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Who made the Early Aurignacian? A Reconsideration of the Brassempouy Dental Remains

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S. E. Bailey et J.-J. Hublin

Who made the Early Aurignacian? A Reconsideration of the Brassempouy Dental Remains

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1 Henry-Gambier *et al.* (2004) have recently described a number of human remains (primarily teeth) originally excavated by H. Delporte (1981-1996) from the site of Brassempouy (Landes). The levels from which the remains originate have been dated to an important time period between 30,000 and 34,000 ^{14}C years B.P. and the fossils are associated with an early Aurignacian tool industry[2]. Human remains from this time period are rare, and have been made even rarer now that some specimens have been re-dated to be much younger (*e.g.*, Vogelherd) (Conard *et al.* 2004). With the exception of Mlade™, which includes cranial, dental and postcranial elements (Wild *et al.* 2005) dating to ca. 31,000 B.P., the remaining human fossils securely associated with the Aurignacian are, for the most part, undiagnostic and/or poorly dated (see Churchill, Smith 2000 for a recent review). This has led some authors to conclude that we have little basis for assuming that anatomically modern humans were the makers of the Aurignacian (*e.g.*, Conard *et al*. 2004), at least of its earliest phases. For this reason, it is especially important to review, and to analyze carefully the dental characteristics of the specimens from Brassempouy, a carefully excavated and well-dated site indisputably early Aurignacian, to see what light they can shed on the taxonomic affiliation of the hominins they represent.

2 We agree with Henry-Gambier *et al.* (2004) that Neandertals and anatomically modern humans share a number of dental non-metric traits with which they differ primarily in trait frequencies, ("*Tous les traits qui leur sont attribués existent, avec des fréquences variables, sur les dents des populations d'anatomie moderne fossiles et actuelles.*", Henry-Gambier *et al.* 2004: 78). We also agree that analyses based on complete dental specimens may provide the most powerful taxonomic assessment. However, we disagree with their statement that Neandertals do not possess diagnostic dental traits ("*En ce qui concerne les dents, les Néandertaliens n'ont pas de trait morphologique spécifique*", Henry-Gambier *et al.* 2004: 78) and their conclusion that one cannot determine the taxonomic affinity of a sample based solely on isolated teeth. To the contrary, Neandertals show a unique

3 dental pattern when considering the entire dentition, and also have several teeth that, in isolation, show traits and/or combinations of traits that would allow one to accurately identify a Neandertal based on a single tooth (Bailey 2002a, 2004; Bailey, Lynch 2005).

4 Although we were not given permission to examine the specimens after their publication, we have reviewed the photographs and descriptions of the permanent teeth from Brassempouy published by Henry-Gambier *et al.* (2004). We have found that all of these teeth have traits, and/or combinations of traits that are consistent with anatomically modern human morphology and that none exhibit the combinations of traits that are diagnostic for Neanderthals (see below). On the basis of this evidence, we conclude that the dental remains from Brassempouy are strongly affiliated with anatomically modern humans.

5 Bailey (2002a, b, 2004) and Bailey, Lynch (2005) have outlined several diagnostically Neandertal traits including those found on the 1. maxillary incisors (I^{12}) (see also Mizoguchi 1985; Crummett 1995), 2. maxillary first molar (M^1), 3. mandibular second premolar (P_4) and 4. mandibular molars (M_{123}). Because our assessment of the Brassempouy teeth is based on the published photographs and morphological descriptions (the specimens themselves and original photographs were unavailable), and because no standards were used for scoring the morphology (*e.g.*, Arizona State University Dental Anthropology System—ASUDAS; Turner *et al.* 1991), occasionally we found it difficult to confirm the descriptions of the morphology.

Therefore, when a tooth is described as having "marked marginal crests" we cannot be sure if what is meant by "marked" is what we would consider to be "marked," based on the ASUDAS standard. We hope to be able to clarify any ambiguities by examining the original specimens when they are made available for study.

