MAYBE THE NEANDERTHALS DIDN'T MAKE IT

AN ASSESSMENT OF THE DATA FROM THE CHÂTELPERRIONIAN LEVELS AT THE GROTTE DU RENNE IN ARCY-SUR-CURE, FRANCE.

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An assessment of the data from the Châtelperronian levels at the Grotte du Renne in Arcy-sur-Cure, France

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Picture front: The Grotte du Renne at Arcy-sur-Cure 2012, R. de Vries.

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INTRODUCTION

In 1939 Pierre Poulain, curator of the Musée de l'Avallonnais, discovered the Grotte du Renne at Arcy-sur-Cure, France (Figure 1). Archaeological excavations took place between 1949 and 1963 under the direction of professor André Leroi-Gourhan (David *et al.* 2001, 207). Ever since the discovery, the Grotte du Renne has played an important part in the discussion regarding the Middle to Upper Paleolithic transition because of the recovery of Neanderthal remains associated with personal ornaments such as rings, pendants made from pierced animal teeth or ivory and bone tools. The ornaments and bone tools from the Châtelperronian levels at the Grotte du Renne consist of 142 bone artefacts such as awls and 36 animal teeth that have been pierced or grooved, possibly to be used as pendants or beads. Furthermore, the excavations have yielded indications of structures built by Châtelperronian inhabitants at the Grotte du Renne although the evidence for these structures is ambiguous (Klein 2000, 31). Traditionally, the presence of personal ornaments has been used to determine the origins of modern human behaviour associated with *Homo sapiens* (or more generally, Anatomically Modern Humans) that supposedly started around 40- 50.000 years ago. A seemingly sudden occurrence of symbolic behaviour has been explained as a dramatic shift in human behaviour, also called the Human Revolution, caused by a neural mutation of the brain of AMH (Shea 2011, 3). However, the presence of symbolic artefacts associated with Neanderthals, but also finds from the Middle Paleolithic of the Near East that could have been called modern, seem to contradict the idea of a Human Revolution around 40.000 50.000 years ago (Nowell 2010, 441). Although the idea of a Human Revolution has since been widely rejected, Neanderthals as the authors for personal ornaments such as those excavated at the Grotte du Renne is still debated.

There are several components important regarding the debate on the authorship of personal ornaments from Châtelperronian contexts in general. First of all, many Châtelperronian sites have been excavated during the first half of the twentieth century. Although efforts were made to excavate carefully, many of the techniques used today did not exist at the time of these earlier excavations and many publications occurred years, sometimes decades, after the completion of the fieldwork (Harrold 2000, 66). Second, acquiring direct (radiocarbon) dates have been proven difficult, partly because the use of Accelerator Mass Spectrometry (AMS) radiometric dating has only been in existence since the eighties. The advantages of AMS are the much smaller samples size that are needed, only a few milligrams, and its use on unburned bone, opposed to traditional radiocarbon dating that needed large amounts of

charcoal. Furthermore, dating of Châtelperronian sites is difficult due to low amounts of ^{14}C left in samples because of the ~50.000 year time limit of radiocarbon dating. Samples close to the limit often have higher error rates and there exists a greater risk of contamination when taking samples or during the laboratory procedures (Talamo 2012, 2464). Third, the association of symbolic artefacts and Neanderthal remains suggest comparable cognitive abilities between Neanderthals and AMH. Central to this problem is the moment of arrival of AMH in Europe and the possible interaction between Neanderthals and AMH because of the roughly contemporaneous Châtelperronian and Aurignacian technocomplexes.

Although some have accepted Neanderthals as the makers of symbolic artefacts such as those from the Grotte du Renne, there is still debate as to why they would suddenly have started making these artefacts after an existence of nearly 200.000 years without. Because of the overlap between the Châtelperronian and the Aurignacian, some have explained this as an acculturation by Neanderthals from AMH meaning they adopted this behaviour without a true understanding what they were doing. Others propose an independent development of this behaviour by Neanderthals who felt a greater need to differentiate themselves when they came in contact with AMH, explaining why this type of behaviour has not been witnessed prior to the arrival of AMH, implying comparable cognitive abilities between the two species (Nowell 2010, 442, 444).

Presently there are two known archaeological sites where Neanderthal remains are associated with the Châtelperronian: Saint-Césaire and the Grotte du Renne in Arcy-sur-Cure. The Grotte du Renne has yielded 29 teeth which all belonged to Neanderthals and a temporal bone from the Châtelperronian levels. Despite the association of Neanderthal remains with Châtelperronian artefacts, the complex stratigraphy of the Grotte du Renne has casted doubts on the initial conclusion by Leroi-Gourhan of Neanderthals as the authors of the Châtelperronian artefacts and ornaments (Zilhão 2011, 344). Several cases of roof collapse and the sloping surface at the entrance of the cave have produced a complex stratigraphy at the Grotte du Renne. Because of this, the possibility exists the Neanderthal remains have moved up from the underlying Mousterian deposits while the ornaments have moved down from the overlying Aurignacian levels that are also present at the Grotte du Renne. This problem is further enhanced by possible digging and leveling during the Châtelperronian occupation (Bar-Yosef and Bordes 2010, 589). In addition and despite several attempts, reliable radiocarbon dates have not been obtained for the Grotte du Renne. In 2010, Higham *et al.* published a series of 31 AMS ultrafiltered dates taken from bone, antler, artefacts and

teeth spanning the Mousterian to the Gravettian. The results for the Châtelperronian levels ranged between ~21.000 and 49.000 B.P. and the authors concluded some mixing of the levels has occurred (Higham *et al.* 2010, 202362, 20239). However, in 2011 Caron *et al.* published a statistical analysis from which the authors concluded no large or small scale postdepositional displacement took place, thereby disputing the radiocarbon dates by Higham *et al.* and proposed the wide range of ages for the Châtelperronian levels is caused by incomplete sample decontamination (Caron *et al.* 2011, 1). Palynological, chronostratigraphic data and information from other Châtelperronian sites suggest a duration of about 5000 years at the beginning of the Cottés Interstadial during Oxygen Isotope Stage 3 for the Châtelperronian at the Grotte du Renne between ~38.000 ^{14}C BP and ~33.000 ^{4}C BP (Bailey and Hublin 2006, 192).

