similar though more recent case was that of the deciduous molar from Couvin Cave, Belgium, discovered in a layer containing a Mousterian with leaf points (Ulrix-Closset, Otte, and Cattelain 1988) dated to 46,820 ± 3,290 B.P. (Lv-1559). Neanderthal remains found more recently in Central Europe, such as those from Kulna Cave, in Moravia (Jelinek 1977), and from Mariaremete Cave, near Budapest (Gabori-Csank 1983), together with those known from earlier excavations (Salzgitter-Lebenstedt, Wildscheuer, Klausennische, Subalyuk, Dzerava Skála), provide only inferential information for the question at hand, since they were associated (Allsworth-Jones 1990, Kozlowski 1996) with Middle Paleolithic industries often considered to have phyletic links with the more recent "transitional cultures" of this region (the Bohunician and the Szeletian).

The recently published association in Vindija Cave, Croatia, of Neanderthal human remains with Aurignacian bone points, one with a split base (Smith and Ahern 1996, Karavanic 1995), is, however, questionable. Level G1, which yielded the human remains and the bone tools, is 8–20 cm thick and has been at least partially subjected to cryoturbation (Malez and Rukavina 1975). The poor lithic assemblage yielded by this layer (56 chipped stones) contains only 15 tools, including an atypical burin, several Middle Paleolithic artifacts, and a leaf point. The latter tool type is also represented in the underlying Mousterian levels of the site; similar objects are well known in the Szeletian of Central Europe. The overlying levels contain a mixture of Aurignacian and Gravettian artifacts. All the layers are characterised by small amounts of debitage, very few cores, the absence of anthropic features, and the consistent presence of cave bear bones. All these elements suggest that Vindija Cave was only sporadically frequented by humans during the Upper Pleistocene and that postdepositional processes such as cryoturbation and cave bear denning are the best explanation for the odd artifactual associations found throughout the stratigraphy. This is all the more likely in that the faunas in all layers are ecologically mixed and traces of bioturbation are fairly obvious. Thus, the claim that the Vindija record shows a continuous transition from the Middle to the Upper Paleolithic (Karavanic 1995:26) cannot be accepted on present evidence.

In sum, the sparsity of the fossil record has undermined the heuristic value of all attempts to model Neanderthal–modern-human interactions in Western Europe. All of the proposed scenarios based on the assumption that the Neanderthals were the creators of technocomplexes such as the Châtelperronian depends on an essentially unique find.

In this respect, an important new piece of evidence has recently been brought to light by Hublin et al. (1996). By applying high-resolution computed tomography to a previously undescribed juvenile human temporal found by Leroi-Gourhan in Châtelperronian layer Xb of the Grotte du Renne, these researchers have demonstrated that the bone is to be attributed to a one-year-old Neanderthal child. This result confirms the Saint-Césaire record, strongly suggesting that Neanderthals were solely responsible for the Châtelperronian assemblages and strengthening the hypothesis that the other human remains from Arcy, as well as those from the Uluzzian site of Cavallo, are also of Neanderthals. Neanderthals may therefore have been the producers of all the pre-Aurignacian Upper Paleolithic technocomplexes of Western and Central Europe (Châtelperronian, Lincombian, Uluzzian, Szeletian, et al.), as has been suggested by Hahn (1993).

This identification does not in itself allow obvious inferences about the nature of Neanderthal–modern-human cultural interaction, but Arcy is a key site for addressing the question of the cultural adaptations of late Neanderthals. In particular, it is the only site in which Châtelperronian levels have yielded a considerable number of personal ornaments associated with a rich and varied bone tool assemblage. What are the cultural implications of these finds once the associated human remains have been identified as Neanderthal?

The supposed similarity between the Châtelperronian ornaments from Arcy and those from supposedly contemporary Aurignacian contexts has been tentatively attributed by White (1992*a*, 1993*a*, *b*; 1995) either to imitation by Neanderthals (see also Otte 1995) or to their gathering of objects abandoned by modern humans if not, more simply, to the fact that they are actually Aurignacian artifacts introduced into the Châtelperronian layers by postdepositional disturbance. Hublin et al. (1996:226; see also Demars and Hublin 1989, Hublin 1990), in turn, suggest that this association implies a high degree of acculturation of the Arcy Neanderthals and constitutes possible evidence of trading rather than imitation by Neanderthals of modern-human technology. Although these interpretations differ slightly from each other, they are all based on a popular model (e.g., Harrold 1989, 1992; Mellars 1989, 1991, 1996*a–c*; Hublin 1990; Djindjian 1993; Stringer and Gamble 1993; Bar-Yosef 1996*a*) that has also been used to explain the emergence of the Szeletian and other leaf-point industries of Central and Eastern Europe (e.g., Allsworth-Jones 1986, 1990; Kozlowski 1990, 1993, 1996; Valoch 1990) and of the Italian Uluzzian (Gioia 1990, Mussi 1990). This model can be summarized as follows:

1. Neanderthal populations were totally replaced by

modern humans from the Near East who brought with them a new lithic technology based on the production of blades extracted from prismatic cores, new types of stone tools, a complex bone, antler, and ivory technology, personal ornaments, and a sophisticated representational art (White 1989, 1992*a,* 1993*b*).

2. In several newly occupied regions, the two groups lived side by side for a long time, during which local Neanderthals went through a process of acculturation.

3. The Châtelperronian, with its blade technology, its bone tools, and its personal ornaments, is an example of the outcome of this process, these being foreign elements in an otherwise Middle Paleolithic material culture that continued to lack figurative parietal or mobiliary art (Harrold 1983, 1989, 1992; Mellars 1989, 1991; Farizy 1990*b, c,* 1994; Otte 1990, 1996; Lévêque 1993).

The more or less implicit assumption of this model is that, because of their different biology, Neanderthals did not possess the intellectual capabilities to develop the behaviors traditionally considered characteristic of the "Upper Paleolithic" —that whenever Upper Paleolithic features, particularly in the case of personal ornaments, appear in association with Neanderthals, they represent imitation without understanding, since Neanderthals were incapable of symbolic behavior, probably because of the lack of the requisite sophisticated speech skills (Chase and Dibble 1987; Davidson and Noble 1989, 1993; Davidson 1991; Donald 1991; Noble and Davidson 1993; Dibble 1989; Gargett 1989; Mellars 1989, 1991, 1996*a;* Stringer and Gamble 1993; Whallon 1989; Russell 1996; Klein 1994). Since the skeletal arguments advanced to sustain the notion that Neanderthals were biologically handicapped (Lieberman and Crelin 1971; Lieberman 1975, 1989) have met with increasing opposition among physical anthropologists (Le May 1975, Tobias 1987, Aiello and Dunbar 1993, Aiello 1995, Gibson 1985), particularly since the discovery of the Neanderthal hyoid bone from Kebara (Arensburg et al. 1989), this line of reasoning has of late been based entirely on cultural arguments.

Several writers (Straus and Heller 1988, Clark and Lindly 1989, Simek 1992, Soffer 1992, Hayden 1993, Straus 1993, Liolios 1995, Schlanger 1995, Renfrew 1995, Gibson 1996, Wolpoff and Caspari 1996, Wolpoff 1996; see also Mithen 1994, 1996, for a different approach), however, have held that the criteria often employed to distinguish modern human cognition from the supposed Neanderthal cognitive poverty do not display, as far as an archaeological perspective is concerned, the radical patterns of change predicted by the imitation model.

The first problem with the imitation model is that of the meaning of "acculturation," a concept for which no consensus definition exists in cultural anthropology (Herskovits 1958; Wachtel 1971, 1974; Jolly 1996). The term "acculturation" is usually associated with asymmetrical relationships of dominating and dominated—of colonisers who inevitably overwhelm and assimilate the colonised because of their inherent superiority (cultural, biological, military, economic). The influence of one human group over another has different consequences depending on the realm of life upon which it is exerted (ideological, economical, social, or technological) and on its intensity. The term has, however, been used to describe a variety of relationships from marginal influence to complete assimilation with almost total loss of the elements of a given cultural system (Perlès 1990).

The second problem lies in the establishment of criteria to test the hypothesis of acculturation in the archaeological record. Although it has been often used as the explanatory mechanism of choice for changes in the morphology, decoration, style, or manufacturing technique of artifacts, no obvious ethnoarchaeological frame of reference is available that would supply us with models of archaeologically visible consequences of known cases of acculturation among hunter-gatherers (Champion 1995). Even a minimal definition of "acculturation," however, implies the absorption by the acculturated of cultural behaviors of the acculturators. In the archaeological record of the acculturated group, this should be manifest in the introduction of acquired objects of different types, in the autochthonous production of copies or imitations of those objects, or in the adoption of the technological procedures required to manufacture them even if the final products are not identical.

We argue here that the archaeological record of the Middle-to-Upper-Paleolithic transition in Western Europe provides no material support for the theories developed to accommodate the Arcy record to the notion of "Neanderthal inferiority." When tested against the empirical data, all such explanations of the evidence are revealed as untenable. In fact, in order for them to be acceptable, the following conditions would have to be verified in the first place:

1. If a product of postdepositional disturbance, the personal ornaments and the bone tools from the Châtelperronian levels of Arcy should be typologically identical with and less numerous than those found in the overlying Aurignacian; furthermore, their intrusion should have been accompanied by that of other kinds of diagnostic Aurignacian objects, namely, lithic artifacts.

2. If these artifacts are a product of trade or collection no traces of their in situ manufacture should be present in those levels.

3. If they represent imitation, they should be identical or at least very similar to those found in the culture presumably imitated (the Aurignacian).

4. If Châtelperronian bone and lithic technologies were learned from modern humans, the conceptual models underlying the respective production sequences should be identical to those found in the Aurignacian; furthermore, they should be markedly discontinuous with the technological behaviors documented in Neanderthal contexts clearly preceding the time of contact.

5. If resulting from contact, the emergence of the Châtelperronian and similar industrial phenomena cannot have occurred earlier than the first appearance of the Aurignacian in Western Europe.

6. If the explanation for Neanderthal extinction resides in the biological superiority of Aurignacian modern humans, then the spread of the latter should be patterned as a regular "wave of advance" bringing about the demise of aboriginal populations soon after contact.

In the following sections, we will show that the archeological record is patterned in opposition to these expectations. Following up on previous work (Zilhão 1993, 1995, n.d.*a, b;* Pelegrin 1995), we will also show that, far from being an idiosyncratic case, Arcy is consistent with the hypothesis of an original and independent cultural evolution of Western Europe's late Neanderthals.

The Grotte du Renne Record

The excavations carried out between 1949 and 1963 (Leroi-Gourhan 1961, Leroi-Gourhan and Leroi-Gourhan 1965) at the Grotte du Renne revealed a sequence of archeological layers attributed to the Mousterian (XIII–XI), the Châtelperronian (X–VIII), the Aurignacian (VII), and the Gravettian (VI–IV). The stratigraphic observations made by André Leroi-Gourhan during the excavation, his analyses of the anthropological (1959) and archaeological (1961, 1965) materials, and the palynological analyses of the sequence (Leroi-Gourhan and Leroi-Gourhan 1965, Leroi-Gourhan 1988) have been enriched in recent years by new analyses of the artifacts (Farizy and Schmider 1985; Baffier and Julien 1990; Bodu 1990; Farizy 1990*a–c;* Gouedo 1990; Plisson and Schmider 1990; Taborin 1990; Schmider and Perpère 1995), a geological study of the site, and several new radiometric dates (Girard, Miskovsky, and Evin 1990, Hedges et al. 1994). The results of some of these analyses are summarized in table 1.

The Châtelperronian levels have yielded 36 personal ornaments: perforated or grooved canines of fox, wolf, bear, hyena, and red deer and perforated or grooved incisors of bovid, horse, marmot, bear, and reindeer (table 2, fig. 1). Small perforated beads are made of ivory; a fossil shell (*Rynchonella*), vestigial phalanges, and a lateral metapodial of reindeer show grooves for suspension; a belemnite shows a broken perforation, and a fragment of fossil crinoid, having a natural perforation, was brought to the site and possibly used as a pendant. Worked bones, amounting to a total of 142 objects, include projectile points, awls, pins, "burnishing tools," ivory *baguettes,* bird-bone diaphyses sectioned into tubular elements, large mammal ribs, and by-products of bone and ivory manufacture (table 3, fig. 1). With the exception of some ivory fragments, the personal orna-

TABLE 1
Stratigraphy and Chronology of the Grotte du Renne

Stratigraphic Unit	Lithology	C^{14}	Human Remains	Cultural Attribution
IV	Dry talus	—		
V	Small gravel	20,150 ± 500 (Ly-2161)		Gravettian
VI	Dry talus	—		
VII	Slabs into a red-purple sediment	30,800 ± 250 (GrN-1717), 31,800 ± 1,240 (Ly-2162)	Upper right premolar, immature lower molar	Aurignacian
VIII	Yellowish clay with small worn gravel	33,860 ± 250 (GrN-1742), 33,000 ± 1,400 (Ly-2163)	2d lower right incisor, lower right canine	
IX		45,100 ± 2,800 (OxA-3465)	2d lower left premolar, 2d upper left molar	
Xa	Calcareous slabs with rare pebbles into a purple-ochre clayey silt	25,500 ± 380 (GrN-4251), 24,500 ± 360 (GrN-4216)		Châtelperronian
Xb		33,820 ± 720 (OxA-3464)	Lower left canine, 3d lower right molar, juvenile skeleton	
XI	Yellow clay with gravel	31,520 ± 570 (OxA-3462), 33,700 ± 1,400 (Ly-2164)	2d upper right premolar	
XII	Dark grey clay	34,600 ± 850 (GrN-4217), 33,700 ± 210 (GrN-4256), 37,500 ± 1,600 (Ly-2165), 39,400 ± 1,450 (OxA-3463)		Denticulate Mousterian
XIII	Large blocks in orange clay matrix	—		
XIV	Sandy yellow clay with gravel	—		Typical Mousterian

TABLE 2
Personal Ornaments from Levels X–VII

Type	Levels X	IX	VIII	VII	Cultural Attribution
Wolf canine, grooved	1	—	—	—	C
Fox canine, perforated	1	—	—	—	C
Fox canine, grooved	3	1	—	—	C
Fox canine, broken	1	—	1	—	C
Hyena canine, grooved	—	—	1	—	C
Bovid incisor, grooved	4	—	—	—	C
Horse incisor, grooved	—	—	1	—	C
Bear incisor, grooved	1	—	—	—	C
Reindeer incisor, grooved	1	1	1	—	C
Reindeer metapodial, grooved	1	—	—	—	C
Reindeer phalange, perforated	1	1	—	—	C
Reindeer phalange, grooved	2	—	—	—	C
Red deer canine, perforated	—	—	1	—	C
Marmot incisor, grooved	2	—	—	—	C
Rhinoceros molar (fragment), grooved	1	—	—	—	C
Rynchonella fossil, grooved	1	—	—	—	C
Belemnite, perforated (broken)	1	—	—	—	C
By-product of ivory ring making, grooved	2	—	1	—	C
Fossil crinoid, naturally perforated	1	—	—	—	C
Ivory bead, perforated	—	—	3	—	C
Bear incisor, perforated	—	—	—	1	A
Ivory bead, perforated	—	—	—	1	A
Ivory pendant, perforated	—	—	—	1	A
Ivory pendant (5 fragments), perforated	—	—	—	1	A
Stalactite, perforated	—	—	—	1	A
Total	24	3	9	5	

NOTE: A bear canine from level VIII described by Taborin (1990) as a pendant with an incomplete perforation proved on closer inspection to display only two small flakings of the apex.

ments and the worked bones are in an excellent state of preservation; their surfaces show clear technological marks which warrant their identification as artifacts (d'Errico 1993, d'Errico and Villa 1997).

These objects were produced using a variety of blanks. A cervid metatarsal, a horse metapodial, an ancillary metapodial of the same species, and three hyena fibulae were transformed into awls. Numerous fragments of diaphyses and ribs, also transformed into awls, are attributable without further precision to medium-sized or large herbivores. Mammoth ivory was used for beads, sticks, a possible long point, and two rings. According to Poplin (in Taborin 1990), these two objects were manufactured using ivory flakes produced by the natural desquamation of the tusks. Three bone points, two bird-bone tubes, an awl, and two large mammal ribs are decorated with sequences of regularly spaced notches or incisions.

Personal ornaments and worked bones are associated with a lithic assemblage in which the dominant production system is geared towards the extraction of blades from prismatic cores. These were often transformed into Châtelperron points, interpreted by Leroi-Gourhan and Leroi-Gourhan (1965), Plisson and Schmider (1990), and Pelegrin (1990, 1995) as the lithic components of hafted knives or composite projectiles.

The Hypothesis of Postdepositional Disturbance

To evaluate this hypothesis we will focus on layers XI–VII, which include the most recent Mousterian (XI), the Châtelperronian (X–VIII), and the Aurignacian (VII).

In spite of clear lithological differences between layers XI (post-Mousterian according to Leroi-Gourhan, Denticulated Mousterian according to Girard 1980) and X (Châtelperronian), the hypothesis of a reworking of sediments at their interface cannot be excluded. This might be suggested by the occurrence in layer XI of a few backed knives and a bone awl like those found in the Châtelperronian layers. Leroi-Gourhan and Leroi-Gourhan (1965) and Girard, Miskovsky, and Evin (1990) suggest that this phenomenon should be attributed to a leveling and scooping out of the occupation floor by the first Châtelperronians.

No evidence of reworking, however, can be detected

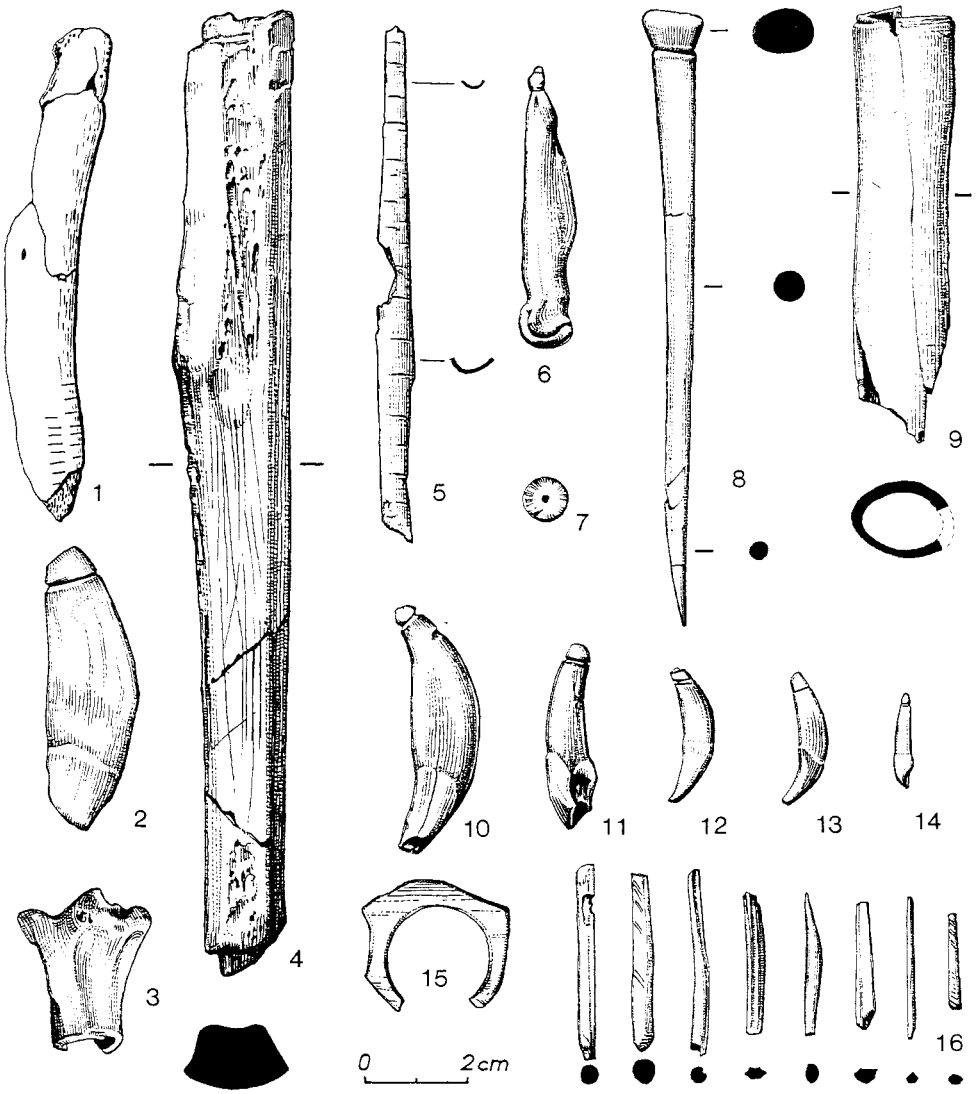

FIG. 1. *Examples of worked bones and personal ornaments from the Châtelperronian levels of the Grotte du Renne.* 1, *proximal end of a rib covered by ochre showing two sequences of regularly spaced notches;* 2, *hyena canine with grooved root;* 3, *epiphysis of a swan ulna sectioned by sawing;* 4, *long bone shaft fragment shaped by scraping;* 5, *bird-bone diaphysis with regularly spaced notches;* 6, *reindeer metapodial with groove for suspension;* 7, *fragment of crinoid with natural perforation;* 8, *bone awl with groove at its base;* 9, *bone tube sectioned by transversal sawing;* 10, *wolf canine;* 11, *bovid incisor;* 12 *and* 13, *fox canines;* 14, *reindeer incisor;* 15, *by-product of ivory ring manufacture;* 16, *ivory pins with traces of manufacture. Items 2 and 3 from level VIII, 1 and 4-16 from level X (after Leroi-Gourhan and Leroi-Gourhan 1965 with modifications).*

between the Châtelperronian and the Aurignacian layers. There is a sharp difference in artifact densities between levels X and IX (corresponding, according to A. Leroi-Gourhan, to intensive occupation) and level VIII, where only a few Châtelperron points and a few bone and ivory objects were found. Leroi-Gourhan (1961:10, our translation)[2] wrote:

> In 40 centimeters [of levels IX and X] of thickness, we have encountered as many as ten clearly identifiable archaeological horizons. The deposits are formed of limestone plaquettes, apparently worn by trampling, and large cobbles, in an unconsolidated

2. "Sur 40 cm d'épaisseur, par places, nous avons dépouillé jusqu'à une dizaine de sols constitués. Le remplissage est formé par des plaquettes de calcaire discrètement usées par le piétinement, au milieu desquelles apparaissent de gros galets, dans une gangue friable. . . . [L'horizon correspondant à la couche VIII] est le plus énigmatique parmi ceux de la grotte du Renne. Il atteint, par places, une vingtaine de centimètres d'épaisseur et il est fait d'une argile jaunâtre à cailloutis petit et usé, contenant des éléments calcaires étrangers à la roche encaissante. Il ne contient ni ocre d'origine humaine réparti dans la masse, ni traces de foyers nettes. Il contient par contre d'assez nombreux vestiges d'hyène et d'ours des cavernes. L'industrie y est présente avec des différences de densité très sensibles d'un point à l'autre et semble témoigner d'un habitat intermittent."