6 Setting aside questions about the precise meanings of the anatomical descriptions, perhaps the most productive way to address this issue is to go through the sample tooth by tooth. We refer only to the permanent teeth because the wear on the deciduous teeth has obliterated the occlusal morphology and we are not confident in making any assessment based on the descriptions.

7 Henry-Gambier *et al.* (2004) correctly conclude that the Brassempouy I^1s (teeth 1046 and 2206) lack the strongly expressed shovel shape that characterizes nearly all Neandertal maxillary incisors (*fig. 1*). Yet, because one may occasionally find a Neandertal that also shows only a moderate expression of this character (*e.g.*, the I^1s of Le Moustier 1), they conclude that nothing can be said regarding their taxonomic affinity. It may be true that the lack of marked shoveling in the Brassempouy I^1s does not mean that they *must* be from an anatomically modern human. However, if one considers the complete crown morphology (*e.g.*, the lack of shoveling, lack of labial convexity, and lack of any well-developed lingual tubercles) it is clear that the I^1s should be assigned to anatomically modern humans. This conclusion is also supported by the presence of very short roots (8 mm and 10 mm), which fall outside the range of variation for Neandertals and are more than three standard deviations below the Neandertal mean (*table 1*).

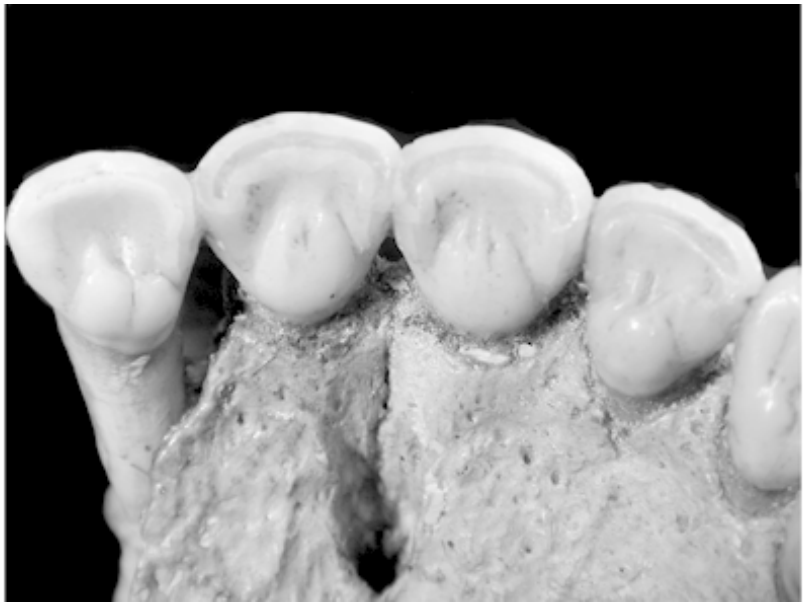

Fig. 1—Type of shovel shaping typically found in Neandertals (Krapina Maxilla E).

Fig. 1 - Morphologie « en pelle » typiquement rencontrée chez les Néandertaliens (maxillaire E de Krapina).

Group	I^1	C^1	M^2
Brassempouy*	8; 10	17	11
Neandertals	17.5 (1.2) 15.7-19.7 n = 13	22.0 (2.1) 18.1-26.2 n = 15	15.5 (1.7) 13.6-17.9 n = 8
Upper Paleolithic and contemporary modern humans	12.4 (1.5) 11.7-15.2 n = 11	15.1 (1.7) 12.5-17.7 n = 6	13.2 (1.7) 11.8-15.6 n = 10

Table I—Relevant root length data (mean, standard deviation and range) in mm.

Tabl. I - Données sur la longueur des racines en mm (moyenne, écart-type, intervalle de variation). *Note: Brassempouy root lengths were derived by scanning the photographs from Henry-Gambier et al. (2004) into SigmaScan Pro, calibrating from the scale in each photograph and measuring the lingual root. While they are estimates, they should not differ much from the actual length. Comparative samples are from Bailey unpublished data.

