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NEANDERTAL/MODERN HUMAN INTERACTION IN EUROPE

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ABSTRACT

The anatomical mosaic comprising both Neandertal and early modern human features identified in the 25,000 year old skeleton of the Lagar Velho child suggests that extensive hybridization between the two groups occurred when moderns entered Iberian regions south of the Ebro basin some 28-30,000 years ago. The archaeological data available for this transitional period, however, show an abrupt cultural replacement of the local late Middle Paleolithic repertoires by the Aurignacian. It is increasingly clear that similar processes of late Neandertal survival may have occurred elsewhere in Europe. The pre-Aurignacian invention of ornaments and bone tools by Châtelperronian Neandertals indicates that, throughout most of Europe, Neandertal/modern contacts were encounters between fully Upper Paleolithic cultures on both sides. On a continental scale, Neandertal extinction must have been a complex, uneven and extremely varied biocultural process, not the simple, straightforward replacement of an inferior brand of humans by a superior one. The available evidence also suggests that contemporaneity between the two groups at a local or regional level must have been very short-lived and that the resulting interaction must have had more lasting or more visible consequences at the biological than at the cultural level.

INTRODUCTION

It is now widely recognized, even by former proponents of strict multi-regionalist models (Wolpoff et al. 2000), that modern human emergence in Europe was associated with gene flow from exogenous populations likely to be of ultimate African origin. Conversely, most former proponents of strict out-of-Africa models now accept that interbreeding between incoming moderns and local Neandertals may have occurred on occasion (Vandermeersch 1995). Thus, after two decades of polarization between total continuity and total replacement, the argument about modern human origins in Europe now seems to have become settled on the clarification of three issues:

1. whether interbreeding was occasional or common and what was the resulting degree of admixture between the two groups;
2. whether the extent to which both groups mixed varied in space and time, or can be assumed to have been fairly uniform across the whole continent and throughout the whole period of coexistence;
3. whether contact and admixture were biological, cultural, or both biological and cultural processes.

Before addressing these issues, one must bear in mind that accepting the immigration of a group of people from one region into another region that was previously inhabited by a different group of people, does not necessarily entail accepting that the two ever had any contact. As recently suggested by Pettitt (1999), it may well be that it was the demise of Neandertals that provided the opportunity for the modern human settlement of Europe, not the arrival of the latter, that acted as a cause for the disappearance of the former. Put another way, it cannot be excluded that the spread of moderns was the adaptive radiation of a successful species, that occupied an ecological niche left vacant by the extinction of a competitor.

In spite of its inadequacies, the available chronometric evidence

shows that this is unlikely to have been the case. South of the Ebro river (Zilhão 1993, 1997, 1998) and along the northern shores of the Black Sea (Chabai and Marks 1998), Neandertals are known to have survived until 30,000 BP or after. The same seems to have happened in Croatia, given the ca. 29,000 BP dates obtained for the Neandertal material from Vindija (Smith et al. 1999), and in England, where no evidence for modern humans is known before ca. 30,000 BP (Aldhouse-Green and Pettitt 1998). However, assuming that the earliest Aurignacian was the work of moderns, their establishment in the Franco-Cantabrian region and the central European plain dates to ca. 36,500 BP (Zilhão and d'Errico 1999a).

Thus, even when the standard error of radiocarbon dates is accounted for, the long-term contemporaneity of the two groups cannot be denied, at least in the extreme peripheries of Europe (Figure 1). On a continental scale, they did coexist but, such coexistence may have taken place across essentially stable, and largely impermeable geographical frontiers, as in the Ebro frontier model of the Middle-to-Upper Paleolithic transition in Iberia (Zilhão 1993, 1997, 1998). Given the size of hunter-gatherer territorial ranges, and the length of time involved, this does not imply that each group ignored the existence of the other: chance encounters and cross-border exchange must have occurred, even if separate biocultural identities were maintained for several millennia.

NEANDERTAL-MODERN CONTEMPORANEITY AT THE LOCAL/REGIONAL SCALE

The long duration of these frontier situations, nevertheless suggests that a simple model of mutual avoidance between immigrants and locals can explain the basic features of the European pattern. Retreating before the advance of moderns,

for epidemiological, demographic, cultural or economic reasons, Neandertals would have become restricted to regions where