TABLE 3
Worked Bone from Levels VII–X

	Level				
	VII	VIII	IX	X	Total
Raw materials					
Bone	49	5	10	73	137
Ivory	15	1	11	42	69
Antler	4	0	0	0	4
Tool types					
Awls	20	3	2	29	54
Mesial fragments of points or awls	6	0	7	26	39
Points	0	0	4	14	18
Small points	0	2	3	0	5
Lozenge-shaped points	2	0	0	0	2
"Burnishing tools"	11	0	0	12	23
"*Lissoirs obliques*"	2	0	0	0	2
Thin *baguettes*	17	0	2	22	41
Tubes	0	1	0	4	5
Large ribs or long shaft fragments (digging sticks?)	0	0	1	3	4
By-products	7	0	1	4	12
Decorated objects	3	0	3	10	16

> matrix. . . . [In contrast, the horizon which corresponds to level VIII] is much more complex. Its maximum thickness is 20 centimeters, and it is made up of a yellowish clay with small-sized, worn gravels and some allochthonous limestone elements. It contains neither human-introduced ochre nor clear traces of hearths. It does, however, present a considerable number of hyena and cave bear remains. The associated lithic assemblage occurs in clearly variable densities from one area to another and thus appears to provide evidence for intermittent occupation.

According to A. Leroi-Gourhan (1961), the violet-colored sediment of the Aurignacian level VII, above the Châtelperronian horizon, is clearly distinguishable from the yellowish sediment of level VIII. This difference in color is important, because if there had been mixing of sediments between this level and level VIII the sediment at the interface would show traces of it. In addition, Leroi-Gourhan points out that the traces of "intermittent" occupation in level VIII are located near the middle of the deposit, with a virtually sterile level at least 10 cm thick separating the last Châtelperronian manifestations from the first occurrence of the Aurignacian. Although the formation process of level VIII, for which we have only a preliminary geological analysis, is not yet well understood, it is clear that its presence isolates the Aurignacian layer VII from the richest Châtelperronian occupations in layers X and IX and thus guarantees the stratigraphic integrity of the latter.

In sum, even if certain objects from the earliest Châtelperronian level may accidentally have migrated downward into the Mousterian, there is no indication of a stratigraphic mixing between the Aurignacian level and the underlying Châtelperronian levels, including level VIII. Obviously, the small size of many of these objects is a factor not to be overlooked. Trampling experiments (Villa and Courtin 1983, Gifford-Gonzalez et al. 1985) suggest that vertical displacement of small objects is likely in sediments unconsolidated at the time of occupation, causing mixing of materials belonging to two separate levels. In several well-stratified sites, where the issue was the object of detailed analysis, refitting has demonstrated vertical displacement of materials up to 1 m and across distinct excavation levels.

The Arcy stratigraphic data, however, are confirmed by the analysis of the archaeological materials. If Aurignacian material had moved, by geological or anthropic processes, into the levels below through holes dug into it from level VII (for which there exists no proof), rodent burrows, or possible interstitial openings along the cave wall, where the sediment was less compact, we would have encountered, in addition to the supposedly intrusive bone tools and personal ornaments, lithic artifacts characteristic of the Aurignacian. None of the researchers who have studied the Châtelperronian lithic assemblage, however, have ever mentioned the presence of such intrusions. The only possible exception is the very few blades (less than 1% of the Châtelperronian stone tools) bearing a marginal, atypical inverse retouch reminiscent of that found in the Dufour bladelets recovered in great numbers (20% of the Aurignacian stone tools) in layer VII (Farizy and Schmider 1985). The Châtelperronian specimens, however, are much larger (Schmider, personal communication) and must have been produced using a different knapping technique, as is also indicated by the absence of carinated cores in the Châtelper-

ronian levels. In addition, no bone tools typical of the Aurignacian (such as split-based or lozenge-shaped bone points, the latter being represented by two fragments in level VII) have so far been identified in the Châtelperronian.

Furthermore, if the bone tools and personal ornaments found in Châtelperronian levels VIII–X had originated in the overlying Aurignacian level VII, we would logically expect their numbers to decline with depth, but the opposite is true (tables 2 and 3): the lowest Châtelperronian level (level X) has more bone tools and personal ornaments than any other level in the sequence; Aurignacian level VII, the second richest, is separated from the level X by two intermediate Châtelperronian levels with very small numbers of these kinds of artifacts; only 5 personal ornaments were found in level VII (while 9 came from level VIII, 3 from level IX, and 24 from level X), representing less than one-fourth of the number found in level X and only 12% of the total number for the whole Châtelperronian-Aurignacian sequence.

In levels IX and X of the Grotte du Renne there were semicircular accumulations of stones associated with mammoth tusks, interpreted by Leroi-Gourhan and Leroi-Gourhan (1965) as traces of huts erected at the cave entrance. The mammoth tusks would have been used as structural elements. This evidence has yet to be critically reexamined. However, the position of the hearths and burnt bones in the centers of the stone circles and the recent refits of bone and lithic pieces by Bodu (1990) and Francine David (personal communication) indicate that the role of postdepositional phenomena in the formation of the Châtelperronian levels of the site was indeed negligible.

The spatial distribution of the worked bone and the personal ornaments inside these structures provides further evidence for their being in situ components of the Châtelperronian occupations (fig. 2). Since levels IX and X are the base of the Upper Paleolithic sequence of the site and are separated from the Aurignacian by at least 20–30 cm of sediment, the spatial association of those objects with the habitation features would become impossible to explain if their stratigraphic position were to be attributed to postdepositional disturbance.

The Hypotheses of Trade or Collection

The hypothesis that personal ornaments were acquired by Arcy Neanderthals through trade or collection on sites previously occupied by Aurignacians is contradicted by two kinds of evidence from the Châtelperronian layers of the Grotte du Renne: the presence of waste products of bone manufacture and the matching of worked bones with by-products of their fabrication. These two kinds of evidence are represented by three types of objects: (1) a fragment of a rod made from a long bone shaft, broken during the process of extraction with the groove and splinter technique, and a fragment of long bone shaft showing traces (two parallel grooves) of the same technique (fig. 3), (2) three bird-bone epiphyses sectioned by sawing, and (3) two incomplete ivory rings, interpreted as broken pendants by Leroi-Gourhan and Leroi-Gourhan (1965) and Taborin (1990) but probably by-products of ornament manufacture.

In its present condition, the bone rod is made up of two refitted elements from the same square (Y11, level Xb) and measures 170 mm in length. One of the edges was separated from the bone shaft by grooving. The cutting of the groove did not completely traverse the thickness of the compact bone, and the rod was detached by percussion. The impact point is still visible at the base of the metaphysis. The same operation was not successfully completed on the opposite edge, where the rod is only one-third the length of the object. On the remaining two, the fracture did not follow the prepared groove and deviated toward the outside edge of the bone flake. The parallel striations observed at the bottom of the asymmetrical, U-shaped groove and the section of the groove itself resemble those we have experimentally reproduced using a burin with a thick point. Several burins compatible with this type of work have been found in the Châtelperronian levels of the site. If this rod had been completely detached it would have had a subquadrangular section and a width of 6–9 mm. These dimensions are analogous to those of several awls and bone points found in the Châtelperronian levels.

Two of the three bird-bone epiphyses are distal ulnas of swan from levels Xb and IX. The other is a distal ulna of fawn vulture from level VIII. All show traces of transversal sawing, indicated by rectilinear, subparallel incisions along the sawed edge, apparently corresponding to accidental exits of the cutting edge during the formation of the groove which was meant to section the bone. The dimensions of the piece from level Xb, square D11, suggest a refit with the tube found in the same level, square A7 (fig. 4). However, it is not possible to conjoin the two elements, because the contact edges were significantly modified by the sawing. The sawing traces on these objects are similar, and the five tubes found in the Châtelperronian levels were obtained through the same technique observed on the by-products, proving that the tubular elements were made at the site. Two of these tubes, one already described by Leroi-Gourhan and Leroi-Gourhan (1965) from level Xb (fig. 1, *5*) and another found in a recent review of the bone assemblage, were decorated with regularly spaced notches. These carefully engraved decorations on very fragile objects were clearly intended to communicate a visual message.

The two incomplete ivory rings from level X (fig. 1, *15*) come from adjacent squares (Y11 and X12) and present manufacturing traces in the form of striations on one of the faces, showing that an engraving tool was used to make a deep circular groove. The round blank produced in this way was removed by incising the external ring at points of minimal width and subsequently breaking the thin area still connected to it. In his work on the ivory technology of the initial Upper Paleolithic,

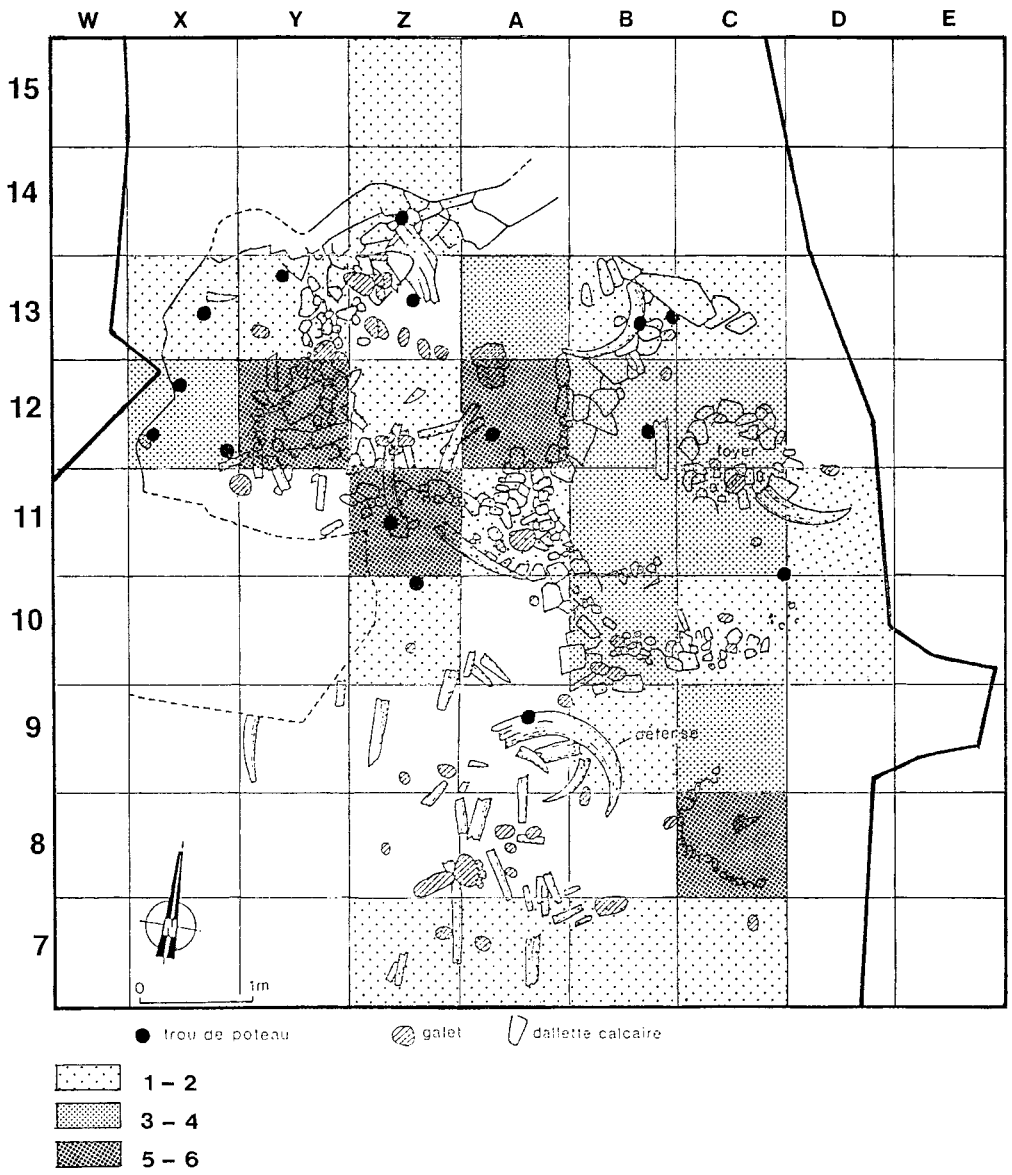

FIG. 2. *Density of bone and ivory artifacts in levels IX and X (Châtelperronian) of the Grotte du Renne. These objects are distributed over the entire surface of these levels, especially within the two most clearly distinguishable adjacent circular structures, which have been interpreted by A. Leroi-Gourhan as the traces of huts (squares XYZA 11–13 and squares BC 10–13). Another concentration of bone artefacts, in squares C 8 and 9, appears to be associated with a small stone arch close to the eastern cave wall. A few isolated objects were also found on the southern slope associated with traces of charcoal and mammoth remains.*

Poplin (1995) considers the possibility that the imperfect appearance of these ivory fragments could be an indication that they are by-products of ivory working instead of broken finished objects. However, he eventually opts for the interpretation that such an appearance was a sign of their belonging to an initial stage in the development of ivory-working techniques, which would explain why those from the Aurignacian already showed a higher level of craftsmanship. In contrast, our analysis of these objects indicates that their interpretation as by-products is the most likely. The more incomplete of the two fragments reveals on one edge traces of the short grooving made in order to fracture the external ring and facilitate the extraction of the inner blank. The outside edge of the other fragment shows a concavity probably corresponding to the removal of a previous blank.

The manufacture of other types of personal ornaments found in the Châtelperronian layers, such as perforated or grooved teeth and phalanges, does not leave archaeologically visible traces (such as by-products or refits). However, there is enough evidence to demon-

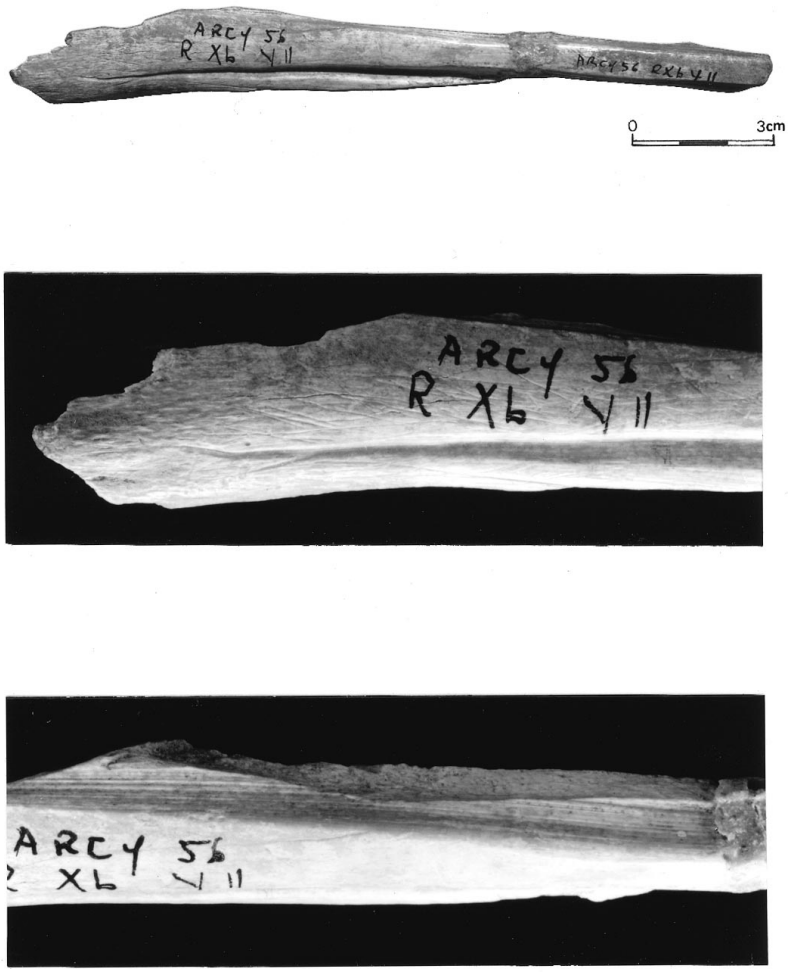

FIG. 3. *Fragment of a long bone diaphysis from layer Xb (Châtelperronian) showing traces of grooving with a flint point to produce a bone rod (photo A. Leroi-Gourhan);* center, *close-up of the groove showing striations produced by the occasional slipping out of the flint point in the grooving process;* bottom, *close-up of a groove with parallel internal striations produced by the repeated movement of the flint point (photo M. Julien).*

strate that the Arcy Neanderthals fully possessed the technical skill necessary to produce notches or perforations on bones or tooth roots. Therefore, there is no reason to believe that they were not the creators of the personal ornaments found in those layers.

The analysis of the faunal remains (David and Poulain 1990) indicates that the majority of the bone artifacts were made on blanks from the same animal species as those consumed at the site. Reindeer and horse, which are the most abundant, provided the raw material for the majority of the points and awls and some body ornaments. Some of the most robust or massive of these tools were made from bovid bones; one utilized rib has been identified as mammoth. In contrast, the small number and the nature (essentially skull fragments and foot extremities) of fox, wolf, and marmot remains suggest that these animals were brought to the site not for consumption but for their furs or for the esthetic or symbolic value of their teeth. The bird remains (*Cygnus cygnus* and *Gyps fulvus*), attested to only by ulna, radius, humerus diaphyses, and phalanges (C. Mouré-Chauviré, personal communication), also suggest selective transport for purposes other than subsistence.

When viewed against their archaeological and paleontological background, the manufacturing by-products found at Arcy show that the most parsimonious explanation for the presence of bone tools and ornaments in its Châtelperronian levels is that they were produced at the site and by the same human group responsible for the accumulation of the lithic and faunal remains and for the installation of the hearths and the other possible habitation features. The hypothesis that those items were either traded or scavenged in abandoned Aurignacian camps is in any case clearly refuted by the available evidence.

Châtelperronian Technology

Since the discovery of the Saint-Césaire skeleton in a layer containing a Châtelperronian industry, many

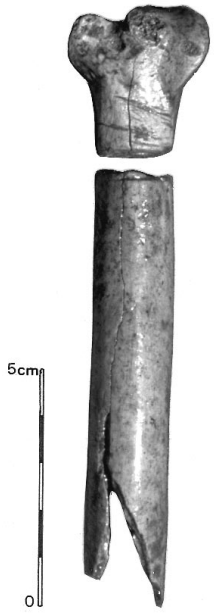

FIG. 4. *Epiphysis of a swan left ulna and a diaphysis probably belonging to the same bone sectioned by transversal sawing (photo A. Leroi-Gourhan). Both objects come from level Xb.*

writers have accepted the interpretation of the Châtelperronian as the result of an acculturation of the late Mousterian human groups by the first modern humans arriving in Western Europe with their Aurignacian technocomplex (Demars and Hublin 1989; Mellars 1989; Demars 1990, 1991; Graves 1991). It has become clear that the bone tools and personal ornaments of Arcy Neanderthals were autochthonous products. We will now discuss whether they can be interpreted as copies of Aurignacian originals and whether the techniques used in their manufacture, as well as in that of laminar blanks for stone tools, can be considered as learned from the Aurignacian.

