

Neanderthals Meet Modern Humans

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The Lagar Velho Child and the Fate of the Neanderthals

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The *Lagar Velho* site: Lagar Velho is a rock-shelter in the Lapedo valley, a limestone canyon cut by the River Caranguejeira. The site is very close to the city of Leiria, ca. 140 km north of Lisbon in central Portugal, and was discovered in November 1998, following reports that late prehistoric rock paintings had been identified in the region. Further survey work in the valley led to the identification of this particular site. The upper 2 to 3 m of its sedimentary fill had been almost entirely removed by the owner in 1992. All that was left of this upper fill was a hanging remnant preserved in a fissure running along the back wall of the shelter which contained an extraordinary density of remains clearly of Upper Paleolithic age. The current ground surface corresponds to the truncation of the lower part of the original sequence of archaeological deposits. The richness of the remnant suggested that this was a major site and, consequently, a rescue operation ensued in December-January 1998-1999, followed by two summer field seasons, in July 1999, and in June-October 2000. As a result, it has been possible to establish that the site contains three major archaeological components (fig. 1).

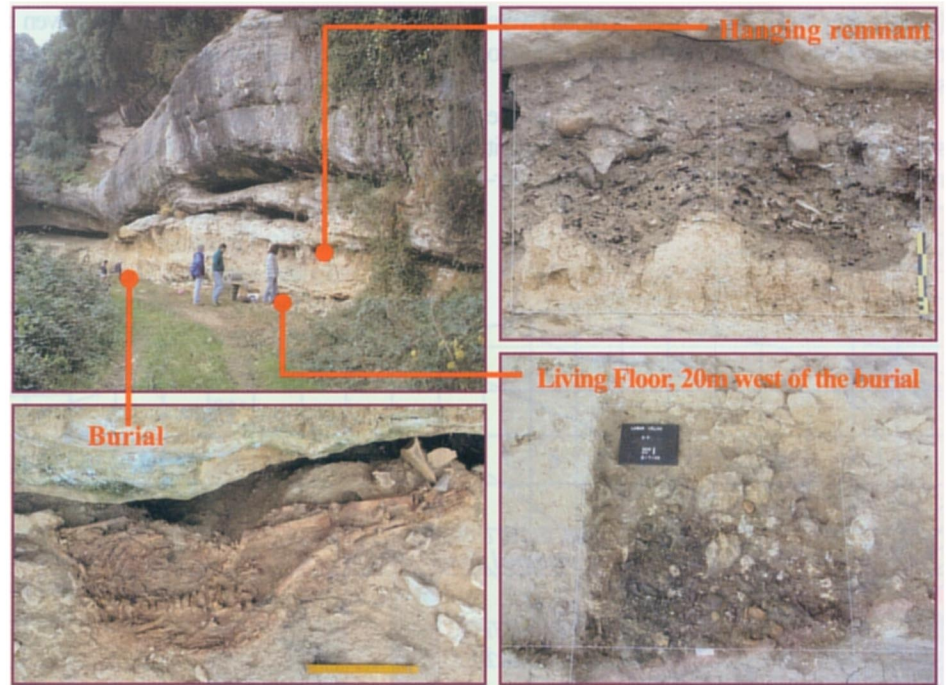


Fig.1: Lagar Velho: panoramic view along rockshelter face with indication of the three major archaeological components: Burial; living floor; and hanging remnant (photos: João Zilhão).

The most recent deposits are those of the hanging remnant, which are particularly rich in its western part. Two main occupation levels were identified there. Level 6, charcoal stained and with abundant burnt cobbles, contains a faunal assemblage dominated by horse remains. The artifact assemblage is rich in quartz tools, contains some carinated cores, and features a couple of fine bone points,

matching the characteristics of the Proto-Solutrean, a common occurrence in Portugal in stratigraphic sequences spanning the Last Glacial Maximum.

Three radiocarbon determinations on charcoal samples place this level, in good accord with the archaeological diagnosis, between 22,000 and 21,000 BP. A marked discontinuity, which corresponds to an erosional hiatus, separates this unit from the overlying *in situ* deposits of Level 9, where charcoal is abundant, but not as much as in earlier deposits, and the amount of faunal remains also decreases somewhat. The lithics, however, are fully diagnostic of the Middle Solutrean, with thermally pre-treated laurel-leaf flint points. In good accord with the results obtained elsewhere in Portugal, this level was radiocarbon dated from charcoal to 20,220±180 years BP (fig. 2).