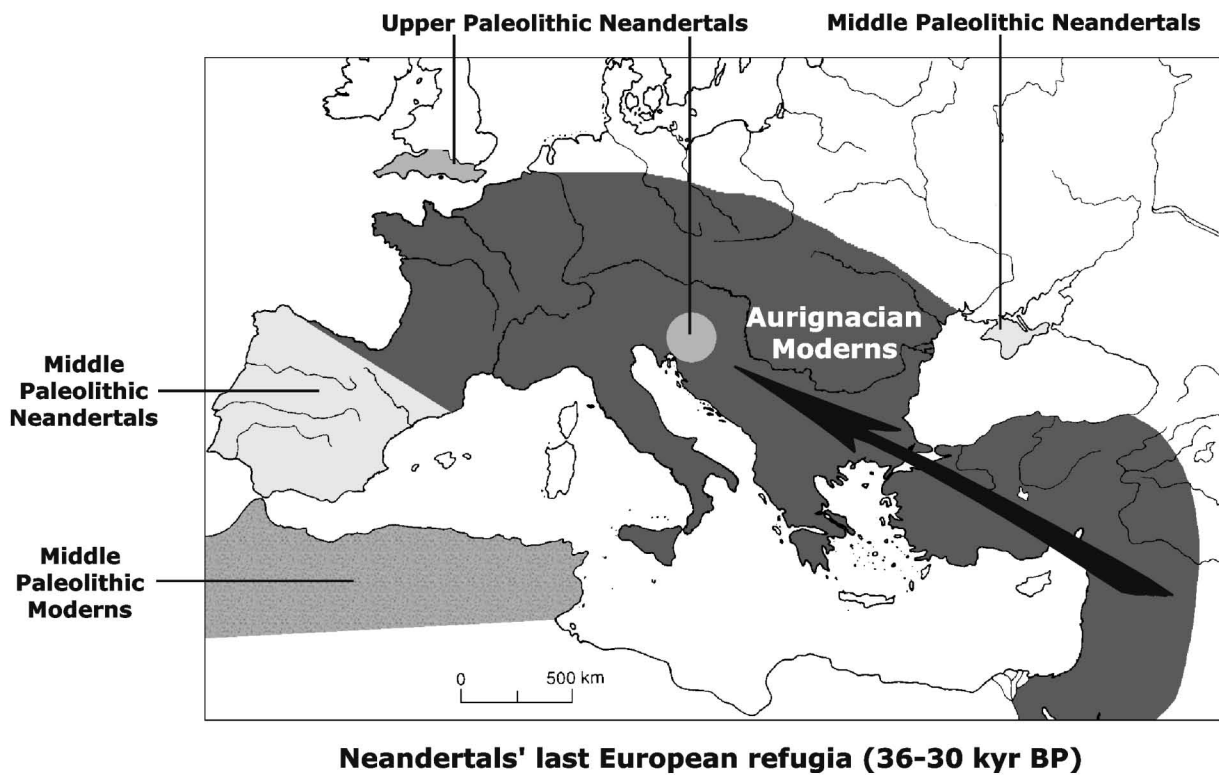
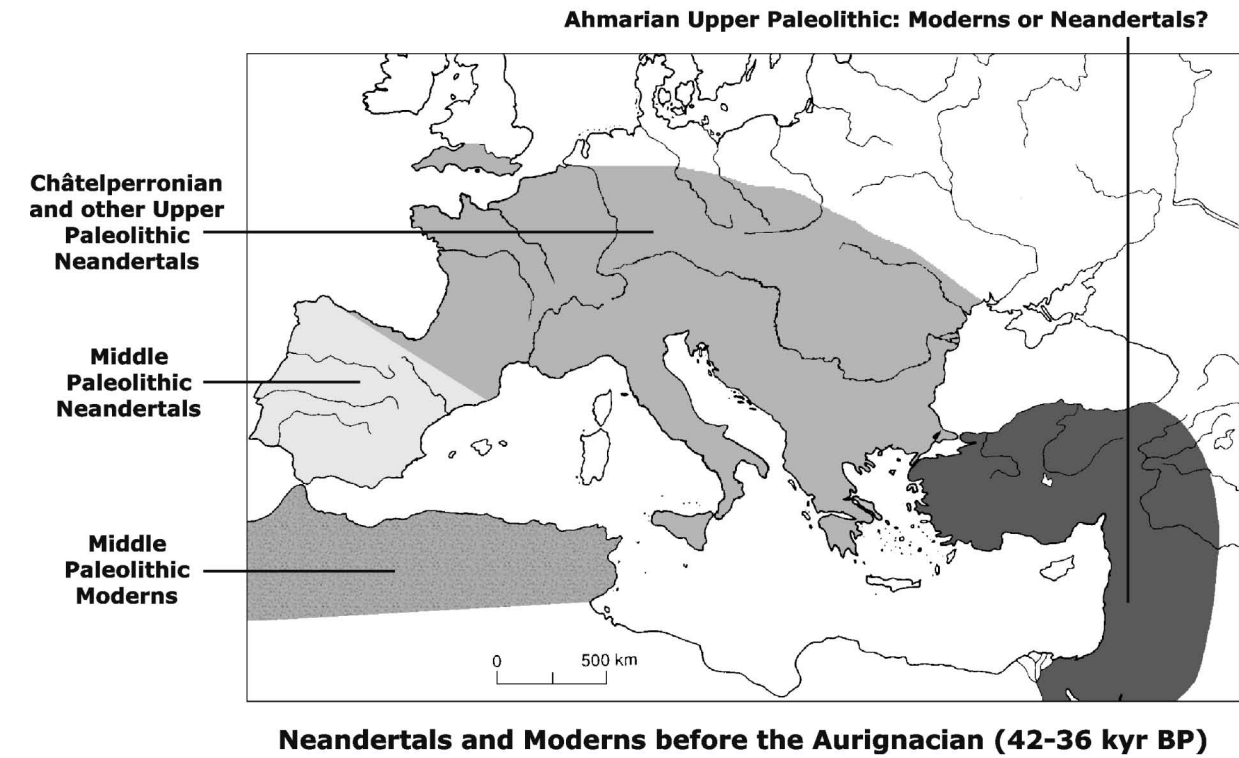