The above illustrates the general discussion regarding the status of the Châtelperronian industry as well as the specific problems to interpret the evidence from the Grotte du Renne. In this thesis, the currently available data from the Grotte du Renne has been compared and is used here to try to assess whether Neanderthals were indeed the makers of the personal ornaments found at the Grotte du Renne.

I. The geology of the Yonne region and the origins of the Grotte du Renne

Arcy-sur-Cure is situated in north-central France in the region of Burgundy between Paris and Lyon (Figure 1). The Grotte du Renne (Cave of the Reindeer) is part of a series of 15 prehistoric caves at Arcy-sur-Cure in the district of Yonne. Spanning a stretch of 800 meters, the caves are located along the bank of a large meander of the Cure, a tributary of the river Yonne, and are worn into the aureole of Jurassic limestone that frames the Morvan (Roblin-Jouve 2002, 29).

Figure 1. The location of Arcy-sur-Cure. Smaller image: location of the Grotte du Renne along the bank of the Cure (Google Maps©, 2012).

Approximately 150 million years ago a corral reef formed in the southern part of the district of Yonne that bordered on the warm, Jurassic ocean. After the sea receded erosion of the limestone started the formation of the series of caves at Arcy-sur- Cure. The predominantly North-South oriented fractions in the strata and the general dip of around 12° has allowed further erosion of the limestone by the river Cure. Underneath the surface, underground channels formed which have been further enlarged due to the corrosive nature of the water from the Cure. The corrosiveness of the water is caused by its origins in the granite of the Morvan, the felsic nature of the granite causing further erosion and contributing to the formation of the extensive karstic cave system (Baffier and Girard 1997, 245-246).

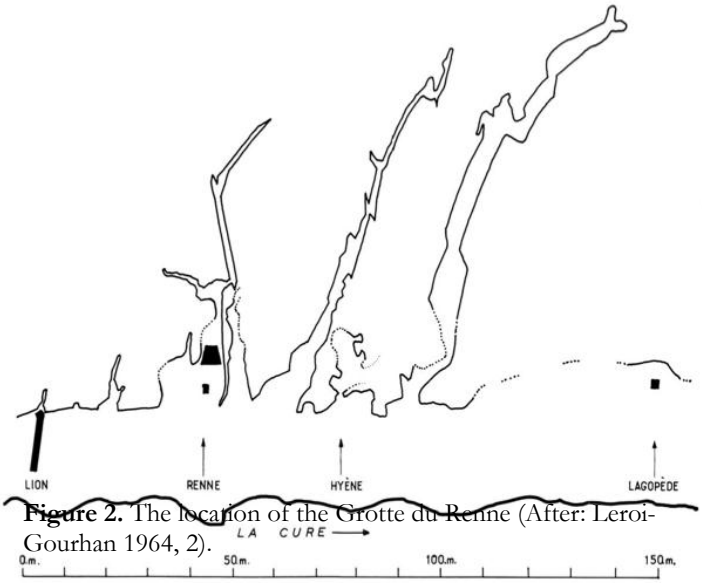

Figure 2. The location of the Grotte du Renne (After: Leroi-Gourhan 1964, 2).

The Grotte du Renne is located between the Grotte du Bison (Cave of the

Bison) and the Grotte des Ours (Cave of the Bears) at a point where the cliff retreats creating a semi-circle of 20 meters deep and 15 meter wide which has been caused by the dismantling of the cliff (Roblin-Jouve 2002, 35).

Generally speaking, the interior of the Grotte du Renne consists of two types of deposits: exogenous and endogenous. The base of the sequence (levels XVII to XIV) is made up of exogenous alluvium that originated in the Morvan by the mechanical weathering and chemical alteration of the granite and has been transported into the cave by the Cure (Roblin-Jouve 2002, 35-36).

The second sequence (levels XIII to VII) consists of endogenous deposits caused by the denudation of the rock shelter. These deposits have accumulated under the ceiling and on the slope of the cave and reach a maximum thickness of around 1,80 meter. These levels have a surface covered in limestone blocks with hardened clay lenses and occasional lamination. The presence of clay lenses is typical for the Mousterian levels at Arcy-sur-Cure. However, the surface has been reworked by anthropogenic and animal activity resulting in polishing of the limestone slabs, hardening caused by trampling and reddening of the sediments due to the addition of ochre. At different times, large slabs of limestone came down from the ceiling and walls of the cave resulting in the interstatification of levels by these slabs (Roblin-Jouve 2002, 35-36).

II. THE STRATIGRAPHY OF THE CHÂTELPERRONIAN LEVELS AT THE GROTTE DU RENNE

During the excavation led by Leroi-Gourhan between 1960 and 1963, the Châtelperronian levels spread over a surface of 62 m² with a combined thickness of around 1 meter (David *et al.* 210, 2001). The Châtelperronian levels are located between XI (Mousterian) and VII (Aurignacian). The levels containing the artefacts that have been assigned to the Châtelperronian by Leroi-Gourhan are level X, IX and VIII. In this chapter, the sedimentological composition of the Châtelperronian levels will be described as well as the stratigraphic succession of the levels X, IX and VIII.

Acquiring direct (radiometric) dates of the Châtelperronian levels has proven difficult adding to the problem of the integrity of the Châtelperronian levels at the Grotte du Renne. Therefore, part of the vertical stratigraphy was opened by David *et al.* in 1998 to determine the chronological position of level X, the level richest in Châtelperronian artefacts and human remains, whilst also giving the opportunity for new sedimentological research which will be described below. The cut made in 1998 by the team of David *et al.* is situated towards the west and the centre of the cave

(Figure 2 and 3) close to the wall that separates the Grotte du Renne and the Grotte du