A settlement area with dense remains of occupation in the same western part of the site (squares G-I/3-4) and beginning ca. 1.5 m below the base of the remnant, is preserved under ground level (figs.1-3). A deep sounding was opened in the summer of 1999 at the eastern edge of this area, in square J13, which was tested down to ca. 3 m. Although there were virtually no artifacts, scattered fragments of heavily burnt bone

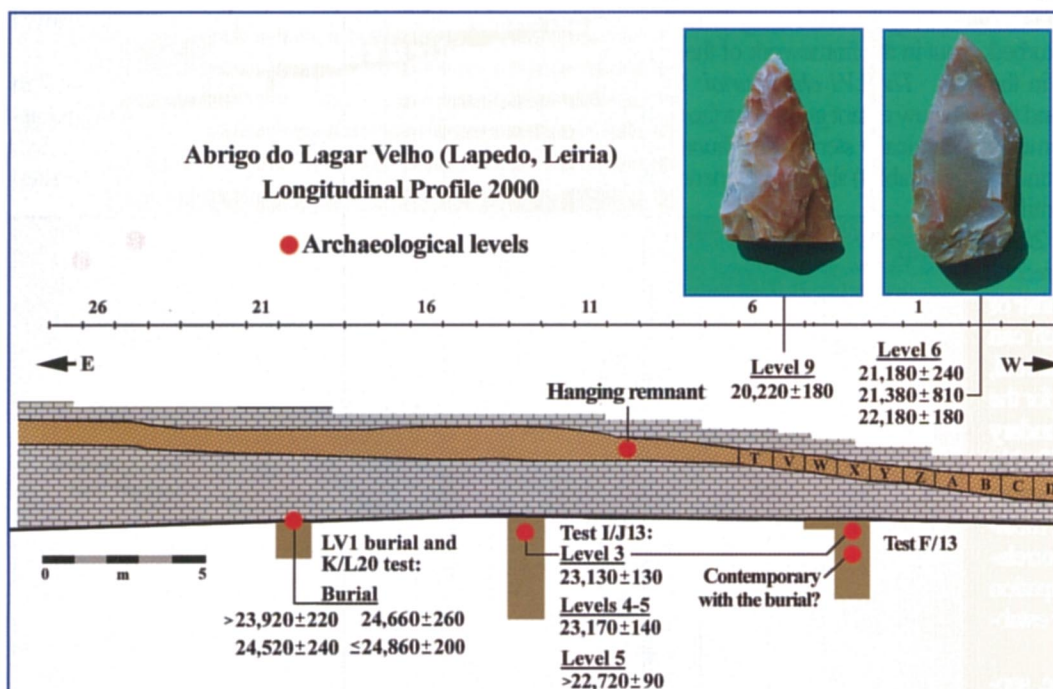


Fig.2: Longitudinal section drawing of the hanging remnant at Lagar Velho, showing inset photos of a Proto-Solutrean Vale Comprido point derived from level 6, and a Solutrean laurel-leaf point from level 9 (photos: João Zilhão).

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(mostly deer and horse, as well as rabbit) were recovered over the ca. 50 cm corresponding to spits 9 to 14 of this sounding.

As the continuation of the work in the summer of 2000 has demonstrated, although it may be possible to establish some finer inter-

2000 field season in squares G-H/3. Given the rates of sedimentation suggested by the above radiometric results, this lower level may be quite close in age to the major archaeological event so far documented at the site: the burial of a ca. four year old child located in the eastern part of the site, in square L20, the first Paleolithic burial ever found in the Iberian Peninsula. The burial will be discussed in detail in the following section but the above had to be established in order to document one of its main features: that it was placed in a part of the site which is totally devoid of any other remains of human activity.

Throughout its Gravettian period occupation, the western part of the shelter was used for ordinary settlement activities. The one burial episode so far documented took place in the easternmost part of the site, located far away from the settlement, and separated from the outer edge of the latter by more than 10 m of archaeologically empty space (fig.3).