Figure 1 - Top: the geographical distribution of Neandertals and moderns before the Aurignacian. Bottom: Neandertals last European refugia.

they maintained some kind of adaptive advantage. In the environmentally homogeneous core areas of the continent, the end-result would have been a rather rapid replacement with minimal cultural interaction and minimal biological admixture.

Once the adaptive advantage enjoyed by Neandertals in the peripheral regions where they survived had vanished, because of changes in the environment or in the demographic and social fabric of both groups, moderns would have begun to encroach in their neighbors' territories. However, contrary to what had been the case in the central European plain a few millennia before, retreat was now impossible, given the cul-de-sac nature of these last Neandertal refugia. Consequently, interaction was inevitable, and extensive admixture likely to have occurred, as suggested for the Iberian case on the basis of the mosaic of modern and Neandertal features apparent in the 25,000 year old Lagar Velho skeleton (Duarte et al. 1999).

In the above scenario, contemporaneity between Neandertals and moderns would have been extremely short-lived at the local and regional levels. This may go a long way into explaining the lack of convincing evidence for a long-term contemporaneity in the same region between assemblages attributed to Neandertals on one hand, and to modern humans on the other. Although claims to the contrary have dominated the literature for the past two decades, (cf. Mellars 1996), and have been widely used to explain away the evidence for an independent Neandertal transition from the Middle to the Upper Paleolithic, none of these claims survives close scrutiny with a taphonomical perspective (d'Errico et al. 1998; Zilhão and d'Errico 1999a, 1999b). In fact:

1. the few reported instances of interstratification between Châtelperronian and Aurignacian levels are an artifact of post-depositional disturbance, not genuine evidence of the alternate use of the same site by different groups over many millennia;
2. in every known stratigraphical sequence whose integrity is attested and contains both Aurignacian and Châtelperronian or Transitional levels, the former always overlies the latter;
3. critical analysis of the radiocarbon dates for the period between 40,000 and 30,000 BP also shows that whenever sample context and sample chemistry are independently verified, the dates for the Châtelperronian and the other Transitional industries are older than those for the earliest Aurignacian.

Two examples show the impact that taphonomical and definitional issues may have on the chronology of the Middle-to-Upper Paleolithic transition in Europe (cf. Zilhão and d'Errico 1999a). El Castillo level 18, conventionally reported in the literature as Aurignacian, has been repeatedly dated to ca. 40,000 BP (Cabrera and Bischoff 1989; Cabrera et al. 1996). But the samples come from the modern excavations, carried out in an area of the level where no Aurignacian items were recovered. The attribution is made by correlation with the interior area excavated in the early twentieth century where, however, level 18 was a thick palimpsest with at least two occupations: Aurignacian (at the top) and Mousterian (at the bottom). This suggests that the dates may well be chemically and contextually correct but, related to the Mousterian, not the Aurignacian.

In the Geissenklösterle cave, the "Proto-Aurignacian" that has been associated with C14 dates between ca. 37,000 and ca. 40,000 BP (Richter et al. 2000) is a post-excavation reconstructed assemblage (Hahn 1988) whose integrity remains to be demonstrated. In fact, refits between the "Proto-Aurignacian" levels and the ca. 33,000-year-old typical Aurignacian levels of the site are far more numerous than refits inside this very well-defined later horizon. On the other hand, refits inside the "Proto-Aurignacian" levels are more numerous than with the overlying Aurignacian. These facts suggest that, whereas the contamination of the latter by upwardly displaced items may not be as important, the "Proto-Aurignacian" levels contain significant amounts of material derived from the typical Aurignacian occupation. Two ivory beads considered to belong in the "Proto-Aurignacian", for instance, are identical to the 12 recovered in the overlying art-rich deposits and in all likelihood derive from them. This may as well be the case with the carinated cores and the other types of Aurignacian lithics listed as part of the "Protoaurignacian" repertoire. Consequently, the historical significance of the pre-37,000 BP dates for the Geissenklösterle is unknown, and their use as evidence for modern human presence in central Europe in that time range unwarranted.