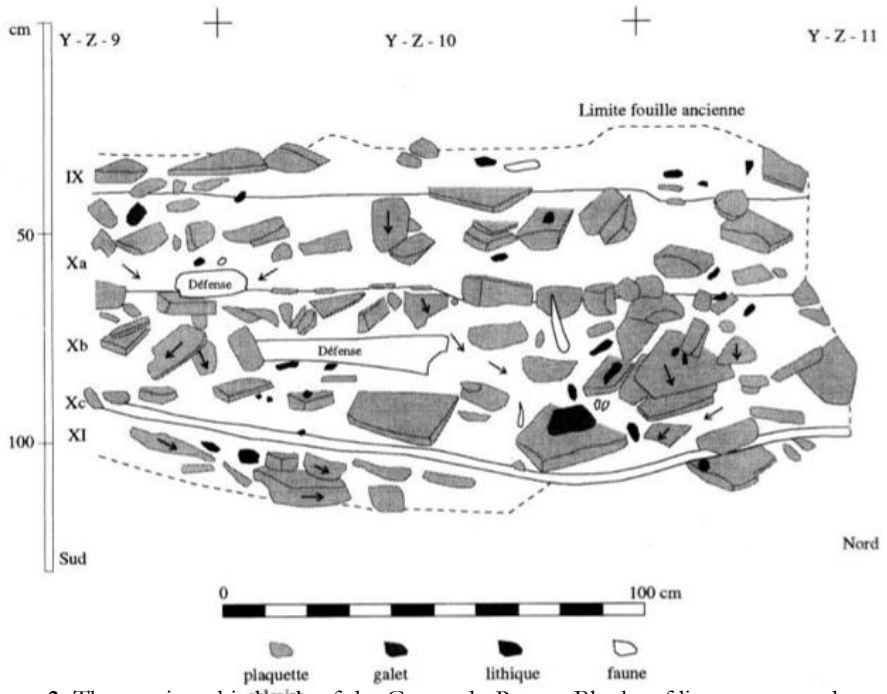

Figure 3. The stratigraphic levels of the Grotte du Renne. Blocks of limestone are shown in gray, key Châtelperronian artefacts in black and the mammoth tusks in white (David *et al.* 211, 2001)

Bison (David *et al* 2001, 210). Andre Leroi-Gourhan established the stratigraphy on the projecting ledge at the entrance where it is the thickest and most complete. David *et al.* have used the grid system from the previous excavations to establish the correlation between the stratigraphy observed by Leroi-Gourhan on the ledge and the one by the wall they opened in 1998. In this location, only level X and the four sublevels are fully represented, therefore the description of the other levels is based on the observations by Leroi-Gourhan and those of the authors (David *et al.* 2001, 210).

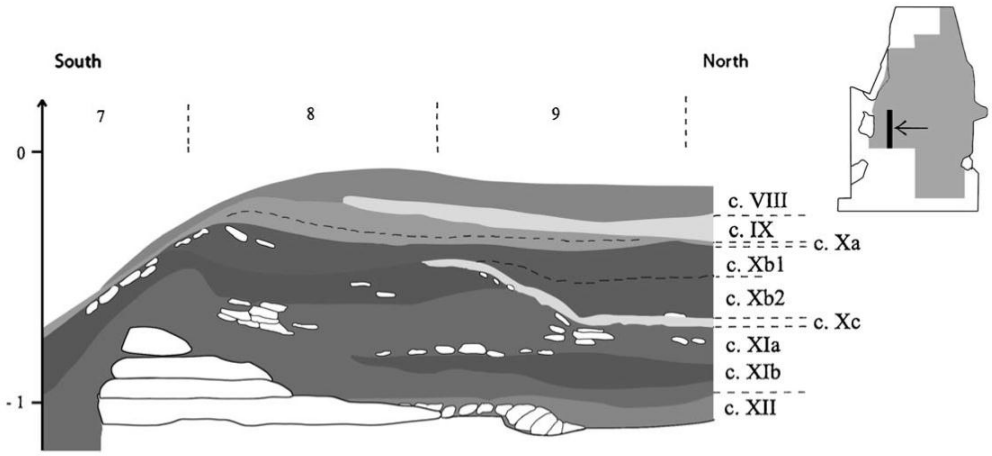

Figure 4. Stratigraphic levels at the Grotte du Renne. The small figure indicates the position of the profile (Bailey and Hublin 2006, 487).

SEDIMENTOLOGICAL COMPOSITION OF LEVELS VII-X

LEVEL VIII

The top of level VIII is made up of yellowish clay and blocks of limestone that are very blunted and worn. The stratification within layer VIII is oblique/slanted and contains exogenous and endogenous pieces of limestone. The maximum thickness is 35cm. The lower part of sublevel VIIIb is distinguished by a slightly pink colour and according to the authors, the thickness, composition and structure of the deposits have excluded intrusion from level VII (Aurignacion) into level X (Roblin-Jouve 33, 2002) (David *et al.* 2001, 217).

LEVEL IX

Level IX consists of a dark brown clay matrix with blunted limestone blocks and is rich in faunal remains. In the upper part (IXa), the clay is a light tan, which darkens towards the base from a gray-brown to a dark brown colour (David *et al.* 2001, 211).

LEVEL X

During the 1960's excavation three sublevels were distinguished within layer X: Xa, Xb and Xc. Xc being the lowest. The sublevels are each individualized by beds of limestone chips that are more or less pressed together. The 1998 excavation by David *et* al confirmed this subdivision of layer X (David *et al.* 2001, 210, 214).

XA is characterized by angular blocks of limestone, sometimes pressed together, and rest on top of a red-brown, plastic clay up to 20cm thick. The clayey layer is packed on top of a bed of blunted blocks of limestone, which marks the separation with level IX. A bed of large slabs and blocks marks the separation with XbI. Where blocks of limestone are rare or absent, layer Xa is rich in stone tools and faunal remains, including a piece of mammoth tusk found at the base of the layer but also contains two archaeologically sterile layers measuring between 5 and 7cm. Layer The 1998 excavation further divided Xa into Xa1 and Xa2 (David *et al.* 2001, 214).

XB is characterized by a high density of limestone blocks that are present throughout the whole level and differs from Xa by a slightly lumpy, sandy, brown-coloured loam. The 1950's excavation has indentified a sterile layer further dividing Xb into Xb1 and Xb2 that has not been found during the recut made in 1998. However, approximately midway through the Xb sequence a high density of blocks has been observed that could mark the distinction between Xb1 and Xb2. David *et al* have kept with this distinction and the division will be used here as well (David *et al.* 2001, 214).

XB1 consists of limestone blocks and blocks embedded in a red-brown crumbly clay with an average thickness of 20cm. Xb1 contained numerous Châtelperronian artefacts as well as a piece of mammoth tusk (David *et al.* 2001, 214).