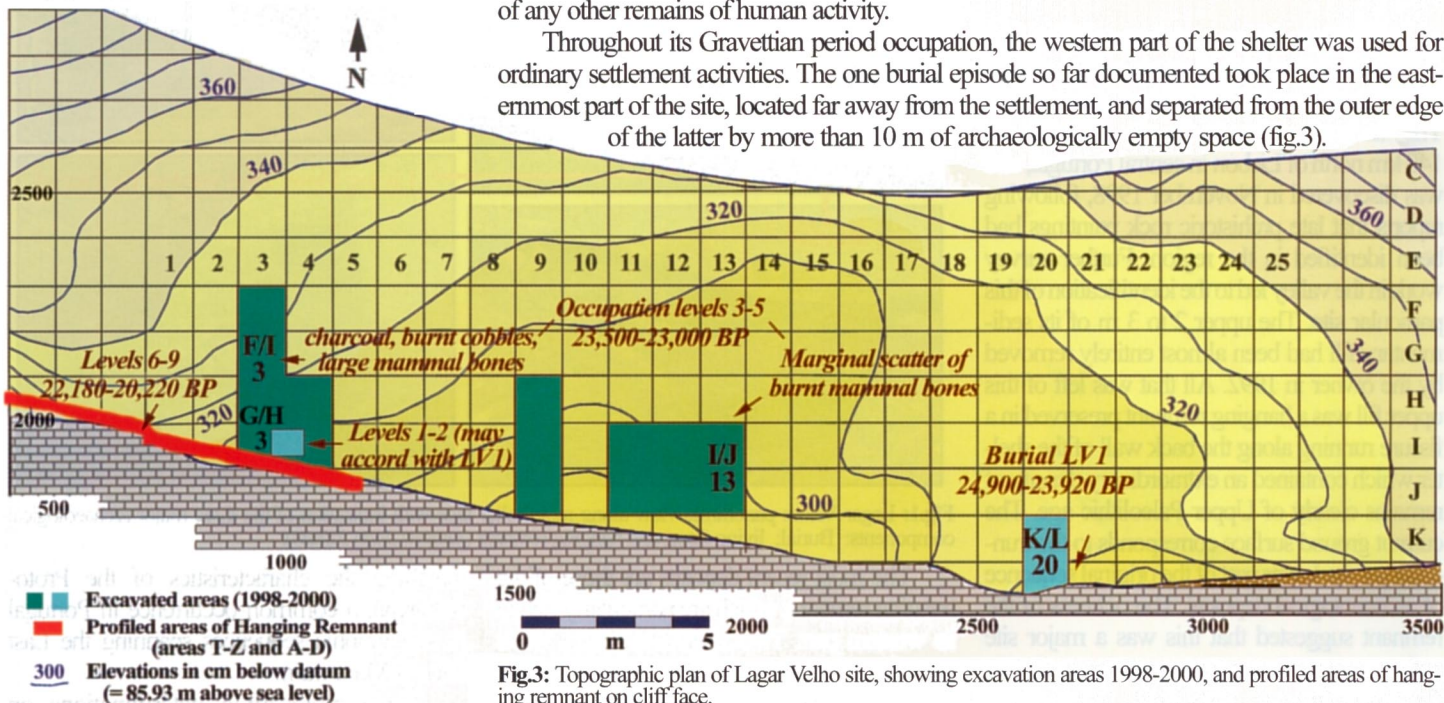


Fig.3: Topographic plan of Lagar Velho site, showing excavation areas 1998-2000, and profiled areas of hanging remnant on cliff face.

nal subdivisions, this entire thickness of deposit corresponds to a single stratigraphic unit. Three statistically identical AMS radiocarbon dates obtained on individual samples of burnt bone from those spits agree to date the accumulation of the deposit to the period between 23,500 and 23,000 BP. Once the thin lens of disturbed material that formed the ground cover in the intermediate areas located between J13 and the F-I/3-4 area was removed, the sediments exposed were shown to be in direct continuity with the very dense occupation level identified in the latter area, tested in the summer of 2000. It is quite likely, therefore, that the bones recovered in J13 correspond to a marginal scatter of material related to that occupation, which can be described as a dense midden of charcoal, burnt cobbles and large mammal bones, for the most part heavily burnt. The eastern boundary of this dense occupation has been identified in squares H-J/9. In the small area tested (squares G-I/3-4), the artifacts are non-diagnostic, mostly quartzite flakes, but the stratigraphic correlation suggests that the age of this occupation will lie in the time range of 23 to 23.5 kyr established for the equivalent levels of J13.

50 cm further down in the sequence, separated by a level of sterile clays, an older level of occupation was exposed at the end of the

The particular location selected took advantage of a small recess in the back wall of the shelter that, at the time of burial, created a protective overhang almost at ground level, forming a kind of natural niche ready-made to receive the body of the child that archaeologists eventually catalogued as fossil LV1. However, similar niches exist in the back wall of the shelter in the area where the living floors are located. It must be concluded, therefore, that there was an unequivocal intention to bury the child away from the areas that people used for the day-to-day living activities carried out in the framework of the site's use as a residential or as a logistical place.

The LV1 child burial: The area where the burial took place was tested down to about 2 m below extant ground surface. The deposits contained faunal elements but were otherwise archaeologically sterile. The faunal assemblage contained abundant coprolites and bones (horse, deer and rabbit) showing evidence of gnawing by carnivores. It is quite likely that this part of the shel-

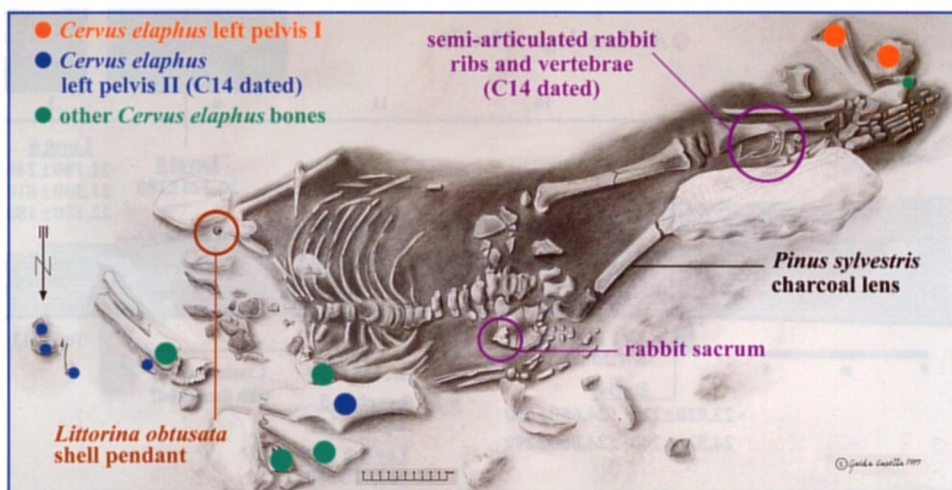


Fig.4: Plan of the Lagar Velho 1 skeleton after exposure was completed, showing artifacts and ecofacts associated with the boy's burial.