Such a presence is all the more questionable once we bear in mind that, in the Near East, where Aurignacian moderns are supposed to have originated, they are no earlier than ca. 36,000 BP (Bar-Yosef 1996). Once the results that are questionable on taphonomic or definitional grounds are removed from further consideration, however, the European picture is fully compatible with the data for the Levant (Zilhão and d'Errico 1999a). Even in southwestern Europe, where the Aurignacian was supposed to appear quite early on, there is not a single site where it has been reliably dated to before ca. 36,500 BP (Figure 2). The situation in Italy, Germany, Austria and the Balkans is no different. Conversely, there is no evidence for the presence in post-36,000 BP times, of the Châtelperronian and equivalent Transitional assemblages anywhere in the geographical range where this earliest Aurignacian has been found. In fact, the much younger results presented in Figure 2, which have often been used to suggest a survival of the Châtelperronian into the period between ca. 35,000 and ca. 30,000 BP, come from contexts for which much older dates, differing at the 95% confidence level, are also available. These discrepancies are more parsimoniously interpreted as evidence for the impact that even a minimal amount of chemical contamination may have on bone samples dating to very near the practical limit of the radiocarbon method than as evidence for a very late survival of the Châtelperronian and of its long-term local or regional contemporaneity with the Aurignacian.

THE ISSUE OF NEANDERTAL-MODERN CULTURAL EXCHANGES

The typical standard deviations of radiocarbon dates in this time range only allow us to continue in units of a thousand years, at best. Thus, the chronological framework presented above does not necessarily falsify the hypothesis that Neandertals and moderns may have lived side by side in closed proximity, that is, in the same territories and competing for the same resources, for many centuries. If that had been the case, the cultural remains