XB2 contained limestone blocks and blocks in a brown clay matrix around 10 to 20cm thick and has yielded many Châtelperronian artefacts (David *et al.* 2001, 215).

XC is around 5cm thick, composed of dark sediment and limestone blocks are rare. Within this layer traces of ash have been found as well as some Châtelperronian artefacts, mainly burned flint (David *et al.* 2001, 215).

INTERPRETATION OF LEVELS VII-X

Level X is clearly individualized between level XI and level IX whose respective composition is that of greenish-yellow sandy-silt and dark-brown clay. The whole of level X (65cm) is characterized by large endogenous limestone blocks packed in a brown clay matrix and a layered structure. The four sublevels are also clearly distinct. Sublevel Xc is the only level where the presence of limestone blocks is rare, indicating this level predates the accumulation of the blocks that is characteristic for the rest of the level These sediments have accumulated as a result of the denudation of the roof and walls of the cave. As mentioned above, levels IX, X and XI are similar in their morphology, and their sedimentological composition is the result of the continuous dismantling of the interior of the cave. Within these levels, a series of four cycles can be recognized that correspond to the accumulation or erosion of sediments. Sand and clay mark the final stage of a cycle before the sediment is eroded completely. The first, and oldest, cycle includes level XI and Xc. The second cycle includes Xb and the greater part of Xa. The third corresponds to the rest of level Xa and the base of IX. Finally, the fourth cycle ends at the top of level IX.

Level X is the most rich in Châtelperronian artefacts, and its composition and formation has been altered by human occupation resulting in the polishing of the then occupational surface and the creation of depressions by local reworking. Furthermore, most levels from XIII and up extend onto the ledge as well as on the slope, which has a steep downward angle, creating a complex stratigraphy. On the ledge, the deposits have gradually filled a depression and from level VII and up the stratigraphy is sub horizontal. However, according to David *et al.,* the general stratigraphy has remained intact (David *et al.* 2001, 216-218).

III. DATING ANALYSIS OF THE GROTTE DU RENNE

In 1962, the archaeological sites at the caves of Arcy-sur-Cure were some of the first in Northern France to use radiocarbon dating. At this time, charcoal was the primary source used for radiocarbon dating. However, charcoal is rare in paleolithic sites and therefore the dating took place on burned bone, which is less rich in carbon. In order to carry out the anlysis, almost one kilogram of charred bone was needed. Furthermore, assumptions had to be made that all the material from the dated layer were in fact indigenous to that specific layer. In the 1980's, new radiocarbon dates were obtained with the use of Accelerator Mass Spectrometry (AMS) albeit that the materials obtained from the previous excavation were still used. In this chapter, the radiocarbon dates obtained from the Grotte du Renne are compared and will be discussed.

THE FIRST SET OF RADIOCARBON DATES FROM THE GROTTE DU RENNE

From layer VII, four radiocarbon dates were obtained that ranged between 32,000 BP and 33,860 BP and thus are homogenous. Furthermore, they seem to coincide with the age of 34,050 + / - 750 BP that has been obtained from layer D of the Grotte du Bison which has been interpreted as being contemporary with VIII at the Grotte du Renne based on their pollen content and pieces of flint that have come from the same core (David *et al.* 2001, 227).

The radiocarbon analysis of layer IX produced several unexpected ages, including one of 15.700 +/- 400 BP and one of 45.100 +/- 1200 BP. It is possible the (too young) age of 15.700 +/- 400 BP is the result of intrusive, modern organic material that has not been properly eliminated during pre-treatment of the samples. The (too old) date of 45.100 +/- 1200 BP (OxA-3465) age could have occurred due to either pollution of the sample with paraffin, which had been used during the excavation to strengthen skeletal remains or because of digging by humans in the past. During the Chatelperronian, digging has indeed taken place but excavation of the postholes has shown that they do not extent deeper then 25cm thus, they have never reached the deeper layers. Additionally, layer XII, which is positioned almost one meter below IX, did not produce ages older then 37.500 BP. The much too old date of OxA-3465 is most likely caused by intrusive organic material. The 31.500 +/- 1200 date is also problematic because it is younger then level VII (David *et al.* 2001, 227).

The dates of layer X came back between 15.350 and 33.820 BP. The only date that fell within the time period of the Châtelperronian is one of 33.820 +/- 720 BP obtained from a bone splinter in layer Xb. However, it does not fit chronostratigraphically and therefore, it has been rejected. This date is identical to the dates obtained from layer VIII, located more then 60 centimetres above Xb (David *et al.* 2001, 227).

These problematic set of radiocarbon dates casted new doubts on the integrity of the stratigraphy at the Grotte du Renne and the on association of the Neanderthal remains with the artefacts. In 1998, the team of David *et.al* collected new samples for AMS radiocarbon dating to try and resolve the above-mentioned problem. Despite taking appropriate precautions to prevent sample contamination, except from Xa, the dates came back in reverse order (Table 1.). In order to determine whether these results were caused by sample reversal in the laboratory one new date was obtained for level Xb1 resulting in an age of 33.400 ± 600 BP which is chronologically acceptable with the adjacent level Xb2. However, it did not solve the problem of the too young age for level Xc and there was not enough material left to obtain a new radiocarbon date (David *et al.* 2001, 228).

Archaeological Level and m^2	Dates BP
Renne Xa - Y 11	25.280 ± 280
Renne Xb1 - Y 10	38.300 ± 1300
Renne Xb2 - Y 11	34.450 ± 750
Renne Xc - Y II	31.300 ± 600

Table 1. Radiocarbon dates obtained from new samples (after: David *et.al.,* 2001)

A NEW SET OF RADIOCARBON DATES

In 2010, Higham *et al.* published a series of 31 AMS dates taken from bones, antlers, artefacts and teeth from levels XII to V (Mousterian till Gravettian). The dates obtained from the Aurignacian level VII provided a mean age of 34.800 ± 300 BP which is consistent with other European sites containing a similar lithic industry. The Châtelperronian dates on the other hand revealed a radiocarbon age between ~21.000 and 49.000 BP and three dates were directly comparable in age to the Proto-Aurignacian level at the Grotte du Renne. Similar to the previously obtained dates by the most problematic ages came from layer X with a range between 21.150 ± 160 and 48.700 ± 3600 BP. Of the 31 dates obtained from the Grotte du Renne around 30% were considered statistical outliers ((Higham *et al.,* 2010,

20236). Higham *et al.* have used a Bayesian model, this enables the incorporation of stratigraphic information together with the radiocarbon likilihoods obtained, within a statistical model (Higham *et al,.* 2010, 20235, S1). The use of this model will be discussed in greater detail in the discussion section. Based on the 31 radiocarbon dates the authors concluded that at least some mixing of the layers has occurred and thereby question the claim that Neanderthals are the creators of the ornaments from the Grotte du Renne (Higham *et al.* 2010, 20239).