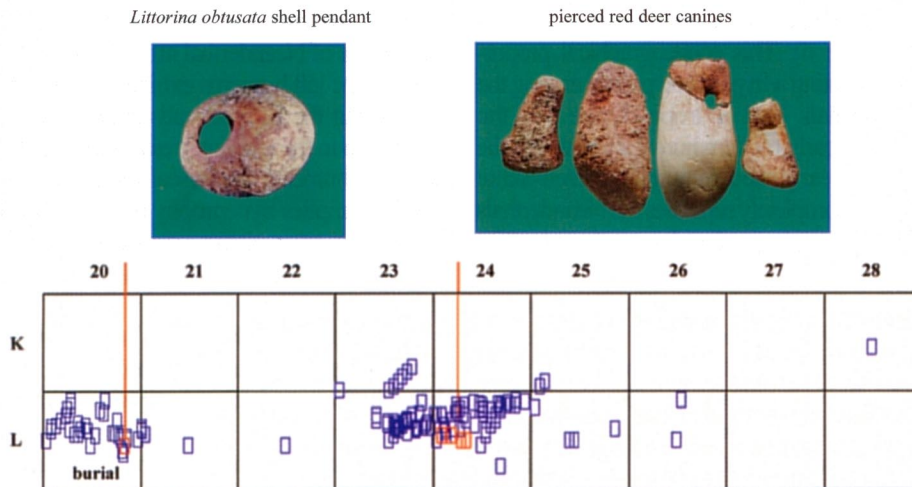


Fig.5: Scatter plot of Lagar Velho cranial fragments, indicating the location of the shell pendant (L= 13 mm) and the perforated red deer canines (max. L= 22.5 mm); both shown in photo insets (photos: José Paulo Ruas).

ter functioned as a wolf den until the time period represented by the burial event. Pollen analysis of the sequence excavated in square L20, under the burial, produced a diagram dominated by pine and heather. These results are compatible with information on the environment of the early Upper Paleolithic in Portugal obtained from other sources. However, pollen preservation is always rather poor in these kinds of deposits, so more work needs to be done before the composition of the site's surrounding paleovegetation can be securely reconstructed.

The burial of the Lagar Velho LV1 child (fig. 4) lay only a few centimeters below current ground surface. It was the above mentioned slight overhang of the shelter's back wall that saved it from total destruction when the site was terraced. The skull was missing because it originally lay slightly higher than the rest of the body and was shattered by the bulldozer. Fortunately, it was possible to recover most of its fragments, which were scattered in the thin level of disturbed deposits that covered the burial and surrounding areas. For the most part they were found in a dense accumulation located some 3 m eastwards of the burial along the back wall of the shelter (fig. 5). Careful excavation and screening of all these disturbed deposits allowed the recovery of some 160 fragments and, subsequently, the reconstruction of something like 80% of the total skull. The post-cranial skeleton was virtually complete as well as the child's permanent and deciduous dentitions.

The reconstructed burial ritual is very similar to that documented in contemporaneous funerary contexts of Central and Eastern Europe, showing that, culturally, these populations were fully integrated in the Gravettian

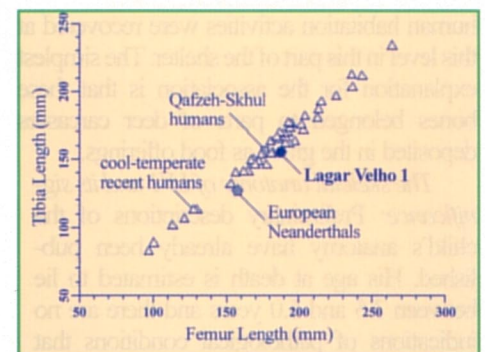
world. The body was laid down in extended position, slightly tilted towards the back wall of the shelter, left foot on top of the right one. Prior to the deposition of the body, a small fire had been lit in the shallow pit excavated for the grave. Analysis of the charcoal recovered from under the child's right leg shows that the burned wood was a single branch of Scots pine, *Pinus sylvestris*. The C14 date of ca. 24,900 BP obtained from this charcoal is, therefore, the closest estimation for the age of the burial event. An absolute upper limit for such an age is provided by the date of ca. 23,900 BP obtained on a bone sample collected from a semi-articulated ensemble of rabbit ribs and vertebrae directly overlying the child's right leg.

The red staining of the burial context is related to the use of ochre in the burial ritual. Since both the upper and the lower surfaces of the bones were stained, we infer that the body must have been wrapped in a shroud of ochre-painted skin, whose subsequent decay caused the transfer of the mineral pigment to the skeleton and surrounding sediment. The presence of a semi-rigid durable wrap around the body would also have provided the empty space necessary for the post-mortem plantarflexion or downward pointing, of the child's feet.