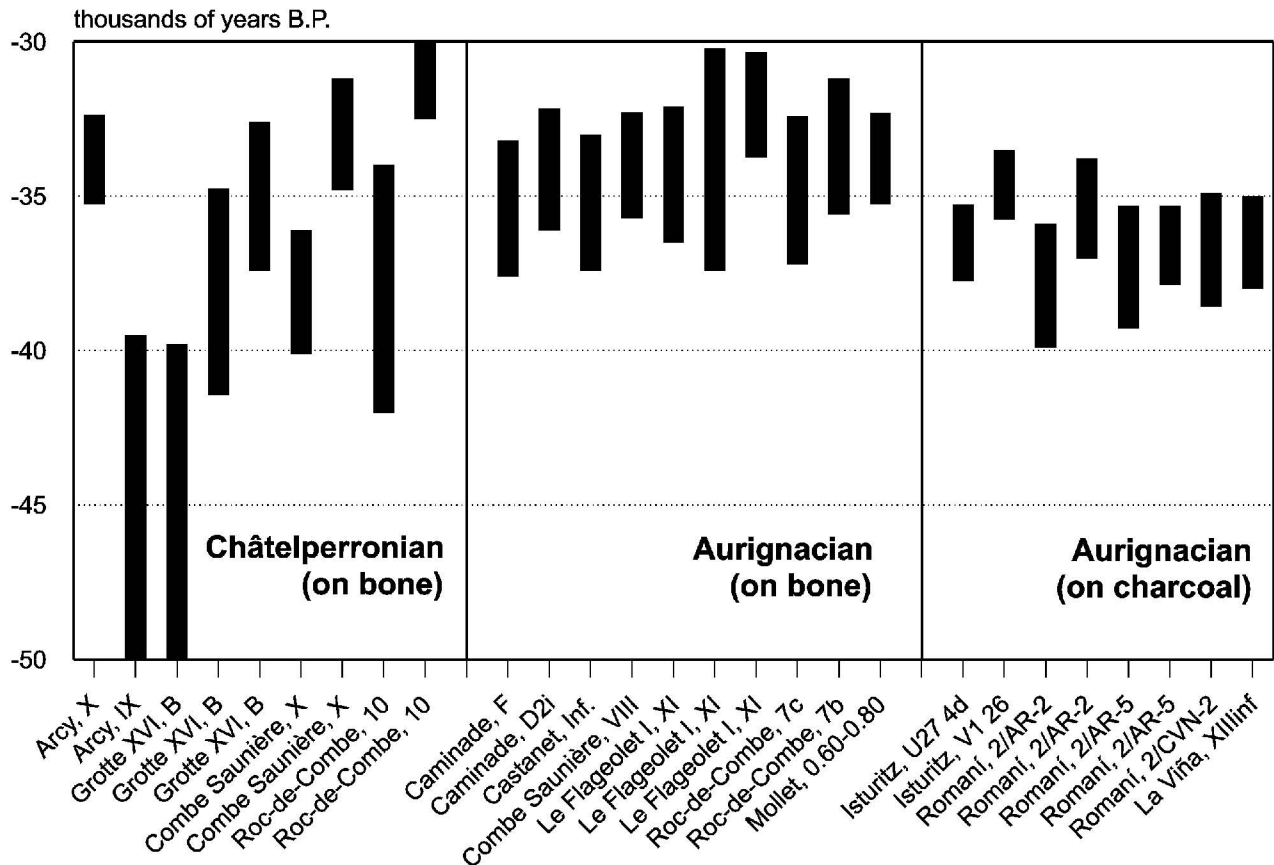


Figure 2 - AMS (and, for La Viña, conventional) C-14 dates (95% confidence intervals) on bone and charcoal for the Châtelperronian and the earliest Aurignacian of southwestern Europe, excluding the results which are questionable on taphonomic or definitional grounds (Reclau Viver and Caminade G on bone, L'Arbreda and El Castillo on charcoal).

left behind at sites should give us some indication of that.

The interstratification of Aurignacian and Châtelperronian levels could be one such indication, provided that one could reject the alternative hypothesis that it represented an ebb and flow of territorial boundaries. However, the few reported instances of such an interstratification are best explained by geological or taphonomical, non-cultural processes, or by mistaken readings of the sites' archaeosedimentary sequences (d'Errico et al. 1998; Zilhão and d'Errico 1999a). Furthermore, the long-term contemporaneity of Neandertals and moderns, at a local or regional level, without admixture, and with Neandertals being able to maintain their separate biological identity and cultural traditions throughout the process, would surely have entailed many instances where the levels from the time period in question would correspond to non-stratified palimpsests containing a mix of remains left behind by both groups. What the archaeological record shows, instead, is that the Châtelperronian and the Aurignacian are always found in well separated levels (at least in modern excavations), and that the presence in one level of items typical of the other, can always be explained by post-depositional disturbance. And when palimpsests do exist, and are not an artifact of taphonomical processes, they correspond to situations of very low rates of sedimentation, where the amount of time represented in the strata is in the order of many millennia, not of a few centuries only.

An alternative way of substantiating the long-term

contemporaneity of the two groups at a local or regional level would be the demonstration that cultural developments occurring in one could only be explained as a consequence of cultural exchange with (or of cultural influence received from) the other. The available radiometric data make it impossible to accept the hypothesis that the emergence of the Châtelperronian was triggered by the arrival of Aurignacian moderns to the Neandertal territories of the Franco-Cantabrian region. On the basis of both the radiocarbon dates and the pollen records, it has been argued, however, that the manufacture of ornaments and bone tools would appear only in the later Châtelperronian, and that their abundance in one isolated site in Burgundy, the Grotte du Renne, might reflect the acculturation of Neandertal groups that had retreated to more northern refugia as a consequence of the occupation by moderns of their traditional territories in the Aquitaine basin (Leroyer and Leroi-Gourhan 1983; Mellars 1996; Hublin 1999).

Major differences between the Aurignacian and the Châtelperronian in the style and technology of these kinds of artifacts make such an explanation of the Grotte du Renne record extremely unlikely (d'Errico et al. 1998). For instance, Châtelperronians preferred to carve a furrow around the tooth root (a technique seldom used, if at all, in the Aurignacian) and, when they pierced them, they used puncturing followed by smoothing and enlarging of the perforation, whereas Aurignacians always pierced their teeth pendants and did so by scraping them thin first. The local manufacture of the bone tools

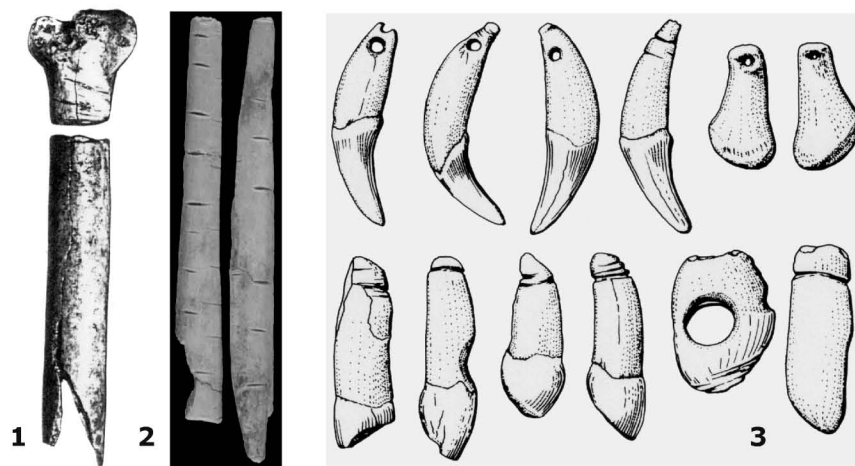


Figure 3- Châtelperronian ornaments and bone tools from the Grotte du Renne, Arcy: 1. bone tube of a swan's left ulna and its manufacture byproduct; 2. decorated bird bone tube; 3. pendants.

attested by the discovery in close proximity of a tube of a swan's left ulna and its manufacture byproduct also provides unequivocal evidence that these kinds of artifacts were an integral part of the material culture of Châtelperronians, not isolated instances of trade with the Aurignacians or of collection from their abandoned sites (Figure 3).