STATISTICAL ANALYSIS

Apart from the conflicting radiocarbon dates discussed in chapter III, several other problems have been formulated regarding the homogeneity and thus the integrity of the artefact assemblage from the Grotte du Renne. Bar-Yosef and Bordes (2010), for instance raise the issue of digging and levelling by the Châtelperronian inhabitants. This could have resulted in the mixing of the underlying Mousterian level with the lower part of the Châtelperronian levels, explaining the presence of the Neanderthal teeth in these levels (Bar-Yosef and Bordes 2010, 589). Furthermore, no refitting of stone tools across levels has been carried out, adding to the questions regarding post-depositional disturbance. Finally, the artefacts from the Châtelperronian levels are common in the Early Upper Paleolithic, therefore it is conceivable that the artefacts are intrusive from the overlying Aurignacian deposits. Based on these three concerns Caron *et al.* have developed three alternatives regarding the integrity of the Châtelperronian levels:

Hypothesis 1: The Neanderthal remains are Mousterian and the personal ornaments are Protoaurignacian or later. Therefore, the Châtelperronian levels lack symbolic artefacts and the ornaments are of unknown authorship.

Hypothesis 2: The colorants and bone tools may be regarded as purely functional and are made by Neanderthals. The personal ornaments are Protoaurignacian or later so the Châtelperronian levels lack symbolic artefacts.

Hypothesis 3: The Neanderthal remains are Mousterian but the ornaments, colorants and bone tools are Châtelperronian and may have been made by modern humans (Caron *et al.* 2010, 1-2).

These three hypotheses have been used as the Null Hypotheses for a Pearson Chi square test, among other statistical analyses. Caron *et al* used the distribution of ornaments, bone tools, colorants, pigment processing tools and human teeth and compared those with diagnostic stone tools. For the Mousterian those were Levallois flakes, Chatelperron points for the Châtelperronian and Dufour bladelets for the Aurignacian (Caron *et al.* 2011, 2).

The probability that more then one item from Protoaurignacian level VII moved down into Châtelperronian levels VIII-X is <0.01. The probability of Levallois flakes having moved up from level XI into the overlying Châtelperronian levels is also <0.01. A different approach assessed whether the ornaments and Neanderthal teeth were all intrusive. For the 39 personal ornaments, the probability that one is intrusive is 0.38 with a 95% confidence level. With a 1% threshold the maximum number of ornaments that could have been displaced is 31 out of 39. For the Neanderthal teeth, this number is 24 out of 29. According to the authors, such a level of disturbance would also have been visible in the distribution of the stone tools (Supplement info Caron et al). The authors concluded that no small or large, localized or generalized postdepositional displacement took place (Caron *et al* 2011, 1).

IV. THE CHÂTELPERRONIAN AND BEHAVIOURAL MODERNITY

The controversy regarding the integrity of the Châtelperronian levels at the Grotte du Renne can be placed in a broader framework regarding behavioural modernity among Neanderthals as well as *Homo sapiens*, and the Middle to Upper Paleolithic transition. If, indeed the ornaments and bone tools from the Grotte du Renne have been made by Neanderthals then that would imply a level of behavioural complexity from Neanderthals that has not been witnessed prior to the Châtelperronian. However, this would suggest that behavioural complexity is only defined by the symbolic use of materials.

TOWARDS A DEFINITION OF MODERN BEHAVIOUR

In 2000, the influential article by McBrearty and Brooks challenged the long-held idea of a "Human Revolution" in which a behavioural breakthrough would have corresponded to increased cognitive sophistication, the manipulation of symbols and the origin of language. This would have been visible in the European archaeological record from around 40.000 years ago, during the transition of the Middle Paleolihic to the Upper Paleolithic and coincides with the arrival of AMH in Europe. McBrearty and Brooks presented a large amount of evidence to support their view that behavioural modernity in *Homo sapiens* did not suddenly arise in Europe around 40.000 years ago but developed slowly in Africa over the last 200.000 years (McBrearty and Brooks 2000, 453-454). However, this did not eliminate the problem of how to define modern behaviour and, as of today, there is no consensus on the definition of this term. Traditionally, Upper Paleolithic traditions were used as a standard for modern behaviour because of their known association with *Homo sapiens*. This has led to a list of features used to define behavioural modernity including rituals, use of organic materials, structured living spaces and personal images. McBrearty and Brooks argued these lists revealed assumptions about underlying hominid capabilities and composed a list of four characteristics for modern behaviour combined with the traces these behaviours would leave in the archaeological record (Table 2) (McBrearty and Brooks 2000, 492). However, other scholars, such as Shea (Shea 2011) argue for the complete discarding of the term behavioural modernity since it lacks analytical precision due to the fact that there is no consensus on a definition or how it can be recognized archaeologically (Shea 13, 2011). Furthermore, Shea argues that all current models regarding modern behaviour are based on the conviction that there were significant behavioural differences between the earliest *Homo sapiens* and those in existence since 40- 50.000 years ago (Shea 2011, 9).