Artifacts and animal bones were found in close association with the skeleton. A *Littorina obtusata* shell pendant (fig.5) was recovered in the child's neck. Four pierced red deer canines were found in the above-mentioned cluster of displaced, small, red-stained fragments of the child's skull. The association of these deer canines with the cranial vault, as in contemporaneous burials from Italy and Moravia, suggests that they must have been part of a head-dress.

Besides the Scots pine charcoal lens, other natural, apparently unmodified components of the grave may also have been directly related to the burial ritual. The rabbit bones between the child's legs - three vertebrae, four ribs and one sacral fragment - had a reddish color identical to the human bones. Two of the ribs were complete, with their proximal epiphyses preserved, which suggests that, originally, they were articulated to the vertebrae. The simplest explanation for this association is that part of the carcass of one rabbit was deposited in the grave, perhaps as a food offering.

Analysis of the red deer bones found



Figs.6-8: Regression plots of thigh and leg bones of Lagar Velho 1 vs. Skhul/ Qafzeh humans, European Neanderthals, and cool-temperate recent humans.

Fig.6 (above): Tibial length vs femoral length (tibial intermetaphyseal length vs. femoral intermetaphyseal length).

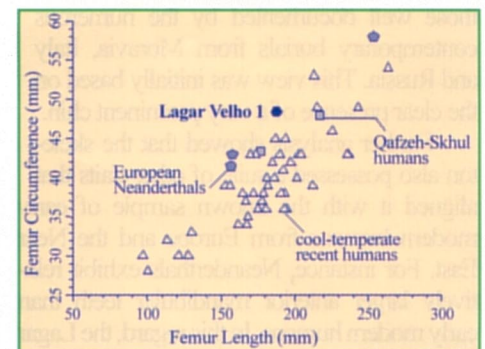


Fig.7: Femoral midshaft circumference vs femoral length (intermetaphyseal diaphyseal length).

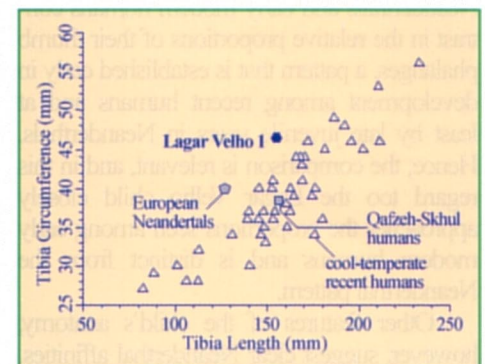


Fig.8: Tibial midshaft circumference vs tibial length (intermetaphyseal diaphyseal length).

along the edge of the burial pit showed that they are taphonomically distinct from those found in the surrounding and immediately underlying sediments. The latter present eroded surfaces, have a shine that suggests they were chewed and digested by carnivores, often display actual teeth punctures, and are associated with coprolites. In contrast, the deer bones found by the head and feet of the child's skeleton - two left pelvises, one distal tibia and two tarsal bones - are very well preserved, show no evidence of carnivore activity, were in contact with the body, and provided C14 dates showing contemporaneity with the burial event. Furthermore, no artifacts or other evidence of human habitation activities were recovered at this level in this part of the shelter. The simplest explanation for the association is that these bones belonged to parts of deer carcasses deposited in the grave as food offerings.

The skeletal anatomy of LV1 and its significance: Preliminary descriptions of the child's anatomy have already been published. His age at death is estimated to lie between 3.5 and 5.0 years and there are no indications of pathological conditions that might have affected normal skeletal development. During the excavation it was assumed that the skeleton represented that of a Gravettian early modern human child belonging to a population no different from those well documented by the numerous contemporary burials from Moravia, Italy and Russia. This view was initially based on the clear presence of a very prominent chin.

Further analysis showed that the skeleton also possessed a suite of other traits that aligned it with the known sample of early modern humans from Europe and the Near East. For instance, Neanderthals exhibit relatively larger anterior mandibular teeth than early modern humans. In this regard, the Lagar Velho child falls in the middle of the early modern human distribution. In addition, Neanderthals and early modern humans contrast in the relative proportions of their thumb phalanges, a pattern that is established early in development among recent humans and at least by late juvenile years in Neanderthals. Hence, the comparison is relevant, and in this regard too the Lagar Velho child closely approaches the proportions seen among early modern humans and is distinct from the Neanderthal pattern.

Other features of the child's anatomy, however, suggest clear Neanderthal affinities. Of paramount importance in this regard are the relatively short lower limb segments, reflected

in the proportions of its tibial length to femoral length (fig. 6). This ecogeographical proportion, indicating a hyperarctic pattern among the Neanderthals and a tropical one for the European early modern humans (as well as the Levantine early modern human Qafzeh-Skhul sample), completely separates the Neanderthals from these early modern human groups. The Neanderthals have proportionately shorter tibiae relative to their femora. These proportions appear early in development, are well documented for Neanderthal children, and remain stable for a number of millennia in Late Pleistocene and Holocene human populations.