BONE TOOLS AND PERSONAL ORNAMENTS

The Arcy material suggests that the manufacture of bone tools and body ornaments was not occasional in nature. The choice of particular anatomical parts for the manufacture of different types of personal ornaments and the systematic application of distinct techniques to different categories of blanks indicate that the use of bone and ivory by the Châtelperronians of Arcy was the expression of a varied technological tradition. This is also reflected in the marked standardization of the bone tool types, allowing their grouping into well-defined categories (table 3): projectile points; thin, elongated points, or pins, shaped along the total length of the object; large awls, shaped on the extremities of long bone fragments, sometimes with the epiphyses remaining at the opposite ends; small awls shaped on the extremities of short, thick fragments; bone and ivory rods, most with a circular or oval section; "burnishing tools"; picks or digging sticks made from large ribs or long shaft fragments; and bird-bone tubes.

The choice of particular raw materials for the fabrication of bone tools and personal ornaments (long bones of large mammals and birds, teeth, ivory, phalanges) may have determined the choice of prey (i.e., hunting strategies) and conditioned the exploitation of the animal carcasses. There can be no doubt that technological knowledge concerning bone, tooth, and ivory artifact manufacture was consciously transmitted within the group. If such varied, apparently "new" behaviors were acquired by imitation or learning, we should find strong similarities between Aurignacian and Châtelperronian in the morphology of the artifacts and in the techniques used to manufacture them. The differences, however, are more significant than the similarities. Although nondiagnostic awls, points, and rods are present in both the Châtelperronian and the Aurignacian layers, no typical Aurignacian bone tools such as the lozenge-shaped points were found in the Châtelperronian. Reindeer antler, used as a raw material in the Aurignacian, was totally neglected in the Châtelperronian, where the use of ivory was three and a half times more frequent. Small, thick awls on short bone fragments are found exclusively in the Châtelperronian levels.

The same kinds of bone tools found in the latter, as well as by-products of manufacture and personal ornaments, have also been recorded in nine other Châtelperronian contexts (table 4), none of which contained typical Aurignacian bone tools such as split-based points (Taborin 1990). The bone points, possibly used as the tips of thrusting weapons, show a variable morphology. Some are thin and have circular sections; the larger are flatter and have oblique bases. None of these tool types is common in Aurignacian contexts. The same differences are observed when the bone tools associated with other transitional industries, such as the Uluzzian of Italy, are compared with those of the Aurignacian. Uluzzian bone tools are almost entirely awls with well-polished cylindrical points, made, as at Arcy, of ancillary metapodials of horse; some broken tips, however, may have belonged to sagaie points (Gioia 1990, Palma di Cesnola 1993). This has recently been confirmed by the publication of the Castelcivita sequence (Gambassini 1997). The Uluzzian levels in this cave, dated between 32,470 ± 650 (F-171) and 33,220 ± 780 (F-107), have yielded a notched awl, the broken tip of another awl, and three points, two conical and one biconical (fig. 5).

Palma di Cesnola (1993) also mentions the occurrence of perforated shells of *Cyclonassa neritea, Columbella rustica,* and fragments of *Dentalium* in Uluzzian contexts, as well as that of red and yellow colorants (ochre and limonite), present throughout the whole Uluzzian sequence of Cavallo. Gambassini (1997) reports the presence of bivalve fragments, one of them identified as *Pecten,* from the Uluzzian level of Castelcivita.

Comparison of Châtelperronian with Aurignacian personal ornaments is rendered difficult at Arcy by the small number of objects found in the Aurignacian levels (Leroi-Gourhan and Leroi-Gourhan 1965). It should be

TABLE 4
Châtelperronian Sites with Bone Tools, Personal Ornaments, and Marked Bones

	Bone Tools				Personal Ornaments					
Site	Awls	Points	Others	By-Products	Teeth	Shells	Ivory Rings	Others	Marked Bones	Overlying Upper Palaeolithic Deposits
Brassempouy	—	—	—	x	—	—	—	—	—	—
Cauna de Belvis	—	—	—	—	—	x	—	—	—	x
Châtelperron	x	x	—	—	x	—	—	—	—	—
Grotte du Renne	x	x	x	x	x	x	x	x	x	x
Laussel	x	x	—	x	—	—	—	—	—	x
Roc-de-Combe	x	—	—	—	x	—	—	—	x	x
Roche-au-Loup	x	x	—	—	x	—	x?	—	x	—
Roche de Quinçay	—	—	—	—	x	—	—	—	—	—
Trou de la Chèvre	x	x	—	—	—	—	—	—	—	x

remarked, however, that Châtelperronians made perforations in the roots of the fox canines and grooves on the other teeth, while the latter technique is unknown among the ornaments found in Aurignacian layer VII.

Hublin et al. (1996) cite Lejeune (1987) and Taborin (1990) to stress the similarity between the Châtelperronian personal ornaments of Arcy and those found in the Aurignacian layers of Belgian and French sites. The technique of grooving the tooth root or the bivalve's umbo, very common in the Arcy Châtelperronian, is unknown, however, among the 121 teeth of the nine Belgian sites which have yielded Aurignacian pendants (Lejeune 1987). Also, according to Taborin's (1993) survey of the evidence, the belemnite and the fossil *Rhynchonella* shell used at Arcy have never been found in an Aurignacian context. Although the use of fox canines is indeed a shared feature, bovid, marmot, and reindeer incisors and fragments of rhinoceros molars, used at Arcy, are absent in the Belgian sample. Even when the same species is used, differences appear in the choice of the teeth. The Châtelperronians from Arcy made pendants of bear incisors and wolf canines, while the Belgian Aurignacians preferred bear canines and wolf incisors.

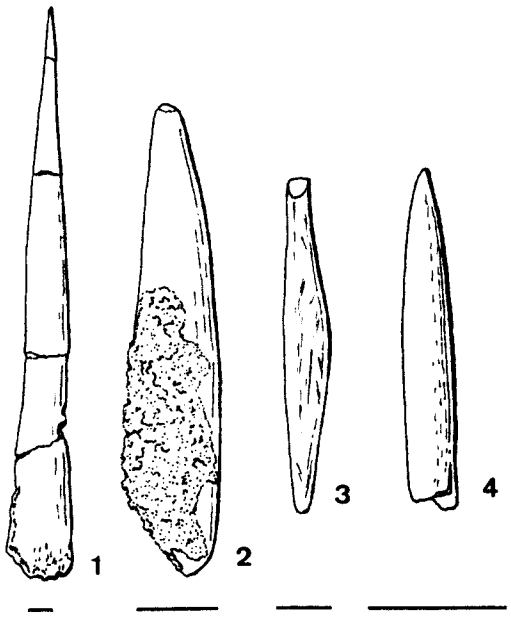

FIG. 5. *Bone tools from the Uluzzian layers of Grotta di Castelcivita.* 1, *awl;* 2, *conical point partially covered by concretion;* 3, *biconical point;* 4, *broken tip of an awl (redrawn from Gambassini 1997). Scales = 1 cm.*

The only possible point of similarity would be the ivory rings. Before interpreting these as evidence of imitation or exchange, as suggested by White (1993*a*) and Otte (1995), one should bear in mind that this raw material was worked at Arcy, as demonstrated by the long ivory point (possibly a spear) recovered in level Xc and by the many thin points discussed above. This means that the Châtelperronians from Arcy had the technical ability to produce ivory rings. A similar object, apparently produced with a different technique, was recently found at the Roche-au-Loup cave, a few kilometers from the Grotte du Renne (Poplin 1995). Though the object comes from a reworked layer, this site has revealed a single Châtelperronian occupation, dated to ca. 40,000 years B.P. Given the in situ condition of the Arcy material, this new find makes it clear that trading is the least parsimonious explanation for the presence of such rings in Châtelperronian contexts.

Furthermore, it should be noted that all other ivory rings traditionally attributed to the Aurignacian come from old excavations at the sites of Spy, Grotte de la Princesse, and Trou Magritte (Belgium). At Spy (Otte 1979; 1984:160) the layer in which they were found contained a mixture of Mousterian, Aurignacian, and "initial Upper Paleolithic with foliate points" (the chronological equivalent of the Châtelperronian in France and the Uluzzian in Italy). At Trou Magritte, the ivory ring

was found in layer 3 and was attributed to the Aurignacian on the basis of its similarity to the one from Spy (Lejeune 1984:212). The layer in question was reexcavated recently (Otte and Straus 1995). Its radiocarbon dating indicated an age of ca. 40,000 years B.P., but it yielded a nondiagnostic lithic assemblage hardly classifiable as Aurignacian, dominated by Mousterian elements and in all likelihood corresponding to an oxygen-isotope stage 3 mixed context identical to that from Spy.

In light of the evidence from Arcy, and given the absence of similar objects in all of the pure Aurignacian contexts known, the hypothesis that the Belgian ivory rings were associated with the "initial Upper Paleolithic with foliate points" of the region, not with the Aurignacian, needs to be considered. In any case, the similarity in shape is probably misleading and seems to have blinded previous comparisons to the existence of some important technological differences, already noted by Poplin (1995), between the Arcy and the Belgian pieces. The latter are more regular and symmetrical and have different cross sections, differing from the Châtelperronian material as much as the Aurignacian pendants from Arcy level VII, whose edges are thinned. Even if one accepts that the Belgian material is indeed Aurignacian, that need not imply an approximation between such artifacts, which may indeed have been functional ornaments, and the Châtelperronian rings from Arcy level X, which are likely to be by-products of the manufacture of other kinds of ivory objects.

In the context of our taphonomic analysis of the Arcy sequence, we considered the hypothesis that, being manufacturing by-products, the two Châtelperronian ivory rings might be functionally connected to the ivory pendants found in Aurignacian level VII and thus constitute evidence of significant postdepositional disturbance. However, we could find no unequivocal technological marks linking the two categories of objects to the same *chaîne opératoire.* Furthermore, the hypothesis required an explanation for why the by-products came from Châtelperronian levels and all the finished pieces from Aurignacian ones—that is, why the by-products would have been selected for intrusion by the operative taphonomic agents. In this context, the most parsimonious explanation is that the two rings in question are related to the production of hitherto unidentified Châtelperronian ivory objects.

Seven other Châtelperronian sites, apart from the Grotte du Renne, have yielded personal ornaments consisting of perforated and sawed teeth and perforated shells of different species (table 4). We do not include in this sample the personal ornaments associated with the Combe Capelle burial or the engraved slab from the Grotte du Loup. The former, long described as Châtelperronian, is now convincingly attributed to more recent phases of the Upper Paleolithic or even to a post-Paleolithic period (Asmus 1964, Gambier 1989). The latter is an Aurignacian object (Mazière 1978) erroneously considered Châtelperronian (Lumley 1984).

The stratigraphic and cultural attribution of the objects from these other sites could obviously be questioned and their presence within the Châtelperronian layers attributed to a reworking of sediments or an intrusion of more recent material. It should be considered, however, that, as was also the case at Grotte du Renne, two of these sites (Belvis and Quinçay) were investigated recently or by means of modern excavation techniques and that no other Upper Paleolithic levels were present at Quinçay from which the Châtelperronian pendant found there could have come. Two of these sites, Roc-de-Combe and Roche-au-Loup, have also provided bones with single sets of parallel incisions, confirming that the similar objects found at Arcy do not constitute an isolated occurrence.

STONE TOOLS

According to the acculturation hypothesis, the blade technology of the Châtelperronian and the standardization of tool types such as the Châtelperronian points are behaviors acquired through contact with or under the influence of modern humans (although the precise mechanisms are rarely explained). Recent studies of transitional stone tool assemblages challenge this view.

Technological analyses of diverse early Aurignacian assemblages from southwestern France show that the Aurignacians reduced large, thick blocks, which were often only cursorily prepared, in order to produce blades which were wide, robust, and had variably curved profiles (Demars 1990, Lebrun-Ricalens 1993, Rigaud 1993). These blades were preferentially chosen as blanks for the fabrication of the principal family of Aurignacian tools: simple and double end scrapers on retouched blades which underwent several progressive stages of reuse and rejuvenation—retouched blade, "Aurignacian" blade, and eventually "strangulated" blade (*lame etranglée*). At the same time, Aurignacians selected and utilized thick flakes as cores for the production of fine bladelets, some of which were retouched into Dufour bladelets (Tixier, Inizan, and Roche 1991, Schmider and Perpère 1995).

Châtelperronian lithic technology is very different from that of the Aurignacian both in the procedure for producing blades and in the way blanks were transformed (Guilbaud 1987, 1996; Bodu 1990; Pelegrin 1990, 1995). For cores, the Châtelperronians used large, thick flakes or small blocks and plaquettes which were purposefully shaped by the production of a crest along a smooth, long surface; subsequently, using either one or two opposed striking platforms, small, fairly regular and rectilinear blades were detached. According to a large experimental reference base, it appears that the technique utilized in this blade production was direct percussion with a soft hammer (Pelegrin 1995). The best blanks resulting from this reduction sequence (the most regular and rectilinear) were used in the fabrication of Châtelperron points. The "second-rate" blades—those which were too irregular or had curved profiles—were used as blanks for the fabrication of end scrapers, truncated pieces, and backed or retouched blades. The debi-

tage by-products (cortical flakes and core maintenance flakes) were used to produce scrapers on particular types of flakes (thick, subcircular, or with a limited front on a thinner flake), becs (borers), burins, and notched and denticulated flakes. Rigaud (1996) has recently emphasized the originality of the Châtelperronian technology; Châtelperronian lithic assemblages from sites with underlying Mousterian levels are systematically richer in Mousterian tools than those where isolated Châtelperronian layers are present, suggesting that the Châtelperronian has a less pronounced Mousterian component than previously thought.

In sum, we face two technocomplexes which are very different both in their reduction sequences and in the selection of blanks for transformation into different tool types. Even the nature of the retouch on blades shows different habits. Such differences are clearly the expression of two distinct technical systems, resulting from different traditions.

One might think that more or less occasional contacts between human groups belonging to the two traditions would have resulted in some exchange of stone tools or some influence on tool morphology. In fact, no typical Aurignacian tools are found in Châtelperronian layers, nor are Châtelperronian tools found in Aurignacian layers (Pelegrin 1995). The few such cases known (Bos del Ser or the "Perigordian 2" from La Ferrassie, for instance) have long since been reconsidered as the result of a reworking of sediments or a mixing of archaeological materials coming from stratigraphic units in direct contact (Sonneville-Bordes 1955, Bordes 1963).

The interpretation of the Châtelperronian as a technocomplex stemming in some way from or influenced by the Aurignacian is therefore difficult to maintain. This conclusion is confirmed by analyses of late Mousterian of Acheulean Tradition (MAT) assemblages such as the more recent layers of Pech de l'Azé Ib (7, 6, and C) and layers 1–4 of Combe Grenal (Pelegrin 1990). Technological analysis of these assemblages shows, as has been observed by Bordes (1954–55, 1958, 1961, 1968), that some technical behaviors and tools present in the Châtelperronian and more recently interpreted as the consequence of acculturation are present in this type of Mousterian, well before the spread of the Aurignacian.

At Pech de l'Azé and Combe Grenal, after the creation of a striking platform, the reduction sequence proceeds with removals oriented along the long axis of the nodule resulting in more or less elongated flakes. These products were used as blanks for naturally backed knives and for knives backed by abrupt or semiabrupt retouch. These knives were often wide, but in these assemblages some were made on light blade blanks with finely retouched backs and, as Peyrony has pointed out, closely resemble Châtelperron knives. Several "Upper Paleolithic" tool types (end scrapers, burins, truncated pieces) are also present in these assemblages. Differences between the late MAT and the Châtelperronian do exist, but elements of similarity clearly make the former the more likely ancestor of the latter. Mellars (1973) has already added further strands to this opinion by pointing to the similar geographical distribution of the Châtelperronian and the MAT industries and arguing that the MAT industries seem to represent the final stages of the local Mousterian sequence. One possible evolutionary mechanism between these two lithic industries can be deduced from the fact that Châtelperronian lithic technology is essentially oriented toward the production of blanks for Châtelperron points (Pelegrin 1990). According to this hypothesis, for the MAT groups before the "Würm interstadial" and perhaps for other Mousterian groups during it, it was the success of such hafted tools that triggered an evolution in lithic technology culminating in the systematic production of blanks adapted to the fabrication of the points (or knives) that define the Châtelperronian.

Because of its emphasis on blade production, some writers have proposed that the Châtelperronian was more "modern" than the great majority of Middle Paleolithic technologies, this "modernity" constituting an argument in favor of influence from the Aurignacian (Mellars 1989, Hublin et al. 1996). This assertion assumes that blade technology is a technical and psychomotor stage that Neanderthals would have been unable to attain without the intervention of modern humans. On the contrary, the necessarily "modern" character of blade production is contradicted by the discovery in recent years of several cases of systematic blade production in many Middle Paleolithic sites of Western and Central Europe (Otte, Boëda, and Haesaerts 1990; Revillon 1989, 1994; Tuffreau et al. 1994; Madeyska et al. 1994, cited in Kozlowski 1996).

Experimental reproduction of lithic reduction sequences developed during the Middle Paleolithic (Levallois) and the Upper Paleolithic, based on the refitting of archaeological cores, demonstrates that these technologies demand the same high degree of concentration and lucidity and equivalent degrees of skill (Boëda, Geneste, and Meignen 1990, Pelegrin 1990, Boëda 1994, Schlanger 1996). In fact, Châtelperronian blade technology may simply represent a particular development of a kind of technical knowledge that already existed in the Mousterian of Acheulean Tradition (namely, direct percussion by soft hammer for the production of bifaces), inspired by the necessity to produce blanks for Châtelperron points, a tool type that has no connection with the Aurignacian.

The most recent reviews of data concerning the Uluzzian also attest to an absence of Aurignacian influence (Gioia 1990, Mussi 1990, Palma di Cesnola 1993). As is the case with the Châtelperronian of France, the Italian Uluzzian differs from the Aurignacian in both technology and typology. The Uluzzian is a flake-based technology, with very low blade indexes (often lower than in the preceding Mousterian), in marked contrast with the succeeding Aurignacian. Typically Upper Paleolithic retouched tools—end scrapers, burins, backed points, and, hallmark of the industry, crescents—are, however, common. The latter are found in all Uluzzian assemblages, may be as small as 15 mm, and tend to be

manufactured preferentially on small, thick flakes, often by the *sur enclume* technique (producing backed sides presenting a *retouche abrupte croisée*). The *pièce esquillée,* a not very characteristic tool found during many time periods, is the only element that these two lithic complexes have in common; there is virtually no occurrence, even sporadic, of tools characteristic of one in layers containing archaeological material of the other. The only exception might have been layer D of Grotta del Cavallo, in Apulia, interpreted by Palma di Cesnola (1966) as an evolved Uluzzian with regressive features and "Aurignacoid" elements. Gioia (1987, 1990), however, has convincingly shown that the assemblage from this layer is composed of a few very typical Aurignacian tools associated with a true Uluzzian industry, suggesting a mixing of material belonging to different occupations of the site.

Aurignacian and Châtelperronian Chronology

Evidence from France and Italy seems to indicate that there was no adoption or absorption of Aurignacian bone technology by the Neanderthals but rather the invention of different ways of solving similar technological problems and satisfying possibly different functional and nonfunctional needs. The same is true of lithic technology. The Châtelperronian and the Uluzzian are completely different from the Aurignacian; instead of having been learned from the latter, the blade technology of the former is deeply rooted in Middle Paleolithic traditions of stone-knapping that go back to the last interglacial and, more specifically, is clearly derived from the Mousterian of Acheulean Tradition that precedes it over its entire geographical range. The ivory rings from Arcy are the only possible material culture item linking the Châtelperronian to the Aurignacian. Even if one were to accept that these rings are indeed ornaments, not by-products, and that they were not produced by Châtelperronians but collected or acquired by trade, their use in association with a variety of true personal ornaments unknown to the Aurignacian would be evidence not of acculturation but rather of cultural interaction similar to that observed between neighbouring modern and submodern human groups. The three ivory beads from the uppermost Châtelperronian level VIII may be (if they are indeed in situ) a further example of such interaction, since their uniqueness in Châtelperronian contexts and their obvious similarity to equivalent objects from numerous Aurignacian sites make it logical to assume that they are either Aurignacian "imports" into a Châtelperronian cultural context or intrusive Aurignacian elements in the immediately underlying Châtelperronian deposits.

According to White (1993*a,* 1995) and Hublin et al. (1996), however, the recent date of the Arcy Châtelperronian (around 34,000 years B.P.) would imply a long period of contact between the two populations and, thus, a "high degree of acculturation" of the late Neanderthal inhabitants of the site. The assumptions behind this reasoning are that the most representative instance of Upper Paleolithic Neanderthals is much later than the appearance of Aurignacian modern humans in Western Europe and that before that appearance the aforementioned cultural traits are not found in Neanderthal contexts; therefore, their occurrence at Arcy must have been a consequence of that lasting contact.

Only a very extreme interpretation of the data presented above would give Aurignacian modern humans any role in triggering the emergence of the Châtelperronian. Even if such a notion were accepted, however, we would still be dealing with a process in which ideas and material culture items were not simply copied or transferred but rather reelaborated in original ways; that is, we would be witnessing Neanderthals reacting to outside stimuli in exactly the same way as modern humans. In that case, however, the acculturation hypothesis would be deprived of its basic foundation: that, the behavior of Neanderthals being essentially nonmodern, they could not have independently developed the new cultural traits found in the Châtelperronian, whose presence would therefore require a special explanation in which contact with Aurignacian modern humans would play the role of prime mover. But once we admit that Neanderthals were capable of such cultural responses no external prime mover is needed, and independent development becomes the most parsimonious explanation for the evidence.