8 The I^2 (tooth 262) is described by Henry-Gambier *et al.* (2004) as having a marked lingual tubercle and marked marginal crests together with a deep lingual fossa. However, without the use of a standard (*e.g.*, the ASUDAS) it is difficult to assess exactly what this use of "marked" means. We note that the co-occurrence of marked shoveling (as in ASUDAS grade 3-6), lingual tubercle development (as in ASUDAS grade 2 or above), and labial convexity (as in ASUDAS grade 2 or above) such as shown in figure 1 occur as a shape-complex in approximately 94% of Neandertals. What distinguishes Neandertals from anatomically modern humans is the occurrence of the combination of these traits, not the occurrence of any one of these traits alone. While the Brassempouy I^2 may exhibit some marginal ridge and lingual tubercle development, it appears to lack the combination of features (especially labial convexity) that typifies nearly every Neandertal. In that sense, it is anatomically modern in its morphology.

9 With regard to the P_4, while it is true that the complexity of the occlusal surface ("replis d'émail", Henry-Gambier *et al.* 2004: 68) is one of the key characters that distinguish Neandertals from anatomically modern humans, it is important to note that this tooth also shows in Neandertals a unique combination of traits that has not been observed in anatomically modern humans. In fact, the P_4 is perhaps the most diagnostic of Neandertal teeth. It typically presents 1) an asymmetrical occlusal outline, with 2) a well-developed, mesially-placed lingual cusp (metaconid) that is 3) attached to the buccal cusp (protoconid) via an uninterrupted crest

(transverse crest). Not all Neandertals have all three of these traits but approximately 95% possess at least two (Bailey 2002a), and none have been found that lack all three traits. In anatomically modern humans the presence of two of these traits is rare (up to 4% in some populations) and we have not yet found any anatomically modern humans that possess all three in the same tooth.

10 In contrast, the P_4s described by Henry-Gambier *et al.* (2004) (teeth 16 and 3040) appear to be anatomically modern in their morphology. Unlike any Neandertals known so far, tooth 16 1) lacks a well developed metaconid, 2) is symmetrical in occlusal outline, and 3) lacks a transverse crest. This configuration is common in P_4s of anatomically modern humans (33% in Upper Paleolithic modern humans, and 10-60% in contemporary populations) and is absent in Neandertals. In our opinion, the likelihood that this tooth came from anything but a modern human is very low. Tooth 3040 is more difficult to assess from the published photograph. While we cannot determine the cusp and fissure pattern, we do note that the crown outline is symmetrical, which is typical of anatomically modern humans.

11 It is unclear why Henry-Gambier *et al.* (2004) state that with regard to mandibular premolars "*Dans les populations néandertaliennes et dans celles de Qafzeh-Skhul, les dents à deux cuspides dominent*" (Henry-Gambier *et al.* 2004: 68) unless they are referring only to the P_3. In P_3 the two-cusped condition (that is, having only one lingual cusp) does, in fact dominate in Neandertals, early and Upper Paleolithic modern humans (80% in Neandertals, 83% in Qafzeh/Skhul, and 93% in Upper Paleolithic modern humans; Bailey 2002b). However, given that both Brassempouy premolars (teeth 16 and 3040) are described as P_4s, the frequency of multiple lingual cusps in P_3 would seem irrelevant. The two-cusped condition in the P_4, however, is much less frequent. The presence of multiple lingual cusps in P_4 is very high in Neandertals, ~ 90%. In anatomically modern humans it is lower but still relatively high (~ 67% in Qafzeh/Skhul and ~ 44% in Upper Paleolithic modern humans). Given these trait frequencies, it would appear that the presence of multiple lingual cusps on tooth 3040 has little diagnostic value by itself. As was the case with the maxillary incisors, we feel it is the combination of traits *in a single tooth* that is important, not the presence or absence of a particular trait (in this case the presence of multiple lingual cusps).