These conclusions are the result of extensive research carried out among both modern and fossil populations and are widely accepted among students of human evolution. Commentators of the anatomical features of the two-year old Dederiyeh child from Syria,



Fig9: Lagar Velho 1: left mandible, lateral view, showing prominent chin, and retreating symphyseal profile (photo: Erik Trinkaus).

for instance, have remarked that the presence of the distinctive Neanderthal body shape in such a young child emphasized the importance of a genetic component in the development of this feature. Therefore, there does not seem to be any reason to reject using the tibial to femoral length proportions of LV1 to indicate its morphological affinities. And the comparison with a recent human cool temperate sample, with the La Ferrassie 6 Neanderthal, and with the Levantine early modern Skhul 1 specimen, shows that the Lapedo child clearly has tibiofemoral proportions in line with those of the Neanderthals. This is reinforced by the closeness to Neanderthals shown when robusticity of the leg bones is analyzed using plots of the femoral and tibial midshaft circumference to length (figs.7,8).

A second feature indicating Neanderthal affinities is the retreat of the mandibular symphysis, despite the presence of a prominent

mentum osseum, or bony chin (fig. 9). Suggestive of Neanderthal affinities is also the fact that the left humerus exhibits a prominent ridge along the M. pectoralis major insertion leading up to the anterior greater tubercle. The proximal humeral diaphyseal morphology of the child implies hypertrophy of the chest and upper arm musculature, a pattern seen in Neanderthals but usually little developed among early modern humans.

It is this morphological mosaic which forms the basis for the interpretation that LV1 is a modern human child with genetically-inherited Neanderthal traits. Given its geochronological and geographical position, this indicates that the population to which it belonged was the evolutionary product of a process of admixture between Neanderthals and early modern humans occurring several millennia before, at the time the latter first dispersed into Iberia, 28,000 to 30,000 years ago. Put another way, this unique combination of derived modern human traits with genetically-inherited Neanderthal traits must be considered phylogenetically significant and suggests that the last Neanderthal groups living in Iberia ca. 28,000 years ago contributed to the gene pool of subsequent early Upper Paleolithic populations of the Peninsula.

Neanderthal-modern admixture and interaction in the empirical record: However, as is the case elsewhere in Europe, no demonstrably Neanderthal-modern mixed cultures exist in the Iberian Peninsula. 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. Although it could be argued that the lack of evidence for admixture in the cultural realm contradicts the phylogenetic interpretation of the Lagar Velho 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 behaviour 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



Fig.10: Map of Europe showing areas of the last Neanderthal refugia, ca. 30,000 BP.

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 behaviour. 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 Neanderthals 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 or Dolní Vestonice 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 3,000 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 Mladec, as well as the suggestion that a genetic input from moderns explains the gracile features of the very late Neanderthals from Vindija's level G1, which have now been radiocarbon dated to ca. 29,000 BP. 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 earlier instances 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 Neanderthals were essentially absorbed by the incoming modern human populations. In this scenario, the anatomical traits inherited from Neanderthals would vanish after a few thousand years, through the operation of demographic or genetic processes that remain to be modelled.

The last Neanderthals: anatomically archaic, behaviorally modern. What the above discussion makes clear is that, regardless of the differences manifested in the archaeologically-documented features of their cultures, the contact and interaction between Neanderthals and moderns as individuals and groups was one of people versus people, not "people" (the moderns) versus "animals" (the Neanderthals). The hypothesis that moderns held some kind of biologically-based intellectual advantage that would have led to a sweeping replacement of Neanderthals, the latter having become extinct without descent, is clearly contradicted by the geographical features of the process outlined above:

- the fact that Neanderthals survived in Iberian regions south of the Ebro river until about 30 to 28,000 years ago, separated from the groups of Aurignacian moderns established north of the Pyrenees since ca. 36,500 BP by a stable frontier that lasted many millennia;
- the temporal and geographical variation from region to region that characterized the interaction process in the different parts of Europe;