Ecology
Range extention to previously unoccupied regions
(tropical lowland forest, islands, the far north in Europe and Asia)
Increased diet breadth
Technology
New lithic technologies: blades, microblades, backing
Standardization within formal tool categories
Hafting and composite tools
Tools in novel materials, e.g., bone, antler
Special purpose tools, e.g., projectiles, geometrics
Increased numbers of tool categories
Geographic variation in formal categories
Temporal variation in formal categories
Greater control of fire
Economy and social organization
Long-distance procurement and exchange of raw materials
Curation of exotic raw materials
Specialized hunting of large, dangerous animals
Scheduling and seasonality in resource exploitation
Site reoccupation
Intensification of resource extraction, especially aquatic and vegetable resources
Long-distance exchange networks
Group and individual self-identification through artefact style
Structured use of domestic space
Symbolic behavior
Regional artefact styles
Self adornment, e.g., beads and ornaments
Use of pigment
Notched and incised objects (bone, egg shell, ocher, stone)
Image and representation
Burials with grave goods, ocher, ritual objects

Table 2. Archaeological signatures of modern human behaviour (McBrearty and Brooks 2000, 492).

A different point of view is offered by Henshilwood and Marean (2003) who conclude that symbolic behaviour is the only type of behaviour that can be recognized archaeologically when preservation, clarity and theoretical justification are taken into account (Shea 2011, 5). Henshilwood and Marean further argue a better understanding of modern human behaviour ought to be sought in evidence of the transition from presymbolic to symbolic behaviour and in complex behavioural systems such as the construction of exchange networks (Henshilwood and Marean 2003, 636-637).

OTHER CHÂTELPERRONIAN SITES

Besides Arcy-sur-Cure, La Roche-à-Pierrot (Saint-Césaire) is the only other site where Neanderthal remains have been recovered in association with Châtelperronian artefacts (Bar-Yosef and Bordes 2008, 58). In 1979, a Neanderthal skeleton was discovered at Saint-Césaire together with Châtelperronian type stone tools, suggesting a Neanderthal authorship of this industry. A recent refit study of bone material indicates all the levels at Saint-Césaire, including the Châtelperronian levels, show a low level of mixing suggesting Neanderthals are

indeed the authors of the Châtelperronian industry at Saint-Césaire (Morin *et al.* 2005, 1084, 1097).

Another site of great importance in the debate is La Grande Roche de la Plématrie in Quinçay, France. Together with the Grotte du Renne, Quinçay is the only other site where ornaments have been recovered in association with Châtelperronian artefacts (Roussel and Soressi 2010, 203).

In 1952 the cave in Quinçay was discovered by two speleologists and in 1968, archaeological excavations started. The cave is around 20 meters deep and fifteen meters wide. Between 1968 and 1990, 20m² has been excavated. The excavation concentrated on the area at the front of the cave where the deposits have been sealed by large limestone slabs caused by downfall of the ceiling. The slabs filled the cave almost completely, leaving just a small space between the floor and the ceiling. The deposits recovered from underneath the slabs have all been assigned to the Châtelperronian. The stone tool industries at Quinçay show a clear continuation from the Mousterian of Acheulian Tradition (MTA) to the Châtelperronian. The Châtelperronian is evident by the presence of bifaces and backed knifes among others and the homogeneity of the assemblages that represent different phases of the industry (Roussel and Soressi 2010, 204-205, 217).

Between 2007 and 2010 fieldwork carried out at the Bordes-Fitte rockshelter in Central France revealed Châtelperronian as well as Middle Palaeolithic flake production. This indicates several occupational phases preserved within one stratigraphic unit. Several episodes of sediment slope-wash and endokarst dynamics are responsible for the stratigraphy and different hiatuses and erosional phases have been recognized at the Bordes-Fitte rochshelter. Furthermore, refit analysis of Châtelperronian points indicate low post-depositional degradation. The timing of the Châtelperronian occupation for this site has been set between 41.0000 and 48.0000 years ago after which the rock shelter collapsed and an erosional event started. Fieldwork is still going on at this site as well as other research (Aubry *et al.* 2012, 135).

DISCUSSION

THE INTEGRITY OF THE CHÂTELPERRONIAN LEVELS X, IX AND VIII

Above, a selection of the research conducted at the Grotte du Renne has been given. One of the biggest issues regarding the Grotte du Renne concerns the integrity of the Châtelperronian levels.

The excavation by David *et al.* in 1998 seemed to confirm the conclusions by Leroi-Gourhan; that the ornaments, stone tools and Neanderthal remains from levels IX, X and VIII were indeed indigenous to these levels and that the deposits represent an undisturbed chronology. Thus, the ornaments found at the Grotte du Renne have been made by Neanderthals indicating a form of symbolic behaviour.

However, Bar-Yosef and Bordes, argue the Neanderthal teeth from the Grotte du Renne have been dug up from the Mousterian deposits and displaced into the Châtelperronian levels by the digging of postholes and the construction of hearths during the first Châtelperronian occupation. Subsequently, the dug up deposits have been dumped at the entrance of the cave together with the Neanderthal teeth. The authors further argue the majority of the Neanderthal teeth have been recovered from the lower part of the Châtelperronian deposits, namely from Xb2 further indicating mixing of the levels. Finally, Bar-Yosef and Bordes criticize the absence of micro-morphological analysis by David *et al.* during their excavation in 1998 (Bar-Yosef and Bordes 2010, 589-590). These observations by Bar-Yosef and Bordes, however, contradict those of Bailey and Hublin (2006) who argue the Châtelperronian levels represent an undisturbed deposit and show extensive vertical development. Furthermore, the ornaments are mostly found in level Xb and not in IX directly underneath the Aurignacian level VIII (Bailey and Hublin 2006, 486-487). Based on their morphology, there is no doubt the teeth found at the Grotte du Renne belonged to Neanderthals and two teeth that likely belonged to the same individual have been found in close proximity. These results indicate limited postdepositional disturbance of the remains (Bailey and Hublin 2006, 118).

A more general problem concerning the stratigraphy of Châtelperronian sites is the observation of a widespread erosion event in the karstic regions of southwest France between Middle Paleolithic and Châtelperronian levels. Extensive erosion during the Last Glacial could have possibly resulted in the mixing of deposits (Aubry *et al.* 2012, 131) especially on slopes where solifluction has probably caused extensive movement of artefacts (Bertran *et al.* 2011, 17).