12 We also note that permanent mandibular molars are also diagnostic for Neandertals (especially M_2 and M_3). Aside from differences in trait frequencies, such as Cusp 6 and Cusp 7, typically (~ 90% of the time or more, depending on molar position) the tooth possesses a well-developed, uninterrupted crest that connects the two mesial cusps (mid-trigonid crest) (Bailey 2002a, b). The complete permanent M_2 (tooth 884) described by Henry-Gambier *et al.* (2004) lacks this character, and thus appears quite modern. The small anterior fovea is also more consistent with anatomically modern, rather than Neandertal, morphology. The second M_2 (tooth 1930) is only partially preserved. However, it too clearly lacks the mid-trigonid crest, aligning it more closely with anatomically modern humans.

13 Regarding the permanent three-cusped M^2 (tooth 542), we believe there has been some confusion in the interpretation of a table of M^2 traits in Bailey (2002b, table 5.20). Henry-Gambier *et al.* (2004) cite this work, stating that three-cusped M^2s have been observed in Neandertals (*"Des secondes molaires à trois cuspides ont cependant été décrites.* Henry-Gambier *et al.* 2004: 68"). However, this table lists frequencies for M^2 hypocone *reduction* not absence. Of the Neandertals in this study, two (n = 33) show hypocone reduction (ASUDAS grade 2) and none show hypocone absence (*i.e.*, three-cusped M^2). Of the teeth showing hypocone reduction, one is from Kebara and the other is from Vindija. The other reference made to three-cusped M^2 in Neandertals by Henry-Gambier *et al.* (2004: 68) refers to the Vindija sample (Wolpoff *et al.* 1981). There are two M^2 in the Vindija sample, tooth Vi 229 is described as having moderate hypocone development (Wolpoff *et al.* 1981: 520). The other tooth, Vi 259, does have a reduced hypocone although it is still present (*fig. 2*). Perhaps the "three-cusped" M^2 at Brassempouy actually has a small hypocone that we cannot detect from the photograph, and there is some confusion in the use of the term "three-cusped". If that is the case and the authors are really referring to hypocone reduction, not absence, the frequency of

M^2s with hypocone reduction is more than twice as high in Upper Paleolithic modern humans (15%, n = 20) than in Neandertals (6%, n = 33). Finally, a comparison of root lengths shows that the length of the lingual root of the Brassempouy M^2 (~11mm) is outside of the range observed in Neandertals and more than 2.5 standard deviations below their mean (*table 1*). The combination of these traits (hypocone reduction/absence and short roots) makes it very improbable that the tooth belongs to anything other than an anatomically modern human.

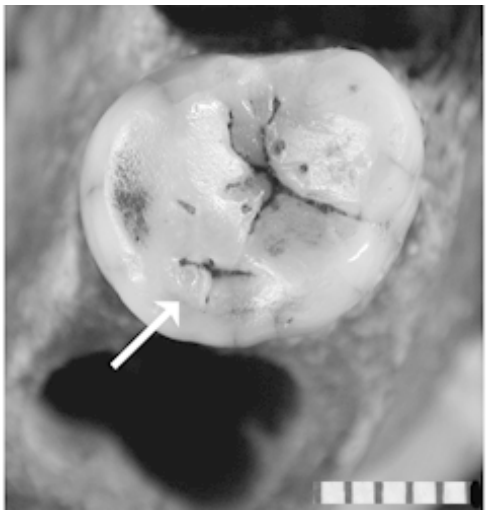

Fig. 2—The Neandertal M^2 from Vindija (Vi 259). Arrow points to the reduced—not absent—hypocone.

Fig. 2 - La M^2 néandertalienne de Vindija (Vi 259). La flèche indique la réduction (mais non l'absence) de l'hypocône.

14 As regards the maxillary canine (tooth 441), we believe there may have been a misinterpretation of a table in Bailey (2002b, table 5.9). The "canine mesial ridge" referred to in this table does not refer simply to the development of the mesial lingual ridge. Rather, the canine mesial ridge refers to a mesial lingual ridge *that attaches to a lingual tubercle* (also referred to as the Bushman canine, see Bailey 2002b Appendix A). This trait occurs in relatively high frequencies in Neandertals (45%) but is not observed on the Brassempouy specimen. In addition, root length of ~17mm for this canine is more than two standard deviations below the Neandertal mean and outside their range. However, it is within the range observed in the modern human sample (*table 1*). Finally, we are unsure about the strong lingual tubercle ascribed to this tooth because the photograph published by Henry-Gambier *et al.* (2004) does not seem support this statement. Figure 3 provides an example of what we would consider a "strong" lingual tubercle (as in ASUDAS grade 4 or above), commonly found on Neandertal maxillary canines.