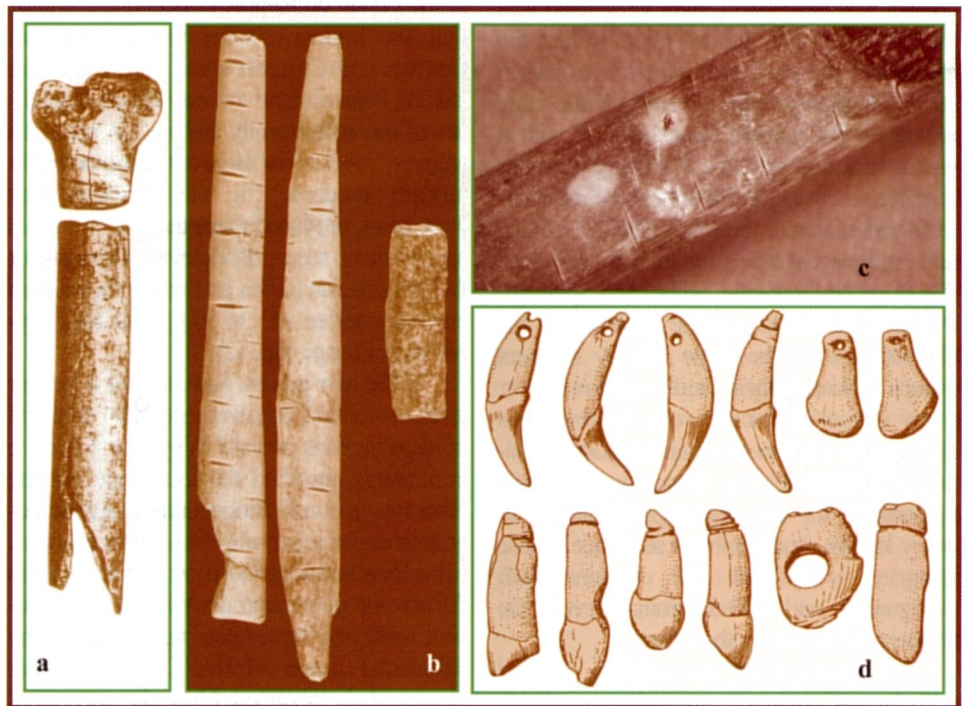


Fig.11: Châtelperronian ornaments and decorated bone tools:

a: Grotte du Renne. Bone tube of a swan's left ulna (level Xb, square A7) and its manufactured by-product (level Xb, square D11) provide unequivocal evidence of stratigraphic integrity of the levels and of local manufacture of the bone tools (not trade with or collection from Aurignacians).

b, c: Grotte du Renne. Decorated bird bone tubes and bone awls indicate that in late Neanderthal societies symbolism was not a foreign, imported behavior used without understanding but something that permeated all aspects of life, exactly as would be expected in a fully symbolic human culture (photos: Francesco d'Errico).

d: Grotte du Renne. Ornaments. Châtelperronians preferred to carve a furrow around the tooth root (a technique unknown 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 anatomical evidence for hybridization provided by the Lagar Velho child and the clues from different central European fossils of the period between 34,000 and 28,000 BP that similar processes of admixture may have occurred in those regions as well;

- the variability in lithic material culture that characterized the Neanderthal world, both before and after Aurignacian moderns entered Europe, even when, ca. 30-28,000 BP, Neanderthals seem to have become restricted to a few peripheral regions where traditions are maintained and no sign of Aurignacian influence is visible (fig. 10).

These facts show that Neanderthals were well-adapted, resilient and culturally very capable people. Instances where mutual avoidance occurred and the fragmentation of social territories and social networks eventually led to the total disappearance of local Neanderthal groups are, of course, conceivable. But the fact that there is no solid evidence for a long-term (i.e. over several millennia) contemporaneity between both human types at a local/regional scale (i.e., sharing the same territories and alternating in the use of the same sites for extensive periods of time) strongly suggests that, once contact was established, swift integration was the rule rather than the exception. In fact, the examples that have been put forward to sustain such a long-term contemporaneity in the same region do not survive close scrutiny with a taphonomical perspective. For many years, for instance, it was argued that the three instances of interstratification between Châtelperronian and Aurignacian levels reported from France (Le Piage and Roc-de-Combe) and Spain (El Pendo) represented genuine evidence of the alternate use of the same site by different groups (Neanderthals and moderns) over many millennia. Recent work, however, has shown that, in all these instances, post-depositional disturbance, not human activity, was responsible for the stratigraphic pattern. In every known stratigraphical sequence whose integrity is attested and contains both Aurignacian and Châtelperronian levels, the former always overlies the latter.

The reanalysis of these claims, coupled with the availability of new and more reliable radiometric results, has also shown that those features of the Châtelperronian which were attributed to acculturation (if not simple imitation) from contact with their modern neighbors are in fact independent cultural developments that arose among some central and western European Neanderthal groups well before moderns started to penetrate the continent. The