This is all the more so in that the chronological evidence referred to by Hublin et al. (1996) is highly equivocal. The new Oxford accelerator radiocarbon dates for Arcy show that the old series of conventional results from the Gröningen and Lyon labs seriously underestimated the age of the Châtelperronian and Mousterian occupations of the site (see table 1). However, the new dates also suffer from the same problem of stratigraphic inversion of results present in the old series: although the results for levels IX and XII show a significant overlap at two sigma, those for intermediate levels X and XI are much younger and, in the case of the latter, statistically identical to the old conventional results. If the dates for level IX and X were ignored, an apparently well-ordered sequence would be obtained and the site might be considered as "well-dated." Although tempting, this would, however, be dangerous, since there is no technical reason to disregard the accelerator date for level IX (Hedges et al. 1996). Furthermore, similar discrepancies are commonly found at sites in the same chronological range whenever radiocarbon is used to date them. At Trou Magritte (Straus 1995), for instance, stratum 3 was AMS-dated to 41,300 ± 1,690 B.P. (CAMS-10352), while underlying stratum 4 was AMS-dated to 30,890 ± 660 B.P. (CAMS-10358) and 21,550 ± 190 B.P. (CAMS-10362); since all three dates were measured on the aspartic-acid fraction of bone collagen, the discrepancy is attributed by Straus to the poor preservation of the bones from stratum 4, which would have undergone significant protein leaching, as opposed to the

sample from stratum 3, where the protein content was still almost as high as in modern bone. At L'Arbreda, the basal Aurignacian was AMS-dated at ca. 38,500 ± 1,000 years B.P. on charcoal (Bischoff et al. 1989); on bone, however, the result obtained for this basal unit was 35,480 ± 820 B.P. (OxA-3730), while that for the overlying level with split-based bone points was 37,340 ± 1,000 B.P. (OxA-3729) (Maroto 1994). And, at Geissenklösterle (Hahn 1996), AMS dates on bone for the "Proto-Aurignacian" in level IIIa ranged from 33,100 ± 680 B.P. (ETH-8268) to 40,200 ± 1,600 B.P. (OxA-4595), while Aurignacian level IIa was dated to 36,800 ± 1,000 B.P. (OxA-4594).

As Hahn (1996) points out, the discrepancies in the dating of archaeological contexts older than 30,000 years B.P. such as those discussed here are a consequence of the fact that we are working at the limits of the radiocarbon method. Therefore, even very limited contamination may have an enormous impact on the results obtained: in a sample 48,000 years old, for instance, 1% of modern contamination would bring about an age some 12,700 years younger, and the same percentage of contamination by a contaminant half the age of the sample would, in turn, bring about a result some 6,350 years younger (Soares 1984). One way of circumventing these problems, as Mellars (1996*a*) has suggested, is retaining only the oldest results in a series of dates, those least susceptible of having undergone contamination. When this is done, it becomes quite clear that the Châtelperronian is older than the Aurignacian.

This anteriority is also highlighted by the fact that, as demonstrated by Hahn (1993), the available chronometric evidence, despite its shortcomings, does allow the recognition of the Aurignacian 1 with split-based bone points as a chronostratigraphic unit with pan-European validity. It is also possible that, in some regions, this unit was preceded by an Aurignacian 0 or Proto-Aurignacian. Thirty sequences document a stratigraphic succession of Châtelperronian under Aurignacian 0—for instance, at Gatzarria (Saenz de Buruaga 1991), La Ferrassie (Tuffreau 1981, Delporte 1984), Saint-Césaire (Lévêque 1993), La Rochette (Delporte 1962)—or Aurignacian 1—for instance, at Brassempouy (Buisson and Delporte 1990), Isturitz (Clottes 1976), Les Cottés (Bastin, Lévêque, and Pradel 1976, Lévêque 1993), Trou de la Chèvre (Arambourou and Jude 1964), Caminade Est (Sonneville-Bordes 1969), Gargas (Breuil and Cheynier 1954–55), Le Basté (Chauchat and Thibault 1968), Cueva Morín (Echegaray and Freeman 1971, 1973), and Labeko Koba (Arrizabalaga 1993). The same is true for the Italian equivalent of the Châtelperronian; a thin Uluzzian context was recently identified underlying the Proto-Aurignacian of Fumane (Broglio 1996), and similar Uluzzian–Proto-Aurignacian sequences are known from the cave sites of Fabbrica and Castelcivita (Gioia 1990, Palma di Cesnola 1993).

The strength of this stratigraphic patterning constitutes, at the same time, a further reminder that the available radiocarbon dates for the Châtelperronian and the Aurignacian (including those obtained by AMS)

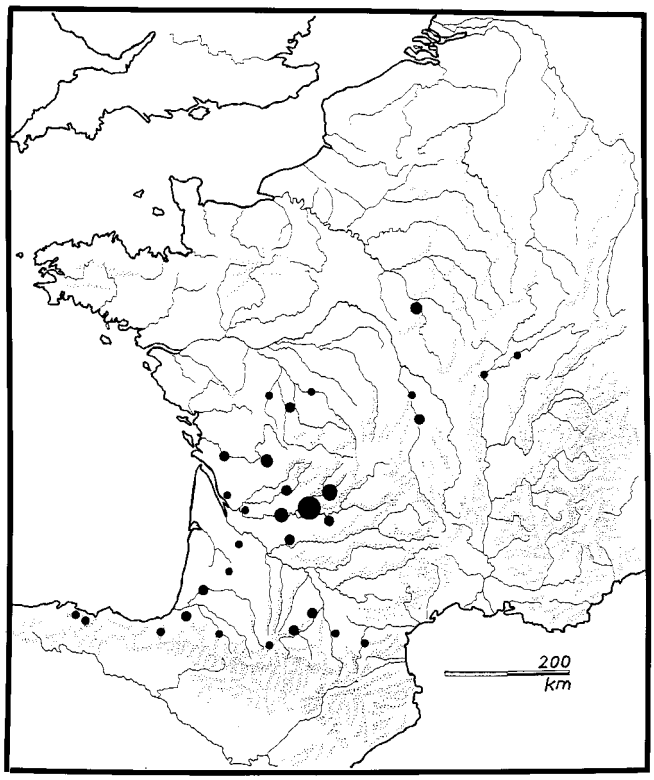

FIG. 6. *Geographical distribution of the 125 Châtelperronian sites found in France and Spain (modified after Demars 1996*b).

need to be critically evaluated. If accepted at face value, they would imply that the Châtelperronian and the Uluzzian would indeed have been contemporary with the Aurignacian for a significant length of time. In spite of this, as has been shown above, the two Neanderthal technocomplexes would have maintained a remarkable technological coherence across vast expanses of territory (figs. 6–8), from northern to southern Italy in the case of the Uluzzian and from Cantabria to the Paris Basin (an area of some 400,000 km^2) in the case of the Châtelperronian. If Aurignacians were there at the same time and influencing the local Neanderthal groups, then (1) why did acculturation produce a flake-dominated Uluzzian in one region and a blade-dominated Châtelperronian in the other? (2) how were acculturated Neanderthals able to maintain such widespread cultural uniformity? and (3) why is it that they never adopted the Aurignacian innovation that constitutes the hallmark of the Proto-Aurignacian—the mass production of bladelets?

Furthermore, if accepted at face value, the available dates would also imply that the Aurignacian sequence began in neighbouring regions with offsets of thousands of years although subsequently proceeding through virtually identical developmental stages. Proto-Aurignacian/Aurignacian 1 sequences, for instance, are known at L'Arbreda, in Spain, and Riparo Mochi, in Italy, located only a few hundred kilometers apart at op-

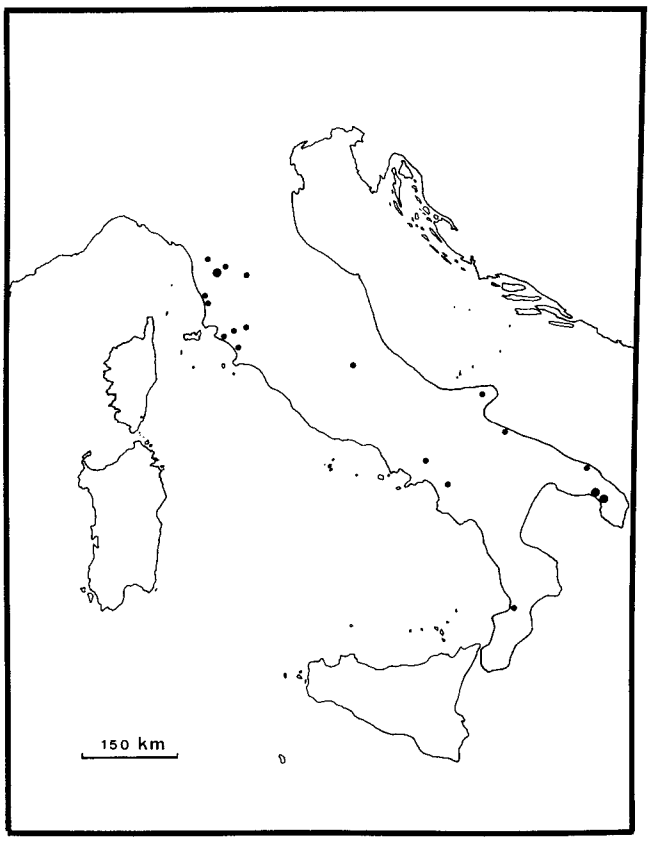

FIG. 7. *Geographical distribution of the Uluzzian sites found in Italy (data from Gioia 1990 and Palma di Cesnola 1993).*

posite ends of the Gulf of Lion. Both have been accelerator radiocarbon-dated on charcoal: at L'Arbreda, as we have seen, the Proto-Aurignacian was dated to ca. 38,500 ± 1,000 years B.P., and the level with split-based bone points atop it (Aurignacian 1) was dated (on bone, this time) to 37,300 ± 1,000 years B.P.; at Riparo Mochi, however, the same Proto-Aurignacian would not have begun until ca. 35,100 ± 1,400 years B.P. and the subsequent more classic Aurignacian with split-based bone points would date to ca. 32,800 ± 900 years B.P. (Hedges et al. 1994). If the earliest Aurignacian is a proxy for the east-west penetration of Europe by modern humans and if such penetration initially followed a route along the 43d parallel, as suggested by Otte (1990), Kozlowski (1990, 1993), and Mellars (1992), then we would be facing two serious problems: (1) why would modern humans have skipped the Riviera littoral on their way to the other end of the gulf? and (2) why would those first modern humans have reverted in the new region to the technology of their ancestors instead of carrying with them the technology of the regions from which they had radiated?

Clearly, there are too many inconsistencies in the paleoethnological scenarios that use radiocarbon dating to substantiate the assumption that Neanderthals and modern humans shared intermingling territories in Central and Western Europe for many thousands of years and that the Châtelperronian and similar industries are a result of the acculturation brought about by that prolonged contact. At the same time, the geographical distribution of the latter suggests the operation of systems of exchange between human groups participating in coherent cultural networks, not the fragmentation of Neanderthal populations predicted by the acculturation model.

When critically examined, then, radiometric and chronostratigraphic criteria point to the same conclusion: that the Châtelperronian and its equivalents are indeed earlier than the earliest Aurignacian and were rapidly replaced by the technocomplex of modern humans (or at least did not survive alongside it for an archaeologically visible length of time). In the case of Arcy, it is of course possible to argue that the Aurignacian of Grotte du Renne, lacking split-based bone points, is late and therefore the Châtelperronian levels of the site may be in the chronostratigraphic position elsewhere occupied by the early Aurignacian. Given the occupation hiatus recorded in the upper part of level VIII, however, the simplest interpretation is that the site was not inhabited during the earliest phases of the Aurignacian and that the Châtelperronian levels of Arcy do predate the appearance of modern humans in Western Europe.

This conclusion is all the more warranted in that the pattern of interstratification between these two technocomplexes identified in rock shelters such as Le Piage and Roc-de-Combe, in southwestern France, often considered proof of long contemporaneity (Bordes and Labrot 1967, Champagne and Espitalié 1981), remains questionable. The new analysis of the "Châtelperronian" layer F1, interstratified within the Aurignacian sequence of Le Piage, has shown that half of the tools are in fact clearly Aurignacian (Demars 1996*a*). Analysis of the stratigraphic illustrations, taking into account the topography of the site, suggests that this impure Châtelperronian lens may very well have shifted from an upper terrace during the later Aurignacian occupation. One can even wonder whether the whole lower stratigraphic sequence (K to F) is not upside down as a consequence of the same phenomenon. Recent research has also shown that previous excavations have tended to overlook the potential for disturbance of level integrity by the postdepositional processes that may have been active in the periglacial environments of the time (Bertrand 1994). At El Pendo, the poorly defined "Châtelperronian" assemblage found in inter-Aurignacian level VIII also contains typical Aurignacian carinated scrapers (González Echegaray 1980, Bernaldo de Quirós 1983) and may well result from an intercalation of earlier deposits.

A further example of these problems, and one with implications for the interpretation of the chronometric evidence available, is the situation at El Castillo. Close to sample 11 (AMS radiocarbon-dated to 37,700 ± 1,800 B.P. [AA-2407]), collected in sublevel B2 of level 18 of the new excavations, there was a Châtelperron point

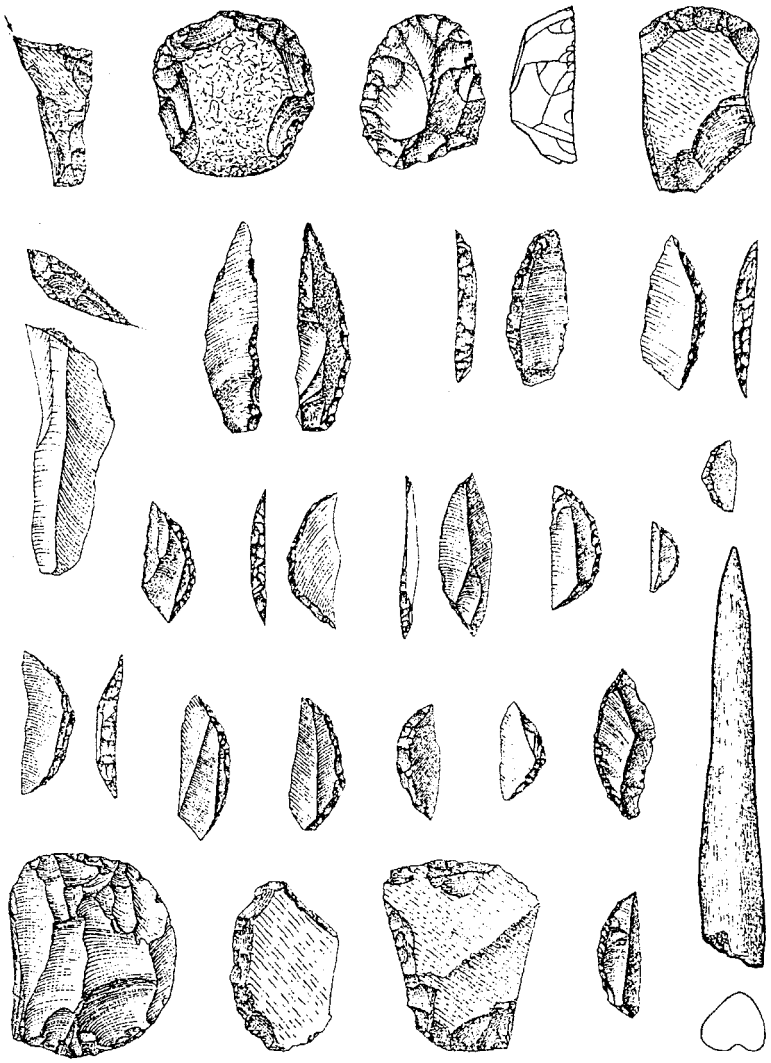

FIG. 8. *Characteristic tools from level E of Grotta del Cavallo (after Palma di Cesnola 1993).*

(Cabrera Valdés and Bischoff 1989:581–82), and no characteristically Aurignacian bone or lithic tools were found in that level. Its attribution to the Aurignacian is therefore entirely made by correlation with the "Aurignacian Delta" of Obermaier's early-20th-century excavations. However, the presence of the point in question suggests that the correlation may be simplistic. Lateral variations of the stratigraphy may have existed, and the date may therefore be related to the Châtelperronian instead of the Aurignacian. It is also possible that the 50-cm-thick sediment package designated level 18 contains both Châtelperronian and Aurignacian components. A similar situation may have existed at Isturitz, where Châtelperronian points have been reported from the base of level SIII in the Saint Martin chamber, although the lithic assemblage from this context is generally attributed to the Proto-Aurignacian (Esparza 1994).

Bearing in mind the situation at the Belgian sites of Spy, Goyet, and Trou Magritte, the French sites of Le Piage and the Roc-de-Combe, the Italian site of Cavallo D, and the nearby Spanish site of El Pendo, Isturitz and El Castillo probably represent two other illustrative cases of the taphonomic complications that may occur in the archaeology of caves and rock shelters. These examples also highlight, in contrast, the importance of the fact that the spatial analysis of artifacts and features and the typological and technological analysis of the lithic and bone tool assemblages from Grotte du Renne gave no indication that the stratigraphic integrity of its Châtelperronian levels had suffered from significant post-depositional disturbance. Furthermore, they show that the debate on Châtelperronian/Aurignacian contemporaneity and interstratification could profit from the lessons of the 1970s debate on the contemporaneity and interstratification of Bordes's six Mousterian variants. As was eventually shown by Mellars (1973, 1996*a*), traditional chronostratigraphic reasoning based on assemblage composition is a very powerful tool and tends to be more reliable than long-distance correlations based on dating techniques derived from the natural sciences

when the methods used are fraught with uncertainty as they are in the time range of interest here.

The Late Mousterian of Iberia

In the circumstances just described, it does not seem possible to maintain that, in France, Neanderthals and modern humans lived side by side, with fluctuating territorial boundaries, for the millennia necessary to produce the interstratifications reported from Le Piage and Roc-de-Combe or the survival of the Châtelperronian from Arcy until the beginning of oxygen-isotope stage 2. This does not mean that Châtelperronian Neanderthals and Aurignacian modern humans never had any contact, since such contact is obviously required once it is accepted that population replacement occurred. However, the large number and extensive geographical distribution of the sites where a prolonged Châtelperronian occupation underlies the earliest Aurignacian indicates the antecedence of the former and challenges the acculturation model's assumption of a long period of contact between the two.

This review of the evidence thus casts serious doubt on the putative prolonged contemporaneity of Neanderthal and modern human groups in the Franco-Cantabran region. The opposite is true, however, when the chronological and spatial distributions of that region's earliest Aurignacian are compared with those of the Late Mousterian of Iberia south of the Ebro (table 5, fig. 9). The two were contemporary for at least 5,000 and probably as much as 10,000 years, during which, inevitably, some form of contact must have taken place. Yet, nothing fundamentally changed in the material culture of Iberian Neanderthals, challenging the hypothesis that the biological superiority of anatomically modern humans would have brought an inevitable acculturation of Neanderthals subjected to contact with them (Zilhão 1993, 1995; Straus 1996).

Radiocarbon dating of Mousterian levels in the cave sites of Caldeirão, Columbeira, Figueira Brava, Lapa dos Furos, Salemas, and Pedreira de Salemas indicates that, in littoral Portugal, Middle Paleolithic industries were manufactured until ca. 28,000–30,000 years ago (Antunes et al. 1989; Antunes 1990–91; Zilhão 1993, 1995). Raposo (1993, 1995) also reports uranium-series dates for three tooth samples from the Mousterian open-air site of Foz do Enxarrique (located at Ródão, on the Tagus, near the Spanish border), averaging 33,600 ± 500 B.P. (table 5); bearing in mind the offset between radiocarbon and uranium-series ages (Bard et al. 1990, Bischoff et al. 1994), this result is equivalent to a radiocarbon age of ca. 30,000 years B.P. Although the laboratory considers the Columbeira results unreliable because of the nature of the sample (Delibrias, Guillier, and Labeyrie 1986) and it has been suggested that the level T.V.b of Salemas lacks stratigraphic integrity (Zilhão 1995), the other results independently confirm the existence of Middle Paleolithic industries in Portugal after 35,000 years B.P. A similar late survival of the Mousterian has been suggested for southern Spain (Vega Toscano 1990, Villaverde and Fumanal 1990) on the basis of sedimentological and biostratigraphical arguments derived from the sites of Cova Negra (Valencia) and Cariguela (Andalucía). This hypothesis was recently confirmed at Zafarraya Cave, also located in Andalucía, where a Mousterian sequence containing Neanderthal remains (Hublin et al. 1995) has been radiocarbon-dated to ca. 30,000 years B.P. at the top and uranum-series-dated to ca. 33,500 years B.P. at the bottom (table 5); bearing in mind, again, the offset between the two dating methods, these results are virtually identical.