Finally, no convincing instances of mixed Neandertal/modern cultural entities (that is, genuine assemblages that are part Mousterian or Transitional and part Aurignacian) have so far been described anywhere in Europe. This has been claimed for sites such as the Trou Magrite (Otte and Straus 1995) or Vindija cave (Karavanic 1995; Karavanic and Smith 1998), on the basis of the co-existence in the same levels of items generally considered to be typical of either the Aurignacian or the Châtelperronian and other Transitional cultures. In fact, however, the levels in question are demonstrably disturbed by post-depositional processes (Zilhão and d'Errico 1999a, 1999b). More importantly, such a coexistence is not enough to demonstrate the influence of one culture on the other since it does not rule out the possibility that we are dealing with palimpsests of different occupations by different groups that may have taken place far apart in time, as indeed must be the case with level G1 of Vindija, given the temporal spread of many millennia shown by the ages obtained on individually dated bone samples. To demonstrate that an actually mixed technology existed, it would be necessary to show, for instance by refitting studies, that items such as a blade with Aurignacian retouch and a Châtelperron point were manufactured from blanks extracted in the framework of a single reduction sequence. So far, such a demonstration is lacking.

The recent discovery in the Turkish cave site of Üçagizli of an initial Upper Paleolithic level dated to ca. 39,000 BP that contained a few perforated marine shell beads (Kuhn et al. 1999; Kuhn personal communication) brings the appearance of art in the Near East to the same time range as the emergence of the Châtelperronian. This might substantiate the claim that the appearance of ornaments in Neandertal Europe was part of an East-West cultural diffusion related to the spread of modern

humans provided that moderns, not Neandertals, are eventually shown to have been the human type responsible for the accumulation of the Üçagizli deposit. That, however, would be a scenario of long-distance influence, much like the bow-wave model of the spread of innovations first developed among African moderns suggested by Mellars (1999). Thus, even if this site is accepted as evidence for art-bearing modern human cultures in the Levant ca. 39,000 BP, it certainly is no support for the hypothesis of long-term contemporaneity of the two groups at a local or regional scale.

BIOLOGY, CULTURE AND ADMIXTURE

As is the case elsewhere in Europe, no demonstrably Neandertal-modern mixed cultures exist in the Iberian Peninsula either. The earliest Upper Paleolithic industries of Portugal and southern Spain show no Mousterian influence, and no Upper Paleolithic influence is noticeable in the latest Mousterian industries from these regions (Villaverde et al. 1998; Zilhão in press). Yet, extensive admixture between moderns and Neandertals has been suggested on the basis of the anatomical evidence provided by the Lagar Velho child. Although it could be argued that the lack of evidence for admixture in the cultural realm contradicts the phylogenetic interpretation of the child's anatomy, such an objection would not be pertinent.

The transmission of cultural traits is a completely distinct process from the transmission of biological traits. The former depends on human volition: whether a given technology or behavior is maintained and taught to the next generation or replaced by something new is a matter decided upon by individuals and social groups. No one, however, has the power to decide whether a given anatomical trait will or will not be transmitted: this is determined by the rules of sexual reproduction and is the domain of Darwinian natural selection, which operate independently of any conscious individual or social decisions. In a scenario of short-lived contemporaneity on a local scale, with extensive admixture resulting in the quick absorption of one group by another group, it would not be unexpected to see the culture of the side that predominated

become the culture of the new biologically mixed populations.

Put another way, in such a scenario one can almost predict that the admixture would be much more visible in the realm of biology than in the realm of culture. This is all the more so if we bear in mind that, with few exceptions, only a very small part — stone tools — of past cultural repertoires tends to survive until the present. In the Iberian case, this is exactly the problem: the cultural information we have on the situation immediately before and immediately after the transition is restricted to lithic technology and subsistence behavior. The lithics of the Aurignacian of Iberian regions south of the Ebro show no Mousterian influence. But this tells us very little about the nature and intensity of the cultural interaction between moderns and Neandertals in the realm of myths, beliefs, usages or, more simply, the technology of perishable materials.