This erosional event can also be witnessed at the Grotte du Renne where the Châtelperronian occupation corresponds to the second cold phase during the Middle Pleniglacial in a periglacial environment (David *et al.* 2001, 218) possibly resulting in the extensive destruction of the interior of the Grotte du Renne that has been witnessed. Pollen has been preserved at the Grotte du Renne representing different climatic phases. At the Mousterian/Châtelperronian border the pollen spectrum indicates several cold phases followed by a relative temperate climate during the Châtelperronian (Leroi-Gourhan 1961 16), which might further implicate the association between the above-mentioned widespread erosional event and the sedimentological history of the Grotte du Renne. This association further implies the start of the Châtelperronian at the Grotte du Renne around the des Cottés Interstadial generally dated between 38.000 and 33.000 ^{14}C BP (Bailey and Hublin 2006, 192).

RADIOCARBON DATES

The 31 AMS radiocarbon dates by Higham *et al.* (2010) did not eliminate the problem of the earlier radiocarbon dates. Many did not seem to fit the chronology that had been based on the stratigraphy and the lithic industries recovered from the Grotte du Renne. However, Caron *et al.* point out that the first set of radiocarbon dates taken from the Grotte du Renne showed that only 2 out of 17 dates obtained from levels VIII-X (12%) were chronologically older then overlying Aurignacian levels. With the new results by Higham *et al.*, this changed to 62%. Furthermore, sample OxA-X-2226-7 showed a C:N ratio of 3,7 and sample OxA-X-2222-21 a ratio of 3.6 indicating addition of carbon. The Oxford Radiocarbon Accelerator Unit (ORAU) considers C:N ranges between 2.9 and 3.5 acceptable. OxA-X-2222-21 yielded an age of 23.120 ± 190 BP and OxA-X-2226-7 of 38.500 ± 1300 (Higham *et al.* 2010, 20237). Furthermore, according to Caron *et al.*, the outcome of the outlier analysis, indicating ~ 30% are statistical outliers (Higham *et al.* S1, 2010), should have invalidated the use of Bayesian modelling because stratigraphic provenance of the samples could not be taken as an indication of relative age since significant post-depositional displacement had been suggested by Higham *et al.* For example, from the two samples used to set the boundary between the Mousterian and the Châtelperronian, one of the samples (OxA-21594) was given a prior outlier probability of 25, the posterior outlier probability came back to 48. The radiocarbon analysis of this sample resulted in an age of 37.000 ± 1000 BP. This sample was used to set the Mouterian/Châtelperronian boundary and the start of the sequence. However, according to Caron *et al.,* the start of the sequence should have been the 48.700 ± 3600 BP sample

from level X because of its too old age, meaning it could only have come from the Mousterian which would have considerably reduced the number of outliers (Caron *et al.* 2011, 7).

Furthermore, of the 31 radiocarbon samples by Higham *et al.* 10 have the prefix Oxa-X meaning they have either been produced using non-routine or experimental chemical procedures or the extracted collagen are lower then or approaching the ORAU threshold (Higham *et al.* 2010, 20237). Three of these ten samples yielded high posterior outlier probabilities.

Finally, as pointed out by Jöris and Street (2008) many radiocarbon dates produced using bone collagen have yielded too young dates probably caused by contaminant carbon. Experiments with the use of ABOX-SC, acid-base-oxidation pretreatment followed by stepped combustion, have suggested the possibility of removing all contaminant carbon. With a widespread implementation of this new technique more reliable radiocarbon dates could be obtained, especially because with the use of ABOX-SC the limit of radiocarbon dating has been pushed back to 50.000 ^{14}C BP with the potential of a 60.000 ^{14}C BP limit (Jöris and Street 2008, 786).

The above suggests incomplete sample decontamination could indeed have caused the outcome of the conflicting radiocarbon dates. At the moment, new dates are being obtained by the Max Planck Institute for Evolutionary Anthropology; hopefully these new dates will improve our understanding of the time frame regarding the Châtelperronian levels at the Grotte du Renne (McPherron 2012, pers. com.).

MODERN BEHAVIOUR AND THE CHÂTELPERRONIAN

At present, it is widely accepted that Neanderthals are the authors of the Châtelperronian industry (Aubry 2012, 117). However, differences in the explanation of how they came to make the ornaments still exist. One side expresses the view of the independent development of this symbolic behaviour, for example indicated by the continuation from the MTA to the Châtelperronian at Quinçay and Bordes-Fitte as witnessed by the stone tools.

Another indication for the independent development of the use and production of bone tools comes from a comparative study of the Châtelperronian bone awls and those from the Aurignacian at the Grotte du Renne by d'Errico *et al.* (2003). This study indicated a

difference in production mode, selection of bone and intensiveness of use between these two industries (d'Errico *et al.* 2003, 267). Furthermore, comparative analyses of the ornaments from the Grotte du Renne show a difference in the production of the pendants. The Châtelperronian ornaments have been mostly produced by carving a groove around the root of the tooth, possibly so a string could be tied around it. The Aurignacian ornaments are mostly pierced (Zilhao 2011, 334).

On the other side, there are scholars who argue Neanderthals adopted this type of behaviour from *Homo sapiens*, implying Neanderthals copied the behaviour without a true understanding of what they were doing or that they traded the ornaments with AMH. This view is partly supported by the notion of 150.000 years Neanderthal existence without the production or use of bone tools or ornaments. The first evidence for the production of these types of artefacts coincides with the arrival of AMH in Europe suggesting an acculturation of this behaviour from neighbouring AMH (Floss 2003, 282). This same view is supported by Mellars (1999) who argued cognitive abilities can not be directly correlated to observed behaviour such as the production of ornaments. Mellars further argues since Neanderthals were clearly able to create complex Levallois points or cordiform hand axes from difficult material such as flint, they would most certainly be able to copy the techniques observed from AMH (Mellars 1999, 351). However, in a response to Mellars paper discussed above, Otte (1999) presents a different view. In historical contexts, the incorporation of elements from both the 'new' as well as from the 'native' populations has been observed together with a need to differentiate oneself from one another. According to Otte, when AMH and Neanderthals met this resulted in the Châtelperronian produced by Neanderthals as they felt the need to express themselves culturally when their territories became smaller and when they were trapped against the Atlantic Ocean (Otte 1999, 352).