The Aurignacian appears in this area later than in Cantabrian Spain, northern Catalunya, and the rest of Europe. In the Valencia region, an Aurignacian level has been radiocarbon-dated to ca. 30,000 years B.P. at the cave site of Mallaetes (Fortea and Jordá 1976); in Portugal, the only date available is that obtained for the base of level 2 at the cave site of Pego do Diabo, north of Lisbon—ca. 28,000 years B.P. (table 5). The material culture also indicates that these occurrences pertain to a late Aurignacian. In Iberia, no split-based bone points or other items typical of the early Aurignacian have so far been found south of the Ebro. The chronostratigraphic position of the early Aurignacian must be occupied, therefore, by the Late Mousterian, as is also suggested by the long and rich cave sequences spanning the Middle/Upper Paleolithic divide (Bajondillo, Beneito, Cariguela, Caldeirão, Gorham's), which all lack early Aurignacian deposits (Vega Toscano 1990, 1993; Iturbe et al. 1993; Zilhão 1993, 1995; Cortés et al. 1996).

It would therefore seem that the valley of the Ebro functioned for some 5,000–10,000 years as a major biocultural frontier: to the north, Western Europe was occupied, from ca. 40,000–38,000 years B.P. (as is unequivocally shown by the dates obtained for L'Arbreda and Abric Romaní [Bischoff et al. 1989, 1994]), by modern humans producing an Aurignacian material culture; to the south, the rest of Iberia continued to be occupied, until ca. 30,000–28,000 years B.P., by Neanderthals with a Middle Paleolithic material culture. Replacement seems to have taken place quite suddenly (at least in comparison with the previous millennia of apparently stable geographical segregation) and is attested by the association of modern human remains with a nondiagnostic Upper Paleolithic tool kit in level Jb of Caldeirão, radiocarbon-dated to ca. 26,000 years B.P.

The reasons for the Ebro "frontier" pattern are still unclear. A possible explanation is that it might correspond to an ecological divide (Zilhão 1995, n.d.*a, b*). According to this hypothesis, modern humans entered Europe and rapidly replaced the local Neanderthal populations because of factors (demographic or epidemiologic) related to population biology. They would have stopped at the Ebro because, during the interstadial, the regions to the south were significantly more wooded. The different environmental conditions, their social correlates, and the relative isolation of the Iberian populations inhabiting these regions would also explain

TABLE 5
Absolute Ages for the Late Mousterian and the Aurignacian of Portugal and Spain South of the Ebro

Site	Level	Material	Cultural Attribution	Lab No.	Age B.P.
Caldeirão	Jb (profile)	Bone	Upper Palaeolithic	OxA-5542	26,020 ± 320
Caldeirão	K top	*Cervus*	Mousterian	OxA-1941	27,600 ± 600
Caldeirão	K top	*Cervus*	Mousterian	OxA-5541	18,060 ± 140[a]
Caldeirão	K base (K5)	*Capra*	Mousterian	OxA-5521	23,040 ± 340[b]
Columbeira	16	Carbonaceous sediment	Mousterian	Gif-2703	26,400 ± 700[c]
Columbeira	20	Carbonaceous sediment	Mousterian	Gif-2704	28,900 ± 950[c]
Figueira Brava	2	*Patella* sp.	Mousterian	ICEN-387	30,930 ± 700
Foz do Enxarrique	C	Tooth enamel	Mousterian	SMU-225*	32,938 ± 1,055
Foz do Enxarrique	C	Tooth enamel	Mousterian	SMU-226*	34,088 ± 800
Foz do Enxarrique	C	Tooth enamel	Mousterian	SMU-224*	34,093 ± 920
Lapa dos Furos	4	Land snail shells	Below Mousterian	ICEN-473	34,580 + 1,010 − 1160
Pedreira de Salemas	2	Bone	Mousterian	ICEN-366	29,890 + 1,130 − 980
Pego do Diabo	2a	Bone	Aurignacian	ICEN-490	23,080 ± 490[d]
Pego do Diabo	2b	Bone	Aurignacian	ICEN-732	28,120 + 860 − 780
Salemas	T.V.b	Bone	Mousterian	ICEN-379	24,820 ± 550[e]
Beneito	C_3	–	Mixed Mousterian/UP	Gif-7650	26,040 ± 890[f]
Beneito	C_3	–	Mixed Mousterian/UP	AA-1388	33,900 ± 1,100[f]
Beneito	D_1	–	Mixed Mousterian/UP	GifTAN-89283	30,160 ± 680[f]
Beneito	D_1	–	Mixed Mousterian/UP	AA-1387	38,800 ± 1,900[f]
Gorham's	D	–	Upper Palaeolithic	GrN-1363	27,860 ± 300
Gorham's	D	Charcoal	Upper Palaeolithic	GrN-1455	28,700 ± 200
Mallaetes	2/XII	Charcoal	Aurignacian	KN-I/926	29,690 ± 560
Zafarraya	I (3–7)	Total tooth	Mousterian	Gif-9140-II*	26,970 ± 5,160[g]
Zafarraya	I (3–7)	Bone	Mousterian	Gif-9140-II	29,800 ± 600
Zafarraya	I (8)	Total tooth	Mousterian	Gif/LSM-9140-I*	31,700 ± 3,600
Zafarraya	I (8)	Bone	Mousterian	Gif/LSM-9140-I	31,800 ± 550
Zafarraya	D	Total tooth	Mousterian	*	33,400 ± 2,000

SOURCES: Delibrias et al. (1986), Antunes et al. (1989), Davidson (1986), Iturbe et al. (1993), Zilhão (1993, 1995), Hublin et al. (1995), Raposo (1995).
NOTE: Dates are radiocarbon except for those marked with asterisks, which are uranium-series.
[a] Date too young, possibly due to very low collagen content (0.32%N; 3.66%C; 0.53%H).
[b] Date too young, possibly due to very low collagen content (0.32%N; 2.39%C).
[c] Date too young, possibly due to the inadequate nature of the sample.
[d] Date too young, possibly due to contamination by later material (the Aurignacian level is surface).
[e] The association between the dated bones and the diagnostic archaeological materials is questionable.
[f] The taphonomy of unit C is poorly understood; traces of occupation are extremely rare (some 200 pieces in a deposit that is 1.20m thick); level D_1 is clearly disturbed, containing a few typical Aurignacian items in an otherwise banal Mousterian assemblage; the sample for level C_3 was collected only 20 cm above the top of D_1; the first clearly defined Upper Paleolithic occupation is the Late Aurignacian in levels B9 and B8 (1 m above C_3), which is followed by the normal regional sequence of Gravettian, Solutrean, and Solutreo-Gravettian occupations in levels B7–B1 (cf. Iturbe et al. 1993).
[g] Average of three determinations, one on dentine (25,000 ± 1,300 B.P.) and two on enamel (26,900 ± 2,700 and 28,900 ± 4,200 B.P.).

why local Neanderthals had not undergone the same changes observed among their biological brothers to the north since a few millennia earlier. Modern humans would eventually have crossed the frontier once the trend toward colder conditions began to compress the human range and to extend southwards into Iberia the kinds of environments to which they had previously become adapted.

So far, the sparseness of paleoecological data from the Iberian peninsula for the period at hand, practically consisting only of the pollen sequences from the Padul pit-bog and Banyoles Lake (Pons and Reille 1988, Perez-Obiol and Julia 1994; see also discussion in Watts, Allen, and Huntley 1996), makes it difficult to establish whether the Ebro boundary and its subsequent crossing by Aurignacian people should be interpreted as the consequence of adaptations to different environments or of other factors. The few available data do, however, show a significant temperate woodland component in the paleoenvironments of southern Iberia during oxygen-isotope-stage 3 times. Palynological analyses of littoral peat bogs located north of Peniche (Diniz 1993*a, b*) indicate a landscape of heathland and pine on the coast and on the sandy soils of the interfluves, with oak woodlands covering the low-altitude limestone massifs, and the faunal data collected in cave deposits from the Tomar region include abundant remains of *Cepaea nemoralis* and presence of beaver, wild boar, and roe deer (Zilhão 1995).

What matters here, however, is that many opportuni-

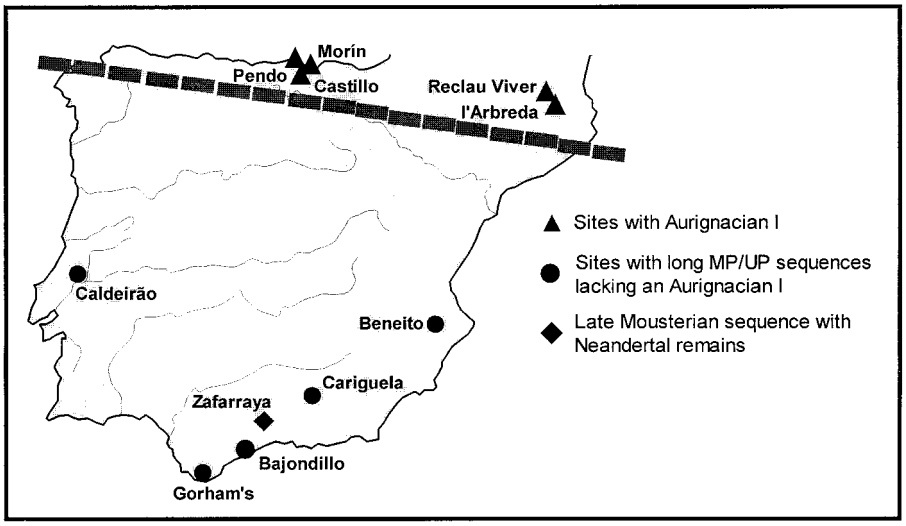

FIG. 9. *The Ebro "frontier."*

ties for acculturation must have occurred through contact between groups living on opposite sides of the Ebro. In spite of these inevitable contacts over at least five millennia of coexistence, Iberian Neanderthals retained traditional Mousterian technologies and tool kits until the end; blade debitage is unknown in the late Mousterian of the peninsula, as are bone tools and personal ornaments. That the Iberian Neanderthals maintained their traditional culture so long after modern humans had reached the Pyrenean region contradicts the interpretation of the Châtelperronian, Uluzzian, and similar European technocomplexes as simple by-products of the inevitable acculturation of Neanderthals brought about by their contact with biologically superior contemporary groups of moderns occupying neighbouring territories.

Conclusions

On the basis of stratigraphical, chronological, and archaeological data from Châtelperronian and Uluzzian sites, we have argued here that the hypothesis that the Châtelperronian Neanderthals were acculturated by the Aurignacians is untenable. If our empirically based conclusions are accepted and the acculturation hypothesis is rejected, the implication is that archaeologists should now turn their attention to the problems posed by the cultural achievements of the late Neanderthals. In our view, this renewed research could take two directions: (1) a reevaluation of Neanderthal cognitive abilities and (2) a critique of biological determinism.

Once the acculturation hypothesis (with its implied asymmetry) is rejected, the way is open for us to think about Châtelperronian and Uluzzian in a new light, applying to them very much the same sort of questions and the same explanatory framework that we apply to the Aurignacian. Most discussions of the body ornaments in the Châtelperronian levels of the Grotte du Renne, for example, have proceeded without considering the profound implications of their manufacture and use. Objects created for visual display on a human body necessarily imply the communication of some meaning (Leach 1976). A varied collection of such objects as are found at this site, which were probably used by the same human group, suggests the elaboration of a code in which different categories of pendants carry complex messages by their presence, absence, association, or position on the body. Symboling is a prerequisite for the development of such codes. In many traditional societies, these codes provide information on the age, gender, social status, and ethnic membership of the holder (Strathern and Strathern 1971, Faris 1972, Ray 1975, Brain 1979, Hodder 1979), and their use requires an intimate and often tacit knowledge of the cultural and social system (Hall 1973). The use of body ornaments by Châtelperronians cannot be interpreted as the result of so complete an acculturation that even such codes would have been adopted from the Aurignacians. Clear differences in lithic and bone technology, in the morphology of stone and bone tools, and in the technology and choice of personal ornaments seem to contradict the possibility of such a high level of integration between the two groups. Therefore, we are forced to admit that Châtelperronian Neanderthals elaborated, used, and transmitted autonomous codes, the reflexion of possibly different social roles and the expression of a different cultural system. Obviously, this does not preclude contacts and cultural exchanges between the two human groups. In our view, however, it makes more sense to approach the issue as a traditional problem of contact between populations with different cultural tra-

jectories; in this case, as has often been documented in both the historical and the ethnographic record, the long-term outcome of contact was that one of those trajectories was truncated and the corresponding genetic lineage became extinct.

Models of a biologically based intellectual superiority of modern humans cannot explain the punctuated process observed for the Iberian peninsula. They also fail to explain a number of features observed at Arcy and confirmed at other Châtelperronian and Uluzzian sites. The archaeological evidence reviewed above seems to indicate that Châtelperronian Neanderthals and Early Aurignacian modern humans were biologically different groups with important similarities in their cultural development. Therefore, there are no grounds to suggest that the biological difference determined different intellectual capabilities or to think that the latter would have visible consequences for the archaeological record.

Our survey argues in favour of a relative independence of biological and cultural classification schemes (Wolf 1994), as is also suggested by the evidence from Near Eastern interglacial and early last glacial times, when the occupation of the region by the two human types featured in both cases similar Middle Paleolithic technologies. The different developmental paths followed by Neanderthal groups north and south of the Ebro frontier also illustrate the perils of looking at the Middle-to-Upper-Paleolithic transition in stadial terms. The fact that the latter never reached the Upper Paleolithic needs no special evolutionary explanation and should be understood in terms of the laws of uneven development, the bread-and-butter of human history. The same processes of uneven development, the reasons for which are to be sought in the realms of ecological adaptations and historical trajectories, also explain why anatomically modern humans in the Maghreb did not become Upper Paleolithic until well after 30,000 B.P., by which time Neanderthals were already extinct. That such laws were in operation in the world of the Neanderthals constitutes further confirmation that they were fully cultured human beings and that there is no reason to assume that they were incapable of "modern behaviour."

Our main purpose here has been to illustrate how anti-Neanderthal prejudice has been blocking a correct appraisal of the empirical data relating to the Middle-to-Upper-Paleolithic transition. Paradoxically, this same prejudice has brought research inspired by the reductionist argument that Neanderthals were biologically inferior to a methodological dead end. If everything is in the wiring of the brain, why should we bother with artifacts, settlement patterns, or faunal exploitation strategies? And if the intellectual inferiority of the Neanderthals is the explanation for their extinction, is not the conclusion already contained in the premises, with the result that nothing is actually explained? Once this reductionist fog is cleared, a much richer world appears—a world in which ecological diversity and historical contingency created a variety of biological and cultural actors the reconstruction and explanation of whose individual trajectories and mutual interactions should constitute the substance of the archaeological inquiry into our origins. Gilman's (1984) concept of the "Upper Palaeolithic revolution" provides a sound starting point for the development of testable models that account for biocultural regional diversity and consider independent development, acculturation, and cultural interaction equally viable explanations for the patterns identified in the record rather than assuming them as postulates to which that record needs to be accommodated.

The evidence reviewed here suggests that uneven independent development in a diverse and sparsely populated geographical context is the best explanation for the Western European pattern of contemporaneity between Châtelperronian Neanderthals in the Franco-Cantabrian region and Mousterian Neanderthals in Iberia, that cultural interaction followed by swift extinction of the aboriginal groups is the best explanation for the contact between Franco-Cantabrian Châtelperronian Neanderthals and westward-moving Early Aurignacian modern humans, and that mutual avoidance between the latter and Iberian Mousterian Neanderthals explains the Ebro frontier pattern. These, however, are abstract explanations that need to be turned into concrete historical scenarios testable against the archaeological record. These important questions will obviously require much study in the years to come, but we hope that our discussion of late Neanderthal acculturation in Western Europe has made it possible to ask and research them on a new footing.

Comments

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Despite several generations of research on problems surrounding the origins of anatomically and culturally modern humans, we remain far from definitive answers. The majority of contemporary scholars support the notion of an origin outside Europe, with a colonization of Europe occurring in the form of the Aurignacian advance across the continent around 40,000 years ago. On the basis of the information now available this general scenario seems likely, although we do not know where and when anatomically modern humans and the Aurignacian initially developed. The association of Neanderthals with Chatelperronian assemblages and modern humans with Aurignacian assemblages and the absence of evidence associating *Blattspitzen* or late Middle Paleolithic assemblages with remains of modern humans support this interpretation. Furthermore,

the late finds of Neanderthals with Mousterian lithic inventories on the Iberian Peninsula provide important clues about the timing and rate of the colonization of Europe. From my point of view we still have only anecdotal evidence in the critical phase between the late Middle Paleolithic and the earliest Upper Paleolithic. By the appearance of the Aurignacian, be it at Vogelherd, Geissenklösterle, La Ferrassie, or elsewhere, we are dealing with hominids that are anatomically and culturally modern.

The question that troubles researchers is the nature of the interaction between archaic and modern hominids. If one excepts the notion of modern humans' originating in a limited geographic area, the problems associated with the interaction of two hominids presumably in conflict over an ecological niche are not limited to Europe but common to nearly all parts of the Old World. Since we rarely have detailed archaeological records of this interaction, d'Errico et al. are entirely justified in examining this question in western Europe, where there is at least enough evidence to allow a discussion of the issue without resorting to wholesale speculation.

Although I have no specific expectations about the nature of the encounters between archaic and modern hominids, I do assume that encounters between the two groups occurred and see no reason to assume that these interactions always followed the same course. While modern humans ultimately outcompeted archaic hominids, I would assume that the encounters, be they in Africa, Asia, or Europe, had many variants. A degree of cultural and perhaps genetic exchange is plausible. At least in the Levant during the first half of the last glacial cycle and in more remote parts of Europe several tens of thousands of years later, it appears that modern humans did not immediately expand like bacteria in a nutrient-rich petrie dish. If we accept Malthus's view of the potential for exponential growth in human populations and Elton's (1958) tenet that organisms rapidly expand to occupy the full limits of their newly colonized spaces, we must ask why, at least in some areas, it took tens or even hundreds of generations after the initial contact for archaic hominids to die out. We must also ask why the expansion of modern humans proceeded at a brisk pace in some areas and much more slowly in others.

Using evidence from the Grotte de Renne and other sites, d'Errico et al. demonstrate beyond reasonable doubt that the latest Neanderthal cultures did include a wide range of nonutilitarian objects that have traditionally been associated with fully modern humans. From these and other observations, as well as a series of explicit criteria for testing whether or not acculturation occurred, they conclude that acculturation cannot explain the archaeological observations made in settings where archaic and modern hominids presumably met. I agree with many of their conclusions, especially their call for hypotheses that are sensitive to ecological diversity and historical contingency. I do not, however, follow what they mean by suggesting that these populations had "different cultural trajectories" and pointing to a "law of uneven development." These strike me as very general statements or even labels that do little to advance the hypotheses based on concrete historical scenarios that they call for.

I am also unconvinced by the suggestion that the replacement of Neanderthals by modern hominids occurred rapidly in areas north of the Ebro frontier. For example, we still know very little about the nature of the transition in classic regions of study such as southwestern Germany. One could argue for quick replacement, but we have no reliable dates for the late Mousterian and lack the necessary chronological resolution for the *Blattspitzen* and Proto-Aurignacian assemblages. The human skeletal evidence is also so scant that we do not definitively know which hominid is responsible for which assemblages. We are often left with arguments that are based on extrapolations across whole continents. If we accept the presence of Aurignacian assemblages in central Europe by 40,000 years ago, there must have been numerous short-lived and longer-lived frontiers as modern humans expanded across the continent. Furthermore, with the presence of Aurignacian assemblages in Baden-Württemberg by ca. 40,000 years ago, there must have been other frontiers that allowed the continued survival of Neanderthals several thousand years later at Grotte du Renne and St.-Césaire. Whether frontiers existed along the Rhine, the Rhone, or elsewhere needs to be considered. At present, too many holes in the archaeological record remain to say where frontiers may have lain, but it seems likely that in addition to the Ebro there were others where complex interaction between archaic and modern hominids could occur over periods of many generations. Another such frontier may help to explain the existence of late Middle Paleolithic assemblages on the Crimean peninsula (Marks 1997). I would also assume, depending on the setting, that modern hominids may have learned about the new territories from the archaic hominids through direct or indirect observation or communication. Why must we assume that all the learning took place on the ultimately failed Neanderthal side of the encounter? Most important, I agree with d'Errico et al. that we should not expect easy answers to these questions, and I would be hesitant to project observations from one region across long distances and many millennia into other regions.

Finally, as the spectacular Lower Paleolithic wooden artifacts from Schöningen (Thieme 1995, 1997) demonstrate for that period, we should never underestimate how rich the organic component of Paleolithic material culture must have been. Because of the nature of archaeological preservation, we must be lacking all manner of practical artifacts and ornaments from Paleolithic contexts. It seems safe to assume that Neanderthals possessed at least the technological sophistication documented by the diverse wooden artifacts dating to ca. 400,000 years ago at Schöningen. Furthermore, given

the well-documented use of ochre and the presence of burials, as well as the rich evidence for ornaments summarized by d'Errico et al., it is likely that we continue to underestimate the technological and symbolic sophistication of Neanderthals. This observation, however, in no way alters the apparent fact that after ca. 15,000 years of interaction across shifting European frontiers Neanderthals were driven to extinction by the technologically and presumably socially more advanced *Homo sapiens sapiens.*

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I want to focus on the meaning of the term "acculturation." Herskovits (1938:10) gives several definitions, among them that of a Social Science Research Council subcommittee on which he served with Redfield and Linton: "Acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original cultural patterns of either or both groups." Another definition is that of Lesser (1933:ix, cited by Herskovits 1938:7): "Acculturation may be taken to refer to the ways in which some cultural aspect is taken into a culture and adjusted and fitted to it. This implies some relative cultural equality between the giving and receiving cultures. Assimilation, however, is the process of transforming aspects of a conquered or engulfed culture into a status of relative adjustment to the form of the ruling culture. The problem of acculturation, when we are considering the American Indians in relation to their adjustment to European culture, is a problem of assimilation." Thus it would appear that "acculturation" refers to the processes that Lesser calls "assimilation"—but a distinction between these two phenomena is necessary. In any case, none of these definitions assumes the "inferiority" of a population, except perhaps in war technology.