For the moment, therefore, we can only work with inferences from the biological facts. And the mosaic anatomy of the Lagar Velho child does indicate that, regardless of what we see in the realm of lithics, admixture between the two groups must have been significant, at least in such cul-de-sacs as the Iberian Peninsula. Conversely, the fact that the same genetically-inherited traits borne by the Lagar Velho child are not found in the contemporaneous skeletal material from such western and central European sites as Paviland (Trinkaus forthcoming) or Dolní Vestonice (Svoboda et al. 1996) suggests that, in these regions, interbreeding may have been rare or insignificant.

Alternatively, the absence of such traits may be related to the fact that the central European material dates to 10,000 years after the time of contact, as opposed to only 3000 in the Portuguese case. Such an explanatory framework would make it possible to accommodate the evidence for gene flow claimed by different authors on the basis of the earlier (but fragmentary) modern human skeletal material from Hahnöfersand or Mladeč, as well as Smith's suggestion that a genetic input from moderns explains the gracile features of the very late Neandertals from Vindija's level G1 (cf. Smith 1984 for a review). In at least some regions of central Europe, therefore, it would be possible to model the replacement process after the Iberian case, that is, as a previous instance of extensive biological admixture in which the culture of moderns (or, at least, the archaeologically visible aspects of culture) became the culture of the new admixed groups: put another way, in which Neandertals were essentially absorbed by the incoming modern human populations. In this scenario, the anatomical traits inherited from Neandertals would vanish after a few thousand years, through the operation of demographic or genetic processes that remain to be modeled.

CONCLUSION

40,000 years ago the Old World was a rather diverse place, from a biological as well as from a cultural point of view. As is made clear by Figure 1, North Africa was populated by Middle Paleolithic moderns, Iberia by Middle Paleolithic Neandertals, and West and Central Europe by Upper Paleolithic Neandertals. In the Near East, a local transition to the Upper Paleolithic from the preceding Tabun B-type industries is documented at such sites as Boker Tachtit (Marks and Ferring 1988), but the human type (moderns or Neandertals) that manufactured this initial

Upper Paleolithic as well as the early Ahmarian remains unknown.

This makes it clear that biological explanations for the Middle-to-Upper Paleolithic transition that explain it as a correlate of modern human emergence, or of the emergence of cultural modernity among previously culturally non-modern moderns, must be abandoned. The disappearance of Neandertals and other anatomically archaic humans as separate biological entities must have been a complex, uneven and extremely varied historical process, not the simple, straightforward replacement of inferior brands of humans by a superior one. In Europe, it is also clear that, with few exceptions, the processes of interaction which eventually led to the prevalence of moderns were between fully Upper Paleolithic cultures on all sides, regardless of the particular combination of anatomical traits involved in each particular instance.

REFERENCES

- Aldhouse-Green, S. and P. Pettitt, 1998. Paviland Cave: contextualising the 'Red Lady'. *Antiquity* 72: 756-772.
- Cabrera, V. and J. L. Bischoff, 1989. Accelerator ¹⁴C dates for Early Upper Paleolithic (Basal Aurignacian) at El Castillo Cave (Spain). *Journal of Archaeological Science* 16: 577-584.
- Cabrera, V., H. Valladas, F. Bernaldo de Quirós, and M. Hoyos, 1996. La transition Paléolithique moyen-Paléolithique supérieur à El Castillo (Cantabrie): nouvelles datations par le carbone-14. *Compte-Rendus de l'Académie des Sciences de Paris* 322: 1093-1098.
- Chabai, V. P., and A. E. Marks, 1998. Preliminary Synthesis: Middle Paleolithic Assemblage Variability in Western Crimea. In *The Middle Paleolithic of Western Crimea Vol. 1*. Edited by A. E. Marks, and V. P. Chabai, Liège, Études et Recherches Archéologiques de l'Université de Liège, pp. 355-367.
- d'Errico, F., J. Zilhão, D. Baffier, M. Julien, and J. Pelegrin, 1998. Neanderthal Acculturation in Western Europe? A Critical Review of the Evidence and Its Interpretation. *Current Anthropology* 39: 1-44.
- Duarte, C., J. Mauricio, P.B. Pettit, P. Souto, E. Trinkaus, H. Van der Plicht, and J. Zilhão, 1999. The Early Upper Paleolithic Human Skeleton from the Abrigo do Lagar Velho (Portugal) and Modern Human Emergence in Iberia. *Proceedings of the National Academy of Sciences USA* 96: 7604-7609.
- Hahn, J., 1988. *Das Geissenklösterle I*, Stuttgart, Konrad Theiss.
- Hublin, J.-J., 1999. Derniers néandertaliens et premiers européens modernes. *Pour la Science* 22: 110-118.
- Karavanic, I., 1995. Upper Paleolithic occupation levels and