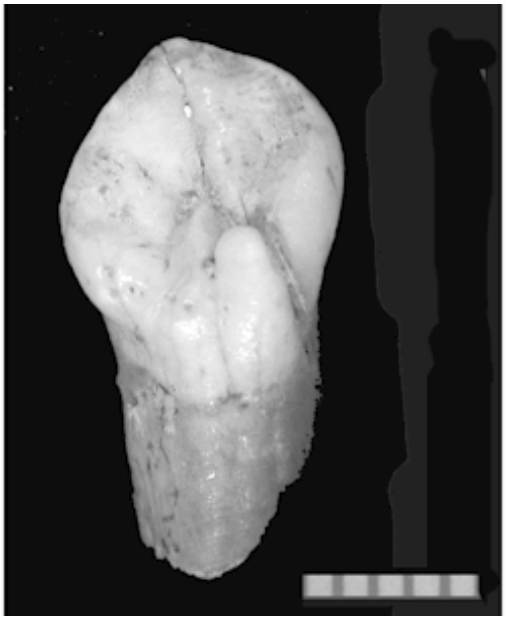

Fig. 3—Neandertal maxillary canine (Hortus) showing a 'marked' lingual tubercle (ASUDAS, grade 4).

Fig. 3 - Canine maxillaire néandertalienne (l'Hortus) montrant un tubercule lingual « marqué » (ASUDAS, grade 4).

15 Finally, a significant portion of Henry-Gambier *et al.* (2004) assessment of the taxonomic affiliation of the Brassempouy teeth is based on comparative metrics. Their main point is that for most teeth the metric values can be accommodated for within the variation of fossil and/or recent anatomically modern humans, as well as Neandertals. We agree. There is extensive overlap between Neandertals and Upper Paleolithic modern humans in postcanine dental metrics, and the only metric value that distinguishes these two is the relative size of the anterior teeth (incisors) to posterior teeth (Bytnar *et al.* 1994; Stefan, Trinkaus 1998). Even the anterior teeth show a great deal of overlap in the middle of their respective ranges. The Henry-Gambier *et al.* (2004) metric analysis simply serves to reinforce the fact that dental crown metrics are a poor way to work out the taxonomy of Mid-Late Pleistocene hominins. To present a case in point, the recently described early anatomically modern human from Oase (Oase 2) has maxillary molar metrics (Trinkaus *et al.* 2003) that are better accommodated in the variation of *Homo erectus* than anatomically modern humans (Bailey, unpublished data). We suggest that root lengths are more informative. Although root lengths are not provided by Henry-Gambier *et al.* (2004), we have estimated them from the published photographs. In each case the root length is below the range observed in Neandertals and at least two standard deviations from their mean (*table 1*).

16 Henry-Gambier *et al.* (2004) conclude that the taxonomic affinity of the human remains from Brassempouy is problematic. We disagree. While we accept that there is individual variation within samples, it does not follow that taxonomic affinity cannot be assessed based on isolated teeth. The teeth at Brassempouy may not necessarily come from the same individual, but they do represent a sampling from the population. Certainly it is true that not all Neandertals have all of the diagnostic characters that have been described (Bailey 2002, 2004; Bailey, Lynch 2005), however, when one assesses the complete sample and focuses on trait combinations, rather than on single traits, a clear picture emerges. In the Brassempouy sample, there is a complete absence of any of the diagnostically Neandertal traits and trait combinations identified by Bailey (2002a, b; Bailey, Lynch 2005). And some teeth (*e.g.*, teeth 16, 542) possess trait-combinations that are found in anatomically modern humans but not in any of the 30 or more Neanderthals observed. This should be considered significant. In no respects is there any reason to suspect that the teeth belonged to Neandertals. Thus, we believe that, *contra* Henry-Gambier *et al.* (2004), the teeth discovered at Brassempouy are clearly affiliated with anatomically modern humans.