It seems to me that the concept of acculturation as Herskovits defines it is better than the notion of independent development for describing the great transformations in the prehistory of Europe between roughly 40,000 and 30,000 B.P. The Mousterian, a technocomplex that has remained roughly the same for many thousands of years, rapidly changes in the direction of the Upper Palaeolithic technocomplex (the systematic production of blades) when the first "pre-Aurignacian" industries appear in Europe. This synchronism is strange if we do not consider exchanges between these two populations. If we accept Herskovits's definition, the acculturation of the Mousterian does not require any simple copying of culture traits. Following Pelegrin (1990), we can imagine the observation of a hunting technique—the use of spears—and the translation of this idea in terms of the many knapping techniques used by Mousterians.

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D'Errico et al. confuse the concept of biological and/or intellectual "inferiority" with the concept of acculturation, which covers a wide range of phenomena and cannot be restricted to cultural assimilation. The debate on Neandertal capabilities still seems to be surrounded by "political correctness," and this is not a scientific approach. The Neandertals developed in Europe for at least 400,000 years and in this regard were biologically quite successful. In fact, they were probably biologically better adapted to the environment of the middle latitudes than the modern invaders of the early Upper Paleolithic (Holliday 1995). Meanwhile, and for a large portion of their history, modern humans maintained a lithic technology similar to that of the Neandertals. Furthermore, the hypothesis of a long coexistence of Neandertals and modern humans in Europe implies that the "superiority" of the latter was by no means overwhelming (Hublin et al. 1995). Finally, even in the acculturation model Neandertals do in fact demonstrate the capability of developing some Upper Paleolithic behaviors or technologies.

The current data support the idea that the development of Chatelperronian and Uluzzian technocomplexes in Europe is synchronous with the spread of the Aurignacian. So far the paleoanthropological evidence indicates that the former were produced by Neandertals and the latter by modern humans. This is consistent with the pattern of technological continuity observed between the local Middle Paleolithic industries and the Chatelperronian and the allochthonous character of the Aurignacian in Western Europe. The Upper Paleolithic is characterized by a number of traits the best-known of which are in the domain of technology and "artistic" expression. The use of prismatic blade nuclei is already demonstrated sporadically in the Lower/Middle Paleolithic of northwestern Europe just as in the Near East and in Eastern Africa. However, Neandertals clearly had not developed certain behaviors before the arrival of Aurignacian groups. The use of hafted spear points (of flint or bone), ornaments, and standardized bone technology are still not demonstrated in pre-Aurignacian European industries. It could also be pointed out that during the Middle Paleolithic the practice of burial and the extensive use of pigments by Near Eastern modern humans seem to predate these behaviors in the Eastern African and European Neandertals, and this raises questions about the possibility of long-distance diffusion of cultural traits.

Imitation or adoption of cultural traits does not always result in strong similarities in morphology and technique. As emphasized by d'Errico et al., similar objects (bone points, ornaments) are produced by different

technological means in Chatelperronian and Aurignacian technocomplexes. The "imitation" process was therefore mainly the adoption of successful concepts and not the direct replication of technological chains. Chatelperronian Neandertals used flint spear points but apparently not split-base bone points. They wore tooth pendants but worked them with different techniques. This kind of process is observed in many cases of imitation. For example, it is reminiscent of the copying, in the European Neolithic, of corded ceramic decorations by neighboring groups that adopted the general concept but made use of different techniques.

I have no doubt that the Chatelperronian Neandertals possessed some skill in bone and ivory technology. In invoking the possibility of trade between the two groups (Hublin et al. 1996), we were referring to the Arcy ivory rings and not the other pendants from the site. If similar objects are known from other Chatelperronian (Roche-au-Loup) or possibly "initial Upper Paleolithic" sites, they are in fact also known in genuine Aurignacian layers, for example, the Grotte de la Princesse (Otte 1974), and they are represented in later Upper Paleolithic technocomplexes as well. They thus seem to represent an exception, as no genuine Aurignacian objects are found in Chatelperronian layers. Another exceptional case of such possible "imports" is exemplified by the ivory beads of Chatelperronian level VIII, as mentioned by d'Errico et al. Actually, while Chatelperronian Neandertals and Aurignacian modern humans coexisted, the Chatelperronian did not become Aurignacian. Similarly, the late Neandertal from Arcy does not look like a biological hybrid. Rather than indicating an assimilation process, this evidence provides us with the picture of two groups sharing a large territory in a context of very low demographic density and discontinuous geographic settlements. In Western Europe, few if any biological interactions occurred. However, in the cultural sphere, a few innovative behaviors were adopted by one group from the other. The demographic expansion of the Aurignacian bands and later the reduction of available territories resulting from colder conditions at the dawn of oxygen-isotope stage 2 increased competition between the two groups for access to resources. The Neandertals disappeared while the modern humans survived and prospered. From this historical perspective and a posteriori, the latter can be said to have been "superior."

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This is undoubtedly one of the most perceptive analyses of the Neanderthal/modern-human transition in Europe to have appeared so far, and I find myself in agreement with large parts of it. The aspects of it which trouble me are as follows:

1. D'Errico et al. accept that the striking component of typically "modern" technology reflected in the Chatelperronian levels at Arcy-sur-Cure (i.e., complex bone and antler tools, Upper Palaeolithic–like stone tools, perforated animal teeth, etc.) occurs at almost exactly the same time as the dispersal of anatomically modern populations across Europe, but in their view this is a result of completely independent, autochthonous evolutionary processes. On the face of it this would seem to imply an extraordinary level of historical coincidence. Why, after over 200,000 years of lacking these behavioural features, should Neanderthals suddenly—and independently—have *invented* these features at almost precisely the point when anatomically modern populations were expanding across Europe? I can find no explanation in the article of exactly what evolutionary mechanisms are being proposed to account for this independent, coincidental invention of Upper Palaeolithic behaviour at exactly the same time as the advance of modern populations across the continent.

2. The arguments advanced for believing that almost all of the Chatelperronian industries in western Europe are entirely *earlier* than the first appearance of typically Aurignacian technology are, to put it mildly, unconvincing. D'Errico et al. accept that both Aurignacian technology and (by their own correlations) anatomically modern populations were present in northern Spain and probably other parts of Europe by around 38,000–40,000 B.P. (in radiocarbon terms). In order to argue that virtually all Chatelperronian industries are earlier than this date they have to dismiss not only virtually all of the current radiocarbon dates for Chatelperronian sites (most of which cluster between 33,000 and 36,000 B.P., including a new series of AMS dates for the Chatelperronian levels at Combe Saunière in southwestern France) but also all of the claimed evidence for the interstratification of Aurignacian and Chatelperronian industries at Roc-de-Combe, Le Piage, and El Pendo and all of the arguments for the relative climatic positions of the Chatelperronian and Aurignacian advanced by Leroi-Gourhan, Leroyer, and others (Leroyer and Leroi-Gourhan 1983, Leroi-Gourhan 1988, Leroyer 1990)—a sweeping dismissal of a large amount of mutually reinforcing data and a virtual rejection of the radiocarbon method for this age-range. They also overlook that at Le Moustier thermoluminescence and electron spin resonance dating have confirmed that the latest, typically Mousterian industries continue until around 40,000 B.P.—which, allowing for calibration, is equivalent to ca. 37,000–38,000 B.P. in radiocarbon terms (Valladas et al. 1986, Mellars and Grün 1991, Bard et al. 1990, Laj et al. 1996). This allows little scope for pushing the whole of the Chatelperronian phenomenon in France (including the long stratified sequences at Arcy-sur-Cure, Quinçay, and elsewhere) to *before* 40,000 B.P. I can see no evidence at present that the Chatelperronian had emerged in western Europe prior to ca. 38,000 B.P. in radiocarbon terms—significantly *after* the appearance of the first Aurignacian technology in northern Spain and elsewhere (Mellars 1992).

3. Having effectively dismissed the validity of radiocarbon dating in this age-range, it is surprising that

d'Errico et al. apparently accept the present radiocarbon evidence for a prolonged survival of typically Mousterian industries in southern Spain and Portugal until ca. 30,000 B.P. Scientifically, this would seem to come close to a case of running with the hare and hunting with the hounds. And if they accept this kind of overlap between Neanderthal and anatomically modern populations in Spain, why not in other areas of Europe?

4. I agree that the meaning of "acculturation" is ultimately a semantic issue and that the main issue is contact and interaction between populations leading to what could be variously described as "copying," "imitation," or "technology transfer." We should not confuse real behavioural issues with semantic quibbles. Incidentally, no one to my knowledge has ever assumed that this technology transfer was an entirely one-way process—although in recent contact situations in Australia, the Americas, and elsewhere the technology transfer often *has* tended to be distinctly asymmetrical. While the copying of technology *may* reflect a transfer of all the associated social, symbolic, ideological, cognitive, and other patterns, this need not be the case, as numerous anthropological examples illustrate (no one has ever suggested that the copying of airplane forms in the New Guinea cargo cults implied a knowledge of aeronautics or international travel). And we should never forget that the most convincing evidence for this apparently advanced technological and "symbolic" behaviour in the Chatelperronian derives at present from a single (and, according to all the available evidence, very *late*) site. Finally, as I have tried on several occasions to make clear (e.g., Mellars 1989:377; 1991:70, 72; 1996*a*:366), very few contributors to the Neanderthal/modern-human debate have assumed that the documented behavioural differences between Neanderthals and modern humans *must* reflect innate, genetic differences in the cognitive capacities of the two populations. But as long as we have evidence that the evolutionary trajectories of Neanderthal and anatomically modern populations are likely to have been separate over a period of around half a million years (see Krings et al. 1997), then the possibility of such genetically based divergences in brain structure, neurology, and cognitive capacities can in no way be ruled out. To argue that some copying of stone and bone technology by expert craftsmen (i.e., the Neanderthals) necessarily proves identical brains would be a curious non sequitur.

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This thought-provoking paper disposes of the common assumption that in Europe the Middle/Upper Palaeolithic transition was started by the arrival of the "moderns." Much of the discussion is aimed at demonstrating that the bone tools and ornaments found in the Chatelperronian levels of Grotte du Renne were made by the same people who produced the lithic industry and that they were in full command of the requisite skills. This exercise would seem odd and futile at just any site, but at Arcy the authors are dealing with cultural remains left by Neanderthals—hence the need to prove beyond any reasonable doubt facts that are usually taken for granted.

The whole discussion and the need for it actually exemplify the double standard prevailing in the scientific community when dealing with Neanderthals as opposed to modern humans. Other examples are the argumentation required before admitting that not only modern humans but Neanderthals were sometimes willing to bury their dead and able to do so (Tillier 1990, Belfer-Cohen and Hovers 1992) or the analysis of bone collections from old excavations, which in Italy led to contrasting conclusions: Fiore and Curci (1995), studying the evidence from Grotta Romanelli, a late Upper Palaeolithic site, demonstrated that modern humans were hunters and that the "head-dominated" bone collection available for analysis was the result of poor preservation and discard of "nondiagnostic" bones in the recent past, while Stiner (1994), dealing with similar collections also excavated by the same team during the same years but at Middle Palaeolithic sites, concluded that "head-dominated" bone collections were firm evidence that, before 55,000 years ago, the Neanderthals of Central Italy were making a living by scavenging the leftovers of other carnivores (see Mussi n.d. for a full discussion).

I certainly agree with d'Errico et al. that to understand the Neanderthal/modern interplay we need a fresh reappraisal of the regional evidence and new models of independent development. This being the case, however, it would be safer to avoid shorthand expressions such as "Neanderthal technocomplexes," which, once again, link the paleontological and cultural data that are carefully kept separate in the rest of the paper. Also, I believe that we are still far from knowing who did what. I am not prepared to give much credit to evidence based on loose human teeth—much less loose deciduous teeth, as in the Italian Uluzzian (see, e.g., Frayer 1978, Gambier, Houet, and Tillier 1990). Careful examination of local evidence also implies avoiding illustrations such as the map of Italy in figure 7, which gives the misleading impression that the Uluzzian is a well-documented industry comparable to the Chatelperronian in its geographical distribution. It has long since been demonstrated by Gioia (1987, 1988, 1990) that most of the so-called Uluzzian sites are mixed and often trampled surface collections. Proper evidence can be found only at four cave sites—Grotta del Cavallo, Grotta M. Bernardini, Grotta di Castelcivita, and Grotta La Fabbrica—while the recent mention of an Uluzzian layer at Riparo di Fumane is based on a single backed tool. It should also be stressed that burins are rare or lacking in the Uluzzian and backed tools frequent only at Grotta del Cavallo level E II–I, while most of the pigments and ornaments so far reported in the Uluzzian are from a single much-disturbed layer, layer D of

Grotta del Cavallo. To get a picture of the Italian peninsula at the Middle/Upper Palaeolithic transition it is better not to focus on the Uluzzian only. Also relevant to the problem are Late Middle Palaeolithic industries such as S. Francesco di Sanremo, in which full use is made of the Levallois technique and a highly laminar industry is produced with nearly 10% backed tools and as many burins (Tavoso 1988). Further regional diversity can be seen in the geographical distribution of the Aurignacian: while in Iberia the last Neanderthal groups effectively prevented its diffusion towards the south, in Italy groups with an Aurignacian lithic industry were able to people the whole peninsula and even to cross the Strait of Messina, settling in southern Sicily (Chilardi et al. 1996). This more articulated scenario for Italy merely confirms the need for a regional approach aptly underlined in this paper. If we accept that Neanderthals were not acculturated by "moderns" and that at some point both started on the path leading to the Upper Palaeolithic, it will become less difficult to understand why outside Europe, for 100,000 years or so, anatomically modern humans had been content just producing Middle Palaeolithic tools.

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This paper is important as a clear statement of various observations demonstrating that for tens of millennia prior to the Aurignacian the cultures of Neanderthals and early modern humans developed independently, in more or less parallel manner, rather than by mutual influence. This parallelism is visible in two aspects of the archaeological record: tendencies towards specialised blade production in the early Middle Paleolithic industries (not only in western and central Europe but also in the Near East, at Tabūn and Hayonim) and, later, bone tools and decorations produced both in the transitional Chatelperronian and in the Upper Paleolithic Aurignacian.

Such evidence seems useful for drawing broader conclusions about intercultural relationships between two biologically distinct populations. A solid chronological framework is required to exclude the Aurignacian as a possible source of the innovations. This explains the traditionally heated debates over the dating of every early Aurignacian site in Europe, the aim being to demonstrate that it could have influenced the various local transitional cultures. Today we have well-dated early Aurignacian sites, for example, in northern Spain, but given their sparse distribution over the continent and the character of the archaeological record they do not prove direct cultural influences on the mosaic of the various transitional cultures.

Unfortunately, none of the transitional cultures thus far recorded provides as complex an archaeological record as the Chatelperronian of France, which includes Neanderthal human remains, bone tools, and decoration at the same sites. Turning to the region where I work, both the Szeletian and the Bohunician are known mainly from lithic technologies that are more "backward" than the typologies and therefore may be compared to the various Middle Paleolithic traditions. Some of these sites are currently under excavation (Stránská skála), but because of the poor preservation of organic material they do not offer much hope for extending the contextual information. Therefore, the West European, Chatelperronian model continues to be unique and may only be used as an example and an analogy in other parts of the continent.

In using this model as the authors do, it seems that we should think in terms of independence, variability, parallelism, convergence, or analogy rather than of acculturation. Perhaps it would be useful to discuss in more detail and on a more theoretical basis what acculturation means in a prehistoric context and how such a process would be reflected in the archaeological record.

This article also demonstrates that the parallelism ended in Europe at a certain moment, around 35,000 B.P.; the expansion of Aurignacian art and technologies on the one side and the persisting Middle Paleolithic traditions south of Ebro on the other side imply a divergence of the cultural developments. This is a good argument for independent development and against acculturation but a bad one if we argue further against biological determinism in general. It still seems that something—something that lies beyond the scope of this paper—happened at that particular moment.

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For more than 30 years prehistorians have debated the intellectual capacities of Neandertals, whom we find troubling because, despite physical similarities to us, they seem ever more distant from us genetically. According to d'Errico et al., the evolutionary potential of Neandertals for creating laminar débitage, bone tools, and the social cohesion manifest in items of personal adornment was limited either by technological and social factors or by genetic ones. In any event, we respond to Neandertals with some emotion, since they were victims of us modern humans, who indisputably presided over their demise even if only as observers.

This article, following on the heels of numerous others, addresses the passionate question that marks our moment in intellectual history and to some extent touches the psyche of each of us: was Neandertal a form of human with intellectual limitations or a genius gone unrecognized?

To begin, it seems to have escaped the notice of various writers that we are dealing with a human—that is to say, a social being conditioned by his society. A human society may stagnate technologically, economically, and socially or reinvent itself in the face of chang-

ing conditions and newly perceived needs. Under no circumstances, therefore, can the Neandertals be understood in the absence of a solid understanding of their society. Such an understanding can only ensue from a synthesis of data obtained from the careful and critical study of all sites excavated to date. This is to argue that research into the creative potential of Neandertals cannot be based on materials extracted from a single level in a single site. However, the case of the Grotte du Renne is unique. Let us trace the arguments developed in this article in order to assess each of them in terms of their novelty, their plausibility, and their scientific basis:

The article distinctly follows the path of "Neandertal as genius." Everything rests on the presumed relationship between (1) the certainty that a juvenile parietal found at the base of the level is indeed that of a Neandertal (Hublin 1996; see citations in this article's bibliography) and (2) the presence in this level of a series of personal ornaments and evidence of the production of bone tools and weapons. The question remains: were the parents of this child really the creators of the first personal ornaments and the first technologies in bone, antler, and ivory?

If I review summarily the problem treated in this article, it is because we find ourselves 30 years behind the times. After all, André Leroi-Gourhan thought that the human of level IX/X was not a Cro-Magnon—this on the basis of the human teeth, which in reality are not diagnostic—and observed that manufacturing debris proved the working of bone material at the site. What arguments do the authors of this article advance to take us beyond our knowledge of 30 years ago?

First, they try to evaluate the hypothesis often invoked to explain the presence of personal ornaments and bone artifacts at a few Châtelperronian sites: acculturation. They take this notion in its boldest sense: the imposition of profound transformations by colonizing modern humans on colonized Neandertals. This is an extreme connotation of the word "acculturation," a process that might simply consist of behavioral imitation, the exchange of individuals between Neandertal and modern human groups, or simply the effects of proximity and mutual assistance. In this regard, we should not forget that at Etiolles the Magdalenian occupants of unit U5 knapped a superb long-blade core in nearby unit P15, whose occupants apparently lacked knowledge of this kind of lithic reduction.

D'Errico et al. reject the acculturation explanation because there is nothing in the lithic industry, either typologically or technologically, that indicates Aurignacian influence. It is noteworthy, however, that the technological study of the Arcy Châtelperronian is ongoing. The few articles that have appeared (Gouedo 1990, Bodu 1990; see also the references cited by the authors) imply various modalities, notably in blade extraction.

The argument frequently employed by the authors, that acculturation involves changes in all categories of production, is widely contradicted by ethnographic cases. It is also contradicted by Paleolithic examples such as the Gravettian female statuary, which has its origins in the Kostienki/Avdeevo/Willendorf cultures and was later adopted by Gravettians in western Europe without simultaneous changes in art or lithic industries.

The strongest evidence in support of Neandertal creativity, according to the authors, is change in techniques for the reduction of cores, especially those destined to provide blanks for Châtelperron points. Yet this argument merely supports the virtually undoubted existence of technical intelligence and gestural know-how in Neandertals. For me, this ability to manage coherent operational chains from lithic procurement through the production of desired tools is born of familiarity with techniques that go back to the Acheulean. This ability is common to all groups from *Homo erectus* on. In essence, knowing how to respond to needs (notably for hunting weaponry) through the pursuit of new lithic reduction techniques is a kind of permanent predisposition among Neandertals (note the numerous modalities of Levallois techniques), but it is not one that would ever lead a user of Châtelperron points to make large Aurignacian blades to serve as blanks for them.

Having rejected acculturation because it is not perceptible in Châtelperronian lithics, the authors seek to show that the Spanish Mousterian south of the Ebro Valley lasted a long time with no possible Aurignacian influence. This argument appears to me to be irrelevant. The amalgam between Mousterian and Châtelperronian societies in far-off territories (whether or not in contact with various forms of the Aurignacian) and from poorly understood cultural levels of questionable chronology is of little importance. Any demonstration of the absence of acculturation cannot proceed from (1) separate and unequal site distributions (numerous Mousterian sites south of and rare Aurignacian sites north of the Ebro) and (2) so-called evidence of 5,000 years of contemporaneity based upon mostly implausible dates, only two of which are for the Aurignacians. What does all of this mean? Of what importance is their contemporaneity if they are separated by thousands of kilometers? Indeed, one can reverse the argument: Mousterian stagnation in isolation from the Aurignacian in Spain demonstrates the revitalizing power of the Aurignacians on the late Middle Paleolithic cultures in other regions where they did come into close contact.