- Late-occurring Neandertal at Vindija Cave (Croatia) in the Context of Central Europe and the Balkans. *Journal of Anthropological Research* 51: 9-35.
- Karavanic, I., and F.H. Smith, F. 1998. The Middle/Upper Paleolithic interface and the relationship of Neanderthals and early modern humans in the Hrvatsko Zagorje, Croatia. *Journal of Human Evolution* 34: 223-248.
- Kuhn S. L., M.C. Stiner, and E. Güleş, 1999. Initial Upper Palaeolithic in south-central Turkey and its regional context: a preliminary report. *Antiquity* 73: 505-517.
- Leroyer, C., and A. Leroi-Gourhan, 1983. Problèmes de chronologie : le Castelperronien et l'Aurignacien. *Bulletin de la Société Préhistorique Française* 80: 41-44.
- Marks, A. E., and C. R. Ferring, 1988. *The Early Upper Paleolithic of the Levant*. In *The early Upper Paleolithic: evidence from Europe and the Near East*, edited by J. F. Hoffecker, and C. A. Wolf, pp. 43-72. Oxford, British Archaeological Reports International Series.
- Mellars, P. A., 1996. *The Neanderthal Legacy*. Princeton: Princeton University Press.
- Mellars, P. A., 1999. In: The Neanderthal Problem. Continued. *Current Anthropology* 40: 341-350.
- Otte, M., and L. Straus (editors), 1995. *Le Trou Magrite: fouilles 1991-1992*. Liège: Études et Recherches Archéologiques de l'Université de Liège 69.
- Pettitt, P., 1999. Disappearing from the world: an archaeological perspective on Neanderthal extinction. *Oxford Journal of Archaeology* 18: 217-240.
- Richter, D., J. Waiblinger, W. J. Rink, and G. A. Wagner, 2000. TL, ESR and C14-Dating of the Late Middle and Early Upper Palaeolithic site of Geissenklösterle cave, Southern Germany. *Journal of Archaeological Science* 27: 71-89.
- Smith, F., 1984. Fossil Hominids From the Upper Pleistocene of Central Europe and the Origin of Modern Europeans. In *The Origins of Modern Humans: A World Survey of the Fossil Evidence*, edited by F. Smith and F. Spencer, pp. 137-209. New York: Alan R. Liss.
- Smith, F. H., E. Trinkaus, P. B. Pettitt, I. Karavanic, and M. Paunovic, 1999. Direct radiocarbon dates for Vindija G₁ and Velika Pecina Late Pleistocene hominids. *Proceedings of the National Academy of Sciences USA* 96: 12281-12286.
- Svoboda, J., V. Lozek, V., and E. Vlcek, 1996. *Hunters between East and West*. New York: Plenum.
- Trinkaus, E., (in press). Late Pleistocene and Holocene human remains from Paviland Cave. In *Paviland Cave and the 'Red Lady': a definitive report*, edited by S. Aldhouse-Green. Newport: University of Wales College.
- Vandermeersch, B., 1995. Homo sapiens sapiens: ce que disent les fossiles. *La Recherche* 277: 614-620.
- Villaverde, V., J. E. Aura, and C. M. Barton, 1998. The Upper Paleolithic in Mediterranean Spain: A Review of Current Evidence. *Journal of World Prehistory* 12: 121-198.
- Wolpoff, M., D. W. Frayer, M. Oliva, and J. Jelínek, 2000. The Mladec males: Aurignacian crania from Moravia. *Journal of Human Evolution* 38: A35.
- Zilhão, J., 1993. Le passage du Paléolithique moyen au Paléolithique supérieur dans le Portugal. In *El Origen del Hombre Moderno en el Suroeste de Europa*, edited by V. Cabrera, pp. 127-145. Madrid: Universidad Nacional de Educación a Distancia.
- Zilhão, J., 1997. *O Paleolítico Superior da Estremadura portuguesa*, 2 volumes. Lisbon: Colibri.
- Zilhão, J., 1998. The extinction of Iberian Neanderthals and its implications for the origins of modern humans in Europe. In *XIII International Congress of Prehistoric and Protohistoric Sciences. Proceedings*, edited by F. Facchini, A. Palma di Cesnola, M. Piperno, and C. Peretto, pp 229-312. Forlì: Abaco.
- Zilhão, J., in press. The Ebro frontier: a model for the late extinction of Iberian Neanderthals. In *Neanderthals on the edge: 150th anniversary conference of the Forbes' Quarry discovery, Gibraltar*, edited by C. Stringer, R. N. E. Barton, and C. Finlayson. Oxford: Oxbow Books.
- Zilhão, J., and F. D'Errico, 1999a. The chronology and taphonomy of the earliest Aurignacian and its implications for the understanding of Neanderthal extinction. *Journal of World Prehistory* 13: 1-68.
- Zilhão, J., and F. d'Errico, 1999b. Reply, in The Neanderthal Problem Continued. *Current Anthropology* 40: 355-364.