The above briefly summarized the fast amount of research and the lack of consensus on the subject of behavioural modernity between AMH and Neanderthals. Despite the absence of symbolic behaviour among Neanderthals there are many factors indicating their capacities for this behaviour. From the ethnographic record it has become clear symbolic behaviour does not always leave archaeologically visible traces (Conard 2006, 8). Furthermore, differences in excavation techniques and preservation bias could also account for a seeming lack of symbolic behaviour (Shea 2011, 5). According to Shea (2011) instead of focussing on behavioural modernity current research should focus on strategic sources of variability in human behaviour (Shea 2011, 12). This notion by Shea can be further exemplified by a paper

from Sandgathe *et al.* (2011) who argue Neanderthals occasionally lost the technology to produce fire, especially during colder phases. According to the authors, a lack of fuels to produce fire during colder phases has not occurred, so the explanation for the missing traces of fire must be sought elsewhere. While evidence for the use of fire by AMH is widespread, evidence for the use of fire by Neanderthals is often missing. This could possibly have resulted from the adaptive advantages Neanderthals had over AMH in the colder regions of Europe due to their smaller bodies and their adaptiveness to cold climates acquired during their long existence in these climates (Sandgathe *et al.* 2011, 217, 233, 234). Perhaps, when Shea's notion of strategic variability is applied to the lack of fire use during especially cold phases an alternative explanation can also be sought in a strategic choice made by Neanderthals. During colder phases, food resources would have been scarce, meaning a higher amount of energy was needed to gather and hunt enough food to stay alive. This raises the possibility of a strategic choice made by Neanderthals between the energy needed to start and maintain a fire and to acquire food. Furthermore, zooarchaeological analysis by Rendu (2010) suggests Neanderthals adapted their hunting choices and strategies according to the environmental circumstances to optimize their exploitation of resources (Rendu 2010, 1808). This example further illustrates the ability of Neanderthals to adapt to their environment, suggesting the production of personal ornaments could have been the result from the contact between Neanderthals and incoming AMH.

CONCLUSION

Although the stratigraphy of the Châtelperronian levels at Grotte du Renne is complicated, the general chronology of the levels seems intact based on their differing composition, the pink colour of the lower part of level VIIIb and the dark brown colour of underlying level IX suggesting two well distinguished levels. Moreover, the overall thickness, composition and structure of level VIII has excluded intrusion from level VII, the clearly individualized nature of level X between IX and XI: the composition of level X is that of a dark brown clay matrix with limestone blocks compared to level XI that is greenish-yellow and sandy-silt and level IX with a dark brown clay. Furthermore, although it is very plausible some artefacts have been displaced due to postdepositional processes, it is highly unlikely all the finds from the Châtelperronian levels originated in other levels especially with regards to the outcome of the statistical analysis indicating most of the artefacts have been recovered *in situ*. This is further strengthened by the recovery of the majority of the ornaments from level Xb and not from level IX, which is directly underneath Aurignacain level VII and the association of two Neanderthal teeth that have been found in close proximity and likely belonged to the same individual.

Despite the contradiction between the radiocarbon dates and the chronology derived from the stratigraphy, these results could have been caused by incomplete sample decontamination combined with the general difficulties of radiocarbon dates obtained on samples close to the time limit of the this method because of higher error rates in the results and a higher risk of contamination by modern carbon, either during sampling or during the laboratory procedures. Also, the discovery of Châtelperronian technocomplexes, including ornaments, at Quinçay where these deposits have been sealed by large limestone slabs, the Saint-Césaire skeleton associated with Châtelperronian artefacts and the recent bone refit analysis at the Bordes-Fitte rockshelter with Châtelperronian levels, which suggested low amounts of postdepositional displacement. Combined, this leaves little doubt for the existence of the Châtelperronian technocomplex as well as Neanderthals as the authors of personal ornaments which implies a symbolic component to their material culture.

Regarding the cognitive capabilities of Neanderthals and the possibility of acculturation from AMH, there are several indications for the high adaptability of Neanderthals, which could explain why the sudden occurrence of symbolic behaviour of Neanderthals coincides with the arrival of AMH in Europe as it is plausible this behaviour was a response to incoming

AMH. The loss of territories could have resulted in increased pressure and a greater need of differentiation from AMH.

One of the biggest problems concerning the Grotte du Renne is probably not the amount of data but the different interpretations of the same data. Whereas some scholars view the above mentioned as ambiguous, other scholars perceive it as being conclusive. Although there are several ambiguities regarding the evidence, especially regarding possible postdepositional displacement, it seems as if the majority of the data points towards the integrity of the Châtelperronian levels at the Grotte du Renne as outlined above which leads to the conclusion that Neanderthals are the authors of the personal ornaments.

SUGGESTIONS FOR FUTURE RESEARCH AND ANALYSIS

Statistical analysis, when used correctly, as well as other objective techniques could improve the reliability of the data and increase our understanding of the formation of the Châtelperronian deposits and their chronological position. Furthermore, to gain a better understanding and to diminish ambiguous evidence a goal should be to discover new sites and to carry out new excavations, preferably with the use of a protocol in order to achieve a standardized dataset so data can be compared, not just from Châtelperronian sites but also from contemporary European sites. Refit studies of stone tools or bone material as well as comparative analysis could also enhance the reliability of the dataset.

ABSTRACT

Ever since its discovery, the Châtelperronian levels of the Grotte du Renne have been the subject of extensive debate. The excavations directed by André Leroi-Gourhan at the Grotte du Renne have yielded Châtelperronian type stone tools as well as symbolic artefacts such as pendants and pigments. The association of these finds together with multiple Neanderthal teeth and a temporal bone, led to the conclusion by Leroi-Gourhan Neanderthals were the makers of the Chatelperroian artefacts, including the ornaments. The ambiguity of this association is caused by the complex stratigraphy of the Grotte du Renne due to phases of extensive destruction of the interior of the cave due to the karstic nature of the region. Furthermore, symbolic artefacts have traditionally been associated with *Homo sapiens* and the Upper Paleolithic. These factors have led some to conclude the Neanderthal teeth have moved up from the Mousterian levels and the ornaments down from the Aurignacian levels, which are also present at the Grotte du Renne, Conflicting radiocarbon dates have not solved this problem.

In this thesis, the available data from the Grotte du Renne has been assessed which has led to the conclusion the majority of the finds have been recovered *in situ*. Therefore, the ornaments from the Grotte du Renne have been made by Neaderthals indicating a symbolic aspect to their material cultre and the integrity of the Châtelperronian levels at the Grotte du Renne.

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