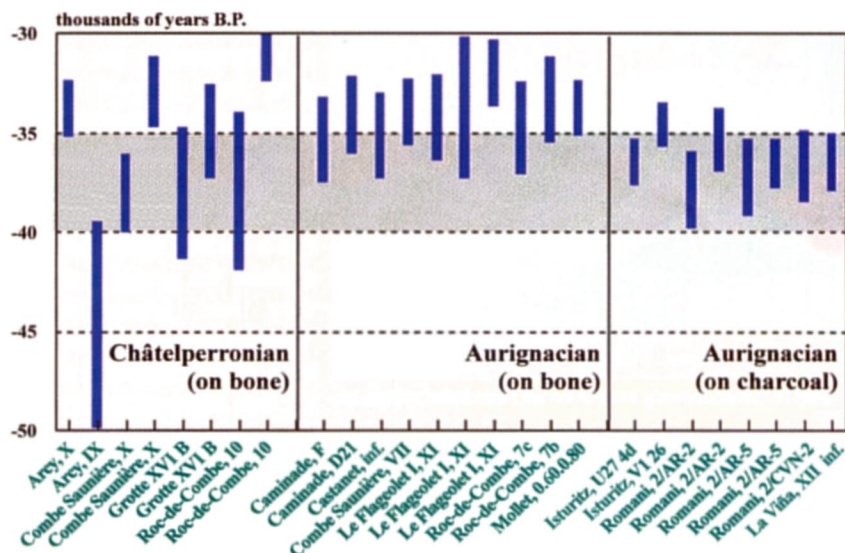


Fig.12: Chart showing ranges of AMS C-14 dates for the EUP of France and Spain, including bone samples for Châtelperronian sites; and both bone and charcoal samples for Aurignacian sites. The scatter in the dates for the Châtelperronian after 35,000 BP is due to contamination of the samples. Other samples from the same sites show that it dates to before 38-40,000 years ago, well before the Aurignacian, whose earliest occurrences in the region date to ca 36,500 years ago. Although mention is sometimes made of Aurignacian dates in the range of 36-43,000 years ago, these have been shown to correspond to instances where the dated samples in reality are not associated with the Aurignacian material they were supposed to date. Such results were excluded from this graph.

production of the numerous fine bone and ivory tools and of the abundant body ornaments recovered in the Châtelperronian levels of the Grotte du Renne, in Burgundy, France (but also known at other French, Austrian, German and Crimean sites), shows that the cultural behavior and the intellectual capabilities of the anatomically archaic Neanderthals were as “modern” as those of the anatomically modern “moderns” (fig. 11). Moreover, they were being produced more than 38,000 years ago, while no secure dating evidence exists for the Aurignacian (taken as a proxy for modern humans) before ca. 36,500 years ago anywhere in Europe (fig. 12).

If the two groups had attained a similar level of cultural achievement, why then did modern humans prevail? Why was it that the immigrants absorbed the locals and not the other way around? Biogeographic and demographic explanations may provide the answers. In the Pleistocene period, most humans lived in Africa, and population densities in that continent must also have been higher than in the periglacial fringe of the Old World that Neanderthals inhabited. Once the success of their cultural adaptation led to the crossing of critical thresholds of population density and, consequently, pushed demographically-growing groups of African moderns to enter a process of expansion into new territories, the fate of the much smaller and scattered populations of Eurasia was sealed. This has nothing to do with anatomical features or biologically-

based anatomical capabilities, it's a simple matter of numbers. All the more so if these African groups also had a higher fertility, as is commonly the case with warm climate populations of the same species when compared with those from colder climates. Given enough time, even a very small difference in fertility would put the much smaller and more scattered populations of Neanderthals at a demographic disadvantage, especially if interbreeding was common. Put another way, “moderns” prevailed not because they were “modern” but because they were African, i.e., because of their geographical origin, not because of their anatomical peculiarities.

Conclusion: Recent DNA research has shown that Neanderthals are significantly different from recent humans. From this, it has been inferred by many that they must also have been significantly different (for some, even at the species level) from the contemporary early modern humans that would have replaced them without admixture. This is an anti-evolutionist view, since it assumes that nothing changed in the genetic make-up of anatomically modern humans ever since they first arose from the original mitochondrial Eve 150,000 years ago. Since it is quite clear that evolution did not stop with the birth of Eve's children, and since it has been an established paleontological fact for about 100 years that the people who currently live on planet Earth are not Neanderthals, these DNA results contribute little to our understanding of what hap-

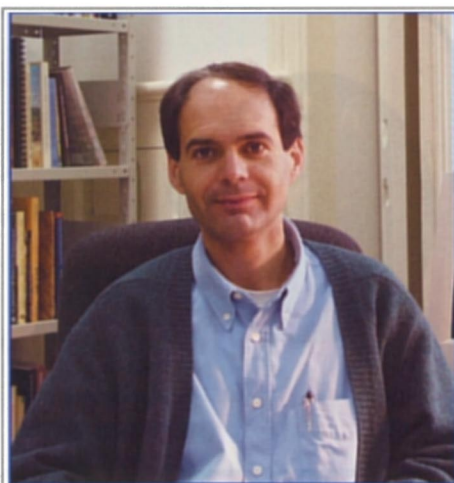
pened in that critical period between 50,000 and 25,000 years ago during which the Neanderthal phenotype disappeared. More Neanderthal samples need to be analyzed, while reliable criteria to ascertain whether the DNA of a Neanderthal that looks like a modern is contaminated or genuine need to be established. Samples of the DNA of early modern humans (so far none have been obtained) have to be used as the basis for these comparisons.

Meanwhile, the archaeological and physical anthropological features of the empirical record suggest that, in order to be productive, further work should proceed on the basis of the recognition of the following realities:

- 1) That Neanderthals fared well and for many millennia in certain parts of Eurasia before being replaced by modern groups, i.e., that, on a continental scale, there was a long-term contemporaneity between the two;
- 2) That there is no evidence of a long-lived contemporaneity on a local/regional scale between the two groups, implying
 - a) either rapid replacement with minimal cultural interaction and minimal biological admixture, perhaps as a result of a behavior of mutual avoidance, which is conceivable in the core continental areas of Eurasia;
 - b) or intensive interaction and extensive admixture, which must have been the rule in the geographical culs-de-sac that were Neanderthals' last refugia once the stable frontiers that separated them from moderns eventually collapsed;
- 3) That anatomical traits are a much better indicator of potential admixture than stone tool technology.

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