Acculturation is also questioned on the ground that Châtelperronian personal ornaments in bone and ivory are different from those of the Aurignacian. This observation is highly questionable, in part because the authors' Aurignacian sample is that from level VII at Arcy, which is at least 2,000 years later than the underlying Châtelperronian. The only valid comparisons are with earlier Aurignacian assemblages. The basal Aurignacian shows a long development around the Mediterranean and from northern Italy to Austria and Germany to Belgium, which is not so far from Arcy in Bourgogne. It has yielded abundant personal ornaments (including circumincised canine teeth and ivory rings), not to mention cylindrical points and small points in bone and

ivory. At Fumane in northern Italy and at Geissenklösterle in Jura Souabe this early Aurignacian is dated to about 36,000 B.P. In sum, the argument for differences between Châtelperronian and Aurignacian personal ornaments is ill-founded, and my own soon-to-be-published research with Randall White on the Arcy ornaments will shed entirely new light on this question.

We simply cannot reject the hypothesis that the contact with the Aurignacian had a dramatic effect on Châtelperronian society, that these contacts operated both locally and regionally, and that they led Neandertals to perceive new needs that they fulfilled through technological changes. Moreover, the authors seem to accept as demonstrated fact that the entire Châtelperronian is the work of Neandertals and the entire Aurignacian was created by modern humans. This is far from proven, given that most sites lack human remains. This article has done little to set aside the acculturation hypothesis. New data are required, as are detailed technological comparisons. For the moment, this hypothesis is neither rejected nor confirmed.

Finally, the most basic question has to do with the stratigraphic integrity of the Grotte du Renne. Anyone familiar with the complexities of cave and rock-shelter excavation can only admire the attempt by Leroi-Gourhan and his team to understand the Arcy stratigraphy. However, this is a very delicate matter, and despite these authors' confidence in the stratigraphy there is need for serious rethinking here. In places the deposits were steeply sloping. There was strong evidence of animal burrowing, and the deposits have a complex and multifaceted origin (cobbles, plaquettes, clay, sand, gravel). Some deposits have been washed away, as indicated by the important hiatus between Mousterian level XI and Châtelperronian level X. The thickness of levels was highly variable over space. Level X was in contact with the post-Mousterian of level XI, into which had penetrated a superb awl. Level X itself was as much as 75 cm thick in places. The ochre concentration in this level was against the outer wall and did not extend inside the cave. Level IX, separated from level X for technical reasons, was the uppermost remnant of the circular habitation structure whose base lay in level XI; in other words, the habitation structure was 50–60 cm thick. Level VIII, full of hyena and bear bones, had no well-defined archaeological surfaces and no visible habitation structures. Its industry is laminar, if quite mediocre, with raclettes and some Châtelperron points. Two occupation zones were identified, along the east and west walls respectively. Given the original stratigraphic observations, the slope of the deposits, the thickness of the levels, the heterogeneous origin of the sediments, the stratigraphic hiatus, and the localized nature of the archaeological remains force us to be extremely cautious. The Arcy Châtelperronian deserves a modern-quality study in which sector-by-sector stratigraphies and spatial distribution maps contribute a degree of certainty that for the moment is lacking.

This article adds no new discoveries or analyses to what we have known for at least 30 years. Moreover, the hypothesis of acculturation, proposed by Leroi-Gourhan and subsequently rejected by him in favor of internal evolution, is the subject of this debate. This is a classic conundrum in attempting to explain any prehistoric cultural change. In the present article it is raised with respect to a poorly understood period and an isolated and unique case; recurrent finds of a similar sort are lacking. Until the publication of the results of more thoroughgoing analyses of the Arcy Châtelperronian, no hypothesis to account for this remarkable cultural change can be rejected.

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When in December 1986, during the congress on Neandertal man at Liège organized by Marcel Otte, we first presented the chronostratigraphic framework, based on palaeoecological, cultural, and geochronological data, for Carihuela Cave (Vega Toscano et al. 1988), we indicated that from it two extraordinary conclusions could be drawn: (1) that the Mousterian survived in the southern Iberian Peninsula until late in the Würm Upper Pleniglacial and (2) that therefore a parietal fragment found at Carihuela by J-Ch. Spahni in 1954–55 in a position corresponding to the current unit V with features well within the range of Neandertal variability (García Sánchez 1960) and the unequivocal remains of this human variety found in the Boquete de Zafarraya Cave, still not securely dated (Barroso et al. 1983), were probably the most modern Neandertals found in Europe. Surprisingly, these conclusions met with no objections and were included without further discussion among the findings presented to that forum. Since then, such perduration has been confirmed in Andalucia (Vega Toscano 1988, 1990, 1993; Barroso et al. 1993), Valencia (Villaverde and Fumanal 1990, Iturbe et al. 1993), the Meseta Central (Adan et al. 1995), and Portugal (Zilhão 1993), and therefore in recent years it has been commonplace to point to the "late and marginal Neandertals" of southern Iberia when talking about the Middle/Upper Palaeolithic transition. As I have said elsewhere (Vega Toscano 1993:148), this can only be understood if we accept that a real paradigm change (in the Kuhnian sense) took place at Liège: the neoevolutionist theories of Bordes, dominant until the past decade, had been abandoned in favor of other, historicist-particularist ones. For more than ten years no investigator, specialist or not, has failed to publish something on the fate of these enigmatic Neandertals or organize a colloquium or a workshop on the topic. Unfortunately, this proliferation of "master syntheses" at the global level tends to produce a repetitive and unstructured model based on regionalization, casuistry, and mosaics of adaptive responses (not, of course, spelled out in detail) which ultimately reflect only the transition model defended by this new particularistic paradigm: that the European

Neandertals between 40,000 and 30,000 B.P. experienced some acculturation before the east-west advance of the Aurignacian/modern-humans, except for the most backward ones of Iberia—who, paradoxically, were the ones most resistant to the invaders but were extinguished without descendants or left only some anatomical traces in the gene pool of the newcomers (Wolpoff 1996).

When I started reading this article, I thought I was seeing something different within this framework—first because it called into question the Chatelperronian as Aurignacian acculturation, implying a return to the neoevolutionist ideas of Bordes (1972) about the cultural potential of the Mousterian of Acheulian Tradition type B, second because it outlined a taphonomic critique of the evidence handled that is indispensable to a discussion of any depth, and third because it was intended as a clear rejection of biological determinism. I was therefore perplexed to find the authors ending their exposition in terms of "ecological diversity," "historical contingency," "individual trajectories," "biocultural regional diversity and cultural interaction," and so on. If such things become the conclusions of a piece that is so rationalist and well-developed, it is obvious that there are weaknesses in the arguments whose evaluation may serve as a guide for future investigations. From my point of view, these weaknesses are as follows:

1. However much the cases of Chatelperronian-Aurignacian interstratification are questioned (in the case of El Pendo, justifiably [Hoyos and Laville 1983]), the radiometric dates are taken as mere statistical approximations (cf. Otte 1996:105), and the presence of Aurignacian elements in Chatelperronian (or equivalent) collections is considered upper-level contamination, certainly, with the degree of chronological resolution that we possess at present, it seems very strange that the Neandertals reach their maximum evolutionary potential, from a cultural point of view, just before being replaced by the Aurignacian wave. That there is no relationship between the sudden technological change of some Neandertal groups and the gradual appearance of the Aurignacians/modern-humans is unconvincing, especially since such "cultural instability" seems to have occurred some millennia earlier in the Middle/Upper Palaeolithic transition in the Near East (Meignen 1966). Sometimes the most parsimonious interpretations are not the most credible ones.

2. However much we separate the anthropological issue from the cultural one, on this topic such separation is very difficult to achieve. If we do not take into account the "intellectual inferiority" of the Neandertals their replacement by modern humans seems inexplicable. Curiously, however, this point is the most obscure of the whole problem of the transition, in part because the record is very poor and in part because anthropologists tend to leap into the discussion with only a fossil in one hand and a radiometric date in the other, without considering the stratigraphic context and the taphonomic problems. The Chatelperronian is the best example of this: 20 years ago the majority of the scientific community was convinced that the creators of this industry were the modern humans of Combe Capelle, but since the discovery of St.-Césaire everyone has considered it the product of Neandertals. If there is anything that can be questioned, however, it is that both the fragmentary remains of Arcy and the strange accumulation of human bones at St.-Césaire—which is not clearly a burial (Vandermeersch 1993)—belong to the real occupants of said levels, because abandoning on the surface seems a strange custom. At most this could mean that while the Chatelperronian was developing there were still Neandertals but not that their remains belong to the material authors of such industries. In a phase for which we had no evidence for the coexistence of different human types this argument might prove irrelevant, but in a case such as that of the Middle/Upper Palaeolithic transition it is something that should not be forgotten.

3. The Ebro frontier is in my opinion only a fictitious boundary whose distinction rests essentially on the abnormally early dates of Castillo, L'Arbreda, and Abric Romaní, overlooking the fact that, taken as a whole, the Aurignacian and the Final Mousterian of the peninsula seem, from the increasingly numerous data we now possess, to follow a clear north-south gradient perhaps implying that beyond the Ebro there were many other boundaries, gradually more and more recent. Indeed, locating an ecological barrier in oxygen-isotope stage 3 is unsatisfactory because of the great variety of landscapes in the Upper Pleistocene of the peninsula due to its irregular topography. This last is confirmed by the palynological sequences published in recent years from Carihuela (Carrión 1992, Vega Toscano and Carrión 1993), Beneito (Carrión and Munuera 1997), and Perneras (Carrión et al. 1995) and Dupré's (1988) synthesis for the second half of the Upper Pleistocene in Valencia.

From my point of view, the great interest of this work lies in its reassessment of the role played by the different autochthonous groups in a global model of the Middle/Upper Palaeolithic transition. If we accept as a determinant factor in such a process the preadaptation of the various Neandertal societies to the approaching cultural changes, I believe that a clinal model (Vega Toscano 1998, 1990; Bar-Yosef 1996*b*) of the distribution of the last Middle Palaeolithic technocomplexes could be the key to explaining what happened between 45,000 and 27,000 B.P. in Europe and the Near East.

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This thought-provoking and complex article is a useful contribution to debate surrounding the so-called Middle/Upper Paleolithic transition in western Europe.

Nevertheless, the authors create several straw men that cloud some key issues. For example, it is difficult to find any of us working firsthand on "transition" materials saying that the absence or rarity of Mousterian bone technology and personal ornaments points to Neandertals' neurological incapacity for such innovations. My position for many years (see White 1982) has been that the Upper Paleolithic revolution reflects social rather than biological changes.

Thus the authors play down the significance of one of my three proposed explanations for the existence of personal ornaments in levels X through VIII at Arcy: that Neandertals made the ornaments (White 1992*b*) by mimicking those of preceding/contemporaneous Aurignacians. Having now studied the Arcy ornaments in microscopic detail, I am more inclined than ever to think that this was the case. Long before the Châtelperronian there are numerous European Upper Paleolithic pierced teeth and fossils, most often of the same animal/fossil species used at Arcy. This being the case, it is a stretch to suggest that the Châtelperronian fabrication of such things was uninfluenced by their Aurignacian/Early Upper Paleolithic predecessors and contemporaries.

Regrettably, the same tired illustrations (or, rather, near absence of illustrations) of the osseous industry from the Grotte du Renne at Arcy-sur-Cure persist; one bone awl (of troubling stratigraphic provenience) is used to stand for it. The same is true of the personal ornaments (which I am now studying with Yvette Taborin). Moreover, the ornament analysis does an injustice to what we now know from microscopic/technological analysis of the Arcy ornaments over the past few months. Finally, we all eagerly await the planned reevaluation of the Arcy stratigraphy, radiometric dating, and taphonomy. Only then will we be able to evaluate the possibility of stratigraphic mixture.

While this is not the place for a detailed presentation of the Arcy personal ornaments, a few firsthand observations are in order. To my knowledge, except for Quinçay, there are no other Châtelperronian ornaments. At Châtelperron itself, the single pierced fox canine comes from a thin Aurignacian lens interstratified within the Châtelperronian and associated with clearly Aurignacian lithics (also, a split-based antler point was found in turn-of-the-century excavations). The gouging technique used to pierce the hole of this canine is consistent with that of the hundreds of pierced Aurignacian teeth I have examined and is in contrast to the hole perforation techniques I have observed at Arcy and Quinçay.

The few pierced animal teeth from Quinçay (all from the upper half of the Châtelperronian sequence [F. Lévêque, personal communication]) were apparently produced with the same technique (pressure or punch) as at Arcy, a technique that is rare in the classic southwestern French Aurignacian but exists in the Belgian (Trou Magritte, Spy) and German (Geissenklösterle) Aurignacian and in the initial Upper Paleolithic of Central and Eastern Europe (Mladec, Kostienki 17).

I disagree with the authors' characterization of the ivory rings and pendants from Arcy level X. My own analysis does not support the idea that the "ring" fragments are by-products of the production of some other kind of object. Nor are these objects substantially different in form or technique from their counterparts at Trou Magritte, which have always been attributed (with uncertainty) to the Aurignacian. These "rings" are morphologically distinct from the famous ivory fishtail pendant and related fragments from Arcy level VII (Aurignacian).

I doubt that the known Châtelperronian ornaments are precursors to those of the Aurignacian. It is especially problematic for the authors to focus their Aurignacian comparisons on the overlying ornament-poor and much later level VII. Indeed, it is problematic to restrict Châtelperronian personal ornament comparisons to the Aurignacian *sensu stricto.* Moving eastward in Europe, we find significant numbers of ornaments in initial Upper Paleolithic levels (e.g., Kostienki 17 at older than 37,000 B.P. and Bacho Kiro at older than 43,000 B.P.) that predate the Châtelperronian. Let's be clear: the earliest personal ornaments are not from western Europe and belong to an early Upper Paleolithic predating the western European Châtelperronian.

A more pan-European perspective supports widespread penecontemporaneity of terminal Mousterian with industries presumed (on very weak grounds) to be the work of modern humans. The contemporaneity of Mousterian-derived and Spitsynskaya (Upper Paleolithic) sites and cultures at Kostienki is a case in point. Given the authors' "Iberian hypothesis," it is surprising not to see discussion of the widely accepted Aurignacian/Châtelperronian interstratification at El Pendo in northern Spain.

The incised-root approach to suspending teeth and other objects is not peculiar to Arcy; it exists in several early Aurignacian levels (e.g., Brassempouy, Cellier, and Blanchard in France, Fumane in Italy, Geissenklösterle in Germany) and cannot be considered exclusively Châtelperronian. This technique is much more complicated than it appears and unlike the Arcy pressure/punch approach to perforation is not found at Quinçay. However, the approach to perforation at both Arcy and Quinçay resembles that seen in the Earliest Upper Paleolithic running in a band from Belgium (Spy, Trou Magritte) across Germany (Geissenklösterle), the Czech Republic (Mladec), and the Russian Plain (Kostienki 17). This perhaps provides a new geographic orientation for evaluating relationships between the Châtelperronian and preceding/contemporaneous Early Upper Paleolithic assemblages.

Why do the authors find it necessary to link an acculturation model with the presumption of cognitively handicapped Neandertals? I reject this linkage, and I propose that we focus instead on the quite different evolutionary trajectories of the Mousterian and the Aurignacian. Mousterians operated successfully in harsh European glacial environments over hundreds of thou-

sands of years, apparently with little or no development of preservable symbolic devices. For me this minimum of symbolic intervention was probably more a matter of fundamental social differences and long-standing cultural tradition (trajectory) than of cognitive capacity.

The authors rightly insist on the enormous social significance of early archaeological evidence for personal adornment. If one argues that at some point Mousterians came in contact with and were influenced by representatives of a different, heavily symbol-reliant cultural trajectory (the Aurignacian or other cultures of the initial Upper Paleolithic), this does not mean that one attributes to them limited cognitive capacity. After all, would the authors argue that the adoption of agriculture by western European hunting peoples in the face of an expanding Neolithic way of life was predicated on Mesolithic cognitive inferiority?

Reply

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We thank the commentators for their constructive criticism and encouragement. The remarks of several scholars whose views we have directly questioned provide us with an opportunity to clarify and develop our positions.

Goals and logic. Taborin, who has conducted valuable work on the Arcy ornaments, argues that our paper does not advance the debate. Although we do offer previously unpublished analyses of the taphonomy of the Grotte du Renne and of its Châtelperronian bone and lithic technology, as well as previously unpublished iconography of this material, most of the information on ornaments that we use has indeed been available for a long time. Two of us (d'Errico and Zilhão) had the opportunity to analyze the ornaments from Grotte du Renne in December 1996, but we made little use of the new observations arising from that analysis—first because we realized that the richness of the material required a more substantial treatment and that Taborin was in the best position to do this and second because what had been published about these ornaments was sufficient to illustrate the major points of our interpretation.

On the basis of empirical patterns that no commentator questions, we believe (in spite of the doubts stated by Taborin and Vega) that it is entirely legitimate to assume that the Châtelperronian was manufactured by Neanderthals. In the only two instances known of secure association between human remains and Châtelperronian levels the remains are those of Neanderthals, and the Châtelperronian represents a development of the preceding Mousterian of Acheulean Tradition, which virtually no one (except Bordes before the discovery of Saint-Césaire) has ever considered the product of other than Neanderthals. All the commentators accept our demonstration that the ornaments found in the Châtelperronian levels of the Grotte du Renne are archaeologically in situ and were manufactured locally—that is, in the framework of the above assumption, by Neanderthals. In this regard, White's comment represents a remarkable change of position. Until now, he has been of the opinion that "the absence of both [self-definition and display functions in the use of jewelry] among Neanderthals must be seen as evolutionarily significant" (White 1989:375). We rejoice that he now agrees that the presumption of cognitively handicapped Neanderthals should be abandoned.

Our demonstration could have been performed by others at any time during the past 30 years, but in fact the vast majority of the countless papers devoted to the replacement of the Neanderthals by modern humans published since Leroi-Gourhan's 1964 report on the Grotte du Renne have assumed the opposite. How are we to explain this? How are we to explain that the straw men which White and, to some extent, Mellars and Hublin accuse us of creating are in fact flesh-and-blood human beings who can even be found among the commentators? Vega says that "if we do not take into account the 'intellectual inferiority' of the Neanderthals their replacement by modern humans seems inexplicable," and White himself would until now have qualified as one of these "straw" creatures. Both belong to a distinguished lineage well represented by two major participants in the debate who clearly epitomized this view of Neanderthals in a book written for a wider audience: "Neanderthals imitated certain aspects of modern behavior. But while they could emulate they could not fully understand"; "the main structural difference distinguishing the Moderns from the Ancients was the practice of symbolically organized behavior" (Stringer and Gamble 1993:207).

Such a long tradition of asserting the intellectual inferiority of Neanderthals in spite of the empirical evidence to the contrary illustrates the power of paradigms and the way in which they condition our evaluation of the empirical data, as Mussi so well underlines. We aimed to show that many of the assumptions underlying the prevailing view of Neanderthals are directly contradicted by the empirical data—that such factors as "postdepositional disturbance," "trade," "scavenging," and "imitation without understanding" cannot be used to explain away the association between Neanderthals and ornaments in the Châtelperronian levels from Arcy and, indeed, that the Grotte du Renne record cannot be accommodated to the notion of Neanderthal inferiority. While it appears that we have achieved our goal, the issue of Neanderthal inferiority deserves further comment. No matter how much Hublin, Taborin, White, and Mellars reject any necessary link between the acculturation hypothesis and the notion of Neanderthal inferiority, the truth is that that hypothesis first arose from precisely such a notion. Like it or not, acculturation in this context carries the "original sin" of having

developed as an explanation only because it was assumed that Neanderthals could not possibly have become "Upper Paleolithic" on their own. The issue of inferiority is therefore not really one of "political correctness," as Hublin seems to believe, but rather one of logic and epistemology. If, as Hublin states, the "superiority" of modern humans is simply the a posteriori recognition that they are the ones who survived, invoking such "superiority" to explain Neanderthal extinction is a tautology. And if a biologically based intellectual inferiority provides all the explanation required, there is nothing left to investigate now that the DNA analysis published by Krings et al. (1997) seems to confirm that Neanderthals were indeed biologically different. In this regard, it is curious that biological explanations for the extinction of Neanderthals which do not contemplate the notion of Neanderthal inferiority, such as epidemiological ones, are rarely explored (Pelegrin 1995, Zilhão 1995).

Finally, when Conard and Vega complain about the very general nature of the alternative suggestions we make in our conclusion they simply echo our own final statement that they are "abstract explanations that need to be turned into concrete historical scenarios." Indeed, we would be disappointed if the commentators were satisfied with these suggestions, which are designed to open the way for future investigations. The need to develop more sophisticated models of what happened to the Neanderthals becomes manifest only once the critical perspective presented in our paper is adopted.