17 The statement that *"Il est donc impossible de déterminer les affinités d'un groupe humain à partir de dents isolées"* (Henry-Gambier *et al.* 2004: 78) is misleading. If we made the same claim about cranial specimens (*i.e.*, we can only use complete specimens) we would have to throw out much of the data on fossil hominins. In fact, we have recently shown conclusively that Neandertals are associated with the Châtelperronian tool assemblage at Arcy-sur-Cure based solely on isolated teeth (Bailey, Hublin in press). While a temporal bone preserving Neandertal-like inner ear morphology supports our conclusions (Hublin *et al*. 1996), the same conclusions could be made based on the isolated teeth alone.

18 The taxonomic affinity of the makers of the early Aurignacian has been debated, with a growing consensus that we cannot draw conclusions based on the present evidence. This is largely a result of the fragmentary nature and scarcity of the human fossils associated with this tool complex and of the confusion surrounding the definition of the European early Upper Paleolithic assemblages themselves. Brassempouy is one of the rare sites containing human fossils clearly associated with the early Aurignacian that are well enough preserved and dated so as to provide an indication of their taxonomic affinity. We have shown that the Brassempouy teeth are anatomically modern in their morphology. Therefore, *Homo sapiens* is still the only species demonstrably associated with the early Aurignacian [1]. And until shown otherwise, we should dismiss the notion that we do not know who made the Aurignacian. The weight of the available evidence points to anatomically modern humans.

Acknowledgements

19 We thank the editors of *BMSAP* for allowing us to present our assessment of the dental remains from Brassempouy. We also thank the two anonymous reviewers who provided helpful comments on the original manuscript.

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Notes

1 We are aware that some feel that the I^1 from level E of La Ferrassie is Neandertal-like in its morphology and robusticity (*e.g.*, Garralda, Vandermeersch 2004). However, this tooth is clearly modern in its morphology. While it possesses moderately expressed lingual tubercles it lacks the labial convexity and marked shoveling that is so typical of Neandertal I^1. Its root is also very short and, like the Brassempouy I^1s, its length is below the range observed in Neandertals.

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Résumés

Qui est l'artisan de l'Aurignacien ancien ? Ré-examen des restes dentaires de Brassempouy

Les restes dentaires humains aurignaciens anciens de Brassempouy (Landes) ont été récemment décrits par Henry-Gambier et al. (2004). Nous proposons un ré-examen critique des caractères qui ont conduit ces auteurs à une interprétation taxonomique incertaine de ces restes. Bien que les travaux de l'un d'entre-nous (S.B.) aient été en partie utilisés et cités par Henry-Gambier et al. (2004), nous sommes en désaccord avec les conclusions qui en ont été tirées. De notre point de vue et considérant les données disponibles, les restes dentaires de l'Aurignacien ancien de Brassempouy sont sans ambiguïté anatomiquement modernes. Ils apportent en fait de nouveaux arguments à la thèse suivant laquelle les artisans de l'industrie aurignacienne ancienne étaient bien les premiers Européens modernes.

The dental human remains from the early Aurignacian layers of Brassempouy (Landes) have been recently described by Henry-Gambier *et al.* (2004). We provide a critical re-assessment of the features that have led these authors to conclude that the taxonomic status of these fossils is uncertain. Although the works of one of us (S.B.) have been partly used and cited by Henry-Gambier *et al.* (2004), we disagree with the conclusions that have been drawn from them. In our view and based on the available evidence, the early Aurignacian dental remains from Brassempouy are unambiguously modern in their anatomy. They indeed provide further evidence that the makers of the ancient Aurignacian were early anatomically modern Europeans.

Index

Mots-clés : Aurignacien, dents, homme moderne, Néandertaliens
Keywords : Aurignacian, Modern Humans, Neandertals, teeth