Matters of fact. Taborin and, to a lesser extent, White are the only commentators who continue to question the stratigraphic association between the ornaments from Grotte du Renne levels IX–X and the Châtelperronian industry they contained. They also criticize us for using level VII as the Aurignacian standard against which to compare the Châtelperronian ornaments. However, they cannot have it both ways. Either the sequence is undisturbed and their remark about standards for comparison is pertinent or the sequence is disturbed and the ornaments in levels IX–X are Aurignacian—in which case they should be identical to those from the single Aurignacian level of the site, level VII. By agreeing with us that the ornaments in question are indeed different, Taborin and White are implicitly accepting the overall stratigraphic integrity of the site. In calling for more detailed study of the stratigraphy and the habitation features from the site—a need that we have emphasized—Taborin seems to forget that in her own study (1990) she expressed no doubts about the cultural attribution of the Châtelperronian and Aurignacian pendants and interpreted the differences observed between the three Châtelperronian levels in the animal species used in the manufacture of the ornaments as due to cultural evolution (1990:343).

Disturbances that occurred during the accumulation of layer X did indeed affect the underlying Mousterian level XI, as we pointed out, but there were no such disturbances in the overlying Châtelperronian and Aurignacian sequence. Several archaeologists who took part in the excavation (A. Montet-White, F. David, and M. Girard, personal communications) can testify that the different layers could be easily distinguished because of the clear color difference they displayed and because they were separated by beds of small conjoining slabs. The separation between level X and level IX in particular was stratigraphic rather than "technical" as Taborin suggests. The integrity of Châtelperronian layer X and the intensity of the human occupation of the cave at the time are also indicated by the extensive ochre-staining of the sediments over the entire surface of the site and not just along the sides of the cave as Taborin has it; level X yielded an impressive 18.5 kg of ochre.

Taborin also hints that disturbances due to animal activity might account for a vertical dispersion of the archaeological material, explaining the presence in the Châtelperronian layers of ornaments and bone tools. However, the bones in general and the worked bones in particular do not present any traces of mechanical abrasion and bear gnaw marks only in a very few cases. The hypothesis of ditches dug by the Aurignacians in the underlying sediments can be rejected as well, since the Châtelperronian bone tools were found scattered over the excavated surface and not in localized clusters. Taborin states that "the localized nature of the archaeological remains forces us to be extremely cautious." In fact, however, of the 28 m^2 of layer X (the richest) that were excavated, 17 square-meter units yielded one or two worked bones each, 7 yielded three or four, and 4 others yielded five or six; the highest concentration was inside the habitation features (which covered some 23 m^2). Such a wide spatial distribution clearly precludes the possibility that these items represent localized Aurignacian intrusions into the Châtelperronian layers. Given that Aurignacian level VII was 1 m above layer X, sustaining such a possibility would in any case require an explanation for why very few bone tools were found in intermediate layer VIII.

Studies of the lithic assemblages confirm our argument. Farizy and Schmider (1985) analyzed the entire tool assemblage from layer X, with particular emphasis on its two richest sublayers (Xc, with 909 tools, and Xb, with 1,794 tools), which are also the richest in worked bone and body ornaments, and found no Aurignacian tool types. A recent study of the lithics from Aurignacian layer VII (Schmider and Perpère 1997) points in the same direction: no Châtelperronian elements were found in the Aurignacian lithic assemblage.

Interstratifications. White suggests that we forgot to mention El Pendo, but we said that "the poorly defined 'Châtelperronian' assemblage found in inter-Aurignacian level VIII also contains typical Aurignacian carinated scrapers . . . and may result from an intercalation of earlier deposits." And, contrary to his assertion, this "interstratification" is far from being "widely accepted": Vega, citing Hoyos and Laville, agrees that our doubts regarding El Pendo are justified.

Mellars points out that we reject the "interstratifications" reported from Roc-de-Combe and Le Piage. He is

absolutely right: we do believe that at these two sites the phenomenon may result from postdepositional disturbance or mixing during excavation. Le Piage is very important in this regard because it is where a genuine interstratification would imply the longest coexistence of Châtelperronian and Aurignacian: Châtelperronian layer F1 lies above several layers attributed to various facies of Aurignacian 1 (some of which, however, would anywhere else have been considered "evolved Aurignacian"). As we noted, half of the tools recovered from layer F1 are in fact clearly Aurignacian, as is acknowledged by Demars himself (1996*a*). The topography of the site (Champagne and Espitalié 1981), recently studied by F. Lebrun-Ricalens (personal communication), suggests that this mixed lens of Châtelperronian and Aurignacian material may very well have shifted from the upper terrace during the later Aurignacian occupation. One may even suspect that the whole early Upper Paleolithic sequence of Le Piage is upside down, an inversion which would explain the typological aberrations of the Aurignacian sequence signaled by the excavators (Champagne and Espitalié 1981:97). The four radiocarbon dates available for the site are also indicative of an inverse stratigraphic order. Thus, until a serious reevaluation of this "interstratification" is undertaken, for example, through systematic refittings, Le Piage cannot be taken as evidence for a long coexistence of the Châtelperronian and the Aurignacian. The same may apply to the other two sites where such interstratifications have been reported (Roc-de-Combe and El Pendo). All three of them were excavated more than 30 years ago, when our knowledge of the multitude of possible postdepositional disturbance mechanisms was very rudimentary.

The need to consider the possibility of disturbance in sites from this time range is quite rightly stressed by Mussi. We are well aware that many Uluzzian sites shown on our map are the result of surface collections including, in some cases, elements of other periods. In this case, however, the point we were making was not one of association or integrity but one of component identification. Even if disturbed, those sites document the wide geographical distribution of the Uluzzian in Italy, much as is the case with the Châtelperronian in France and Cantabrian Spain. The technological coherence of these industries across vast expanses of territory is difficult to explain if their emergence is conceived as a consequence of acculturation by the Aurignacians.

Technology and typology. Back in the days when he was a straw man, White was convinced that the personal ornaments found in the Châtelperronian layers could not have been made by Neanderthals. Now he is "more inclined than ever" to believe that they made them by "mimicking those of preceding/contemporaneous Aurignacians." He does not explain, however, what leads him to this conclusion.

Granger and Lévêque (1997) have studied the techniques used to perforate the roots of the six teeth found in the Châtelperronian layers of Quinçay—a site where the presence of these ornaments cannot be attributed to reworking because there are no other Upper Paleolithic layers—and compared them with those used by the Aurignacians of La Quina and of Gatzarria. At these last two sites, perforations were achieved by the longitudinal scraping of a large surface of the root until the wall was cut through. At Quinçay, however, perforations were achieved by exerting pressure or by percussion with a sharp pointed tool leaving characteristic nibbled marks which, in contrast to what was observed on Aurignacian ornaments, are confined to the area of the perforation. In one case perforation by pressure seems to have been preceded by grinding the root surface. The techniques used at Quinçay are identical to those we observed at Arcy. That Châtelperronians used different boring techniques confirms that trading with the Aurignacians or scavenging from their sites, as previously suggested by Hublin and White, cannot explain the occurrence of ornaments among Neanderthals.

White also rejects our interpretation that the ivory "rings" found in the Châtelperronian layers should be interpreted as by-products of ivory manufacture instead of finished objects. He does not substantiate this, and we maintain our diagnosis. The quickest way of resolving these conflicting interpretations would be to conduct a direct joint analysis, including microscopic examination for technical features, of these pieces at the Nanterre laboratory, where the material is housed. We would be delighted to participate in such an analysis at Taborin and White's earliest convenience.

Hublin is now ready to accept that Neanderthals possessed "some" skill in bone and ivory technology. Our analysis of the Arcy bone artifacts and the more refined study of this material that three of us (Baffier, d'Errico, and Julien) are currently carrying out confirms the high level of complexity in the technical choices made—a complexity that does not appear to be in any way qualitatively different from that observed in more recent periods. Here again we see an a priori against Neanderthal cognitive abilities. Why should we express in the form of a statement of belief what is in fact a matter of scientific inquiry?

Chronology. Some of the commentators seem to believe that the Châtelperronian is a recent phenomenon. Nothing is less certain. It is by now nearly unanimously accepted that the Châtelperronian emerged from the Mousterian of Acheulean Tradition. The beginning of this phenomenon can be traced to Mousterian assemblages older than the first appearance of the Aurignacian in Western Europe (Pelegrin 1995:52, 264).

Mellars is unconvinced by our argument that the Châtelperronian is earlier than the Aurignacian and characterizes our position as "a virtual rejection of the radiocarbon method for this age-range." The long-term contemporaneity he sees between Aurignacian and Châtelperronian in France is also assumed by most other commentators, notably Hublin, Conard, Taborin, and White. We find Mellars's position to be the most awkward, however, because our analysis of the issue was largely inspired by his own approach to the famous Mousterian-variability controversy of the 1960s and

1970s. The reliability of radiocarbon dating in this time range is certainly open to question (see, e.g., Hahn 1996). Whatever one's position in this debate, it is quite clear from the examples we provided that at least some of the radiocarbon dates must be wrong. Thus, if we want to avoid circular reasoning, we need to adopt objective, independent criteria for their evaluation. In selecting these criteria, we decided to follow Mellars's: compatibility of the dates with stratigraphic patterns and retention of only the oldest results.

There are 30 examples of Châtelperronian under Aurignacian 0 or Aurignacian 1. Once the above-mentioned interstratifications were seen for what they might be, we did not find a single demonstrated instance of Aurignacian under Châtelperronian. Rigaud's analysis of Châtelperronian assemblages (1996) agrees with our position. As he did in the past for the Ferrassie-Quina-MAT sequences, Mellars is invited to compute the probability that, after many thousands of years of contemporaneity of Aurignacian and Châtelperronian in the same geographical region, such a clear-cut pattern is simply due to chance. One possible way out of this difficulty would be to adopt the hypothesis of Leroyer and Leroi-Gourhan (1983) that the Arcy area was a northern refuge and that there always was a stable, although receding, frontier between Châtelperronian and Aurignacian in France. However, the dates for Pataud, Ferrassie, and Combe-Saunière would then place the Aurignacian and the Châtelperronian side by side in the same region, the Périgord—just as Bordes argued had been the case with his six Mousterian variants. In this case, however, and in contrast to what Bordes (1968) argued for the Mousterian, people would not even have exchanged their genes as Bordes thought humans were always ready to do. More in line with his model, however, cultural intercourse between the two groups would also have been extremely limited. Unlike their brothers from the Paris basin, Perigordian Neanderthals would not have been culturally influenced by moderns, not even at the level of the simple imitation of the rich tradition of ornaments in the local Aurignacian (White 1989). Such complete cultural isolation would indicate that the Neanderthal/modern-human contact situation in the Périgord was one of competition for the same space and the same resources. However, as Zubrow's (1989) models demonstrate, in such a situation no long-term contemporaneity is possible, because Neanderthals became extinct in less than 30 generations, that is, 1,000 years.

If only the oldest results in a sequence are accepted, then it is clear that the Châtelperronian is earlier than the Aurignacian. Hublin, Mellars, and White insist on ignoring the date of ca. 45,000 B.P. obtained for Arcy level IX, but we believe that this date should be considered the closest to the real age of the Châtelperronian. Consequently, it is quite wrong to suggest that we reject the radiocarbon method. Subjected to the appropriate critical filters, radiocarbon evidence helps to place the Châtelperronian among the various pre-Aurignacian Upper Paleolithic cultures that appeared throughout central and eastern Europe sometime before 40,000 B.P. and not as a marginal epiphenomenon of the Aurignacian expansion. White seems to be heading in the same direction. Unlike him, however, we assume, following Hahn (1993) and in the light of the Châtelperronian pattern, that such cultures were associated with Neanderthals, not with modern humans.

Our acceptance of the late survival of the Mousterian in Iberia south of the Cantabro-Pyrenean mountains is based on exactly the same criteria. Such a survival is also indicated by a wealth of independent stratigraphical and biochronological evidence, as established by, among others, Vega, Villaverde, and Fumanal. More important, however, our conclusion is compatible with the observation that no early Aurignacian industries are known in these regions. It is thus perfectly sensible to accept that, in Portugal, Andalucía, Valencia, and the Meseta, the corresponding chronostratigraphic position is occupied by this late Mousterian. From the epistemological point of view, and contrary to what Mellars suggests, our position has the virtue of meeting accepted scientific criteria. Our proposition that the early Aurignacian does not exist south of the Ebro is falsifiable by purely archaeological methods. In contrast, Mellars's acceptance of the long-term contemporaneity of the Aurignacian and the Châtelperronian in France is incompatible with the results of archaeostratigraphical reasoning and is not based on explicit physical, chemical, or taphonomic criteria for the rejection or adoption of contradictory radiocarbon results.

Matters of interpretation. It would be wrong to disregard acculturation altogether just because we do not approve of the use made of this term in the past. If understood as a process of cultural interaction whereby there is an exchange and imitation of ideas and artifacts between different groups, acculturation is a valuable explanatory concept for understanding what happened when Neanderthals met modern humans. Unfortunately, however, the simplistic way in which the concept is used undermines the concrete formulations of Neanderthal acculturation suggested by some of the commentators. Little more than lip service is paid to the hypothesis that late Neanderthals were not just passive recipients of innovations brought in by modern humans. Mellars, for instance, states that "no one has ever assumed . . . an entirely one-way process," a point that is also made by Conard, Demars, Taborin, and White, but no example is given of what Neanderthals might have contributed to the culture of modern humans. Indeed, to the best of our knowledge, the prevailing formulations of the acculturation model do not contain a single example of the reciprocal nature of the process.

That the notion of Neanderthal inferiority is still deeply rooted among supporters of the acculturation model is well illustrated by the following examples:

1. After correctly pointing out that the genetic distance between Neanderthals and modern humans means that we cannot rule out that they were significantly different in brain structure, neurology, and cognitive capacities, Mellars places the burden of proof on

the side of those who believe that such was not the case. Logically, however, since there is no biological evidence to that effect and since differences in material culture and behavior can be explained in purely cultural terms, it is clear that the burden of proof should be on the other side.

2. Mellars gives the New Guinea cargo cults as an example of how technology can be copied without a simultaneous transfer of all the associated social, symbolic, ideological, and cognitive patterns. This is undoubtedly true when we are reasoning at the one-generation scale, but it took only two or three generations for the practitioners of the cargo cults to become airplane pilots themselves. Models of Neanderthal acculturation assume thousands of years of contemporaneity, and therefore Mellars's example is relevant only if one believes that Neanderthals were totally incapable of accessing the ideational realm behind the ornaments they supposedly copied. And while it is true that a technology may be copied without the simultaneous transfer of the associated social and mental patterns, the simple fact that it was adopted indicates the preexistence among the adopters of the social and mental frameworks necessary to integrate it. American Indians adopted rifles because they represented an innovation which could be integrated with the rest of their technology and their way of life, even if they did not possess the skills to manufacture them and were unaware of the laws of physics underlying the functioning of firearms. Mellars will agree that this does not mean that they were intellectually incapable of acquiring those skills and knowledge once appropriate training provided by contact with the providers of the innovation became available.

3. Hublin extends the acculturation model back into interglacial times to suggest that even the practice of burials and the use of pigments by European Neanderthals may have been adopted from Near Eastern modern humans. This is a dangerous post-hoc accommodative exercise that notably overlooks the evidence from 300,000-year-old Sima de los Huesos, Atapuerca, where only complex behaviors of corpse disposal seem capable of accounting for the large number of human remains.

4. Demars suggests that Châtelperron points are the outcome of Neanderthals' observing a technique which presumably they did not have—hunting with spears—and then "translating" their observation into their own knapping techniques of Mousterian tradition. As Conard reminds us, however, Neanderthals and their ancestors had been hunting with sophisticated wooden spears at least since 400,000 years ago. Many use-wear studies also indicate that hafting was a technique commonly used in the Mousterian.

Mellars argues that it would be too much of a coincidence if, after 200,000 years of stability, the "modern" technological traits that appear at Arcy had developed independently, but this argument can easily be reversed. Why is it that, after 100,000 years of being Mousterian, modern humans developed "modern" technological traits only when they reentered the Near East and expanded into Europe—that is, only after coming into contact with the Neanderthals? If one is not blinded by assumptions of Neanderthal inferiority the question is entirely legitimate. A sound case can be made for the hypothesis that the bone technology first developed among higher-latitude groups inhabiting regions where wood may have been in short supply and ivory was easily available. This hypothesis could also explain the contrast between the rarity of Châtelperronian bone tools in the Périgord and their abundance in the Paris basin. So far as personal ornaments are concerned, a really reciprocal model of acculturation might suggest that their first appearance in the archaeological record resulted from precisely the fact that, after tens of thousands of years during which the different human varieties that developed in the Middle Pleistocene lived in geographical isolation, the expansion of modern humans created an entirely new situation involving close contact between very different people. Thus, one could hypothesize that it was the problems of personal, social, and biological identity arising out of such contact that ignited an explosion in the use of symbols on both sides.

The above examples provide an indication of some of the two-way processes that models of acculturation, in the sense of real interaction between different groups, might consider if they are to provide more satisfactory explanations for the Châtelperronian phenomenon. At present, however, such processes seem unlikely to account for the origins of the Châtelperronian. Our reading of the evidence indicates instead that the emergence of the Châtelperronian predates the spread of modern humans into Europe. Therefore, independent development is a better explanation than acculturation, and the hypothesis that moderns and Neanderthals followed parallel developmental tracks—which is also endorsed by Svoboda—requires no extraordinary level of historical coincidence. In fact, once we abandon the assumption of Neanderthal inferiority, there is no reason to transform a presumed contemporaneity of the two historical processes into a causal link between them.

To explain Neanderthal "modernity" as the product of acculturation by anatomically modern humans requires an explanation of why "modernity" first appeared in the later population. Invoking innate biological capabilities is a dead end, since it does not explain why it took some 100,000 years for such capabilities to manifest themselves. We agree with White that "the Upper Paleolithic revolution reflects social rather than biological changes." What we do not understand is his a priori denial that such social changes may have occurred in the evolutionary trajectory of the Neanderthals as well. Unless we postulate that they were biologically incapable of "modernity" to begin with, there is absolutely no reason to reject this possibility.

Interpreting the Upper Paleolithic "revolution" as a social process rather than a biological one also allows us to explain the Iberian pattern. It may well be that it was the particular conditions of adaptation to the environments of early last-glacial times in the Central European plain that precipitated this process by reinforcing

the need to establish far-ranging social alliances. Elsewhere it might have taken far longer for the critical levels of demography and social interaction to be reached, unless they were actually the result of the expansion of groups that had already undergone this process. Thus, Iberia south of the Ebro and perhaps North Africa may have been peripheral to the first stages of the Upper Paleolithic revolution. This unevenness cuts across biological boundaries (late Mousterian Iberians were Neanderthals, those from the Maghreb were modern humans), and it reinforces our position that explaining these changes has to do with geography and social developments, not with genes or with the mysterious and esoteric "revitalizing powers" postulated by Taborin.

Testing the conflicting views. Once it is accepted that Neanderthal societies also had the potential for internal evolution, the first appearance of bone tools and ornaments among Neanderthals is in itself no more extraordinary than its first appearance among anatomically modern humans, and it should not require a special explanation different from that which is offered for the latter. Once we accept this possibility, the issue becomes a strictly an empirical one. Given the limitations of the chronometric methods available to us today, we believe that it should be addressed and can be tested within the framework of archaeostratigraphy. Thus, we submit the following falsifiable propositions as empirical tests of our view of the facts: (1) the Szeletian, the Bohunician, and similar pre-Aurignacian technocomplexes of central and eastern Europe were made by Neanderthals, as was the Châtelperronian; (2) the same development of Neanderthal bone technology and personal ornaments seen at Arcy will be identified in these or other late Neanderthal contexts from paleoecologically similar areas in the same time range (actually, this may well be the case in the late Mousterian of the Crimea, as pointed out by Conard); (3) in the Périgord, Châtelperronian levels will never be found overlying Aurignacian ones; and (4) early Aurignacian industries will never be found in Iberian regions south of the Ebro.

Our opponents have enormously advanced our understanding of Neanderthals, but today they seem to be in something of a scientific impasse. Apart from their unwarranted belief in Neanderthal inferiority, virtually all of their arguments rest on radiocarbon dating. Given the problems with the application of the method in this time range, theirs is essentially a position of faith. In order for the debate to continue in a productive way, it is now their turn to submit falsifiable propositions derived from their own understanding of the evidence. Hublin argues that acculturation need not result in a transfer of tools or of technology, but he offers no suggestion as to how his view of Neanderthal acculturation could be tested. If the body ornaments and the bone tools are different in raw material, manufacturing techniques, and morphology, as we have demonstrated, the imitation or mimicking suggested by him and by White can only be of concepts and social behaviors. Neither Hublin nor White tells us, however, how such processes can be distinguished from the independent elaboration of those same concepts and behaviors, how such a distinction can be identified in the archaeological record, and how and why that kind of imitation or mimicking would produce artifacts different from those used by the acculturators. Until these questions are adequately answered, the acculturation hypothesis can only be described, in the terms coined by Binford, as a post-hoc accommodative argument. No basis exists for it once the a priori against Neanderthal cognitive abilities is abandoned. We believe that the time has come for the issue of Neanderthal extinction to be addressed with the tools of history and science rather than those of prejudice.

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