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AN AURIGNACIAN «GARDEN OF EDEN» IN SOUTHERN GERMANY ? AN ALTERNATIVE INTERPRETATION OF THE GEISSENKLÖSTERLE AND A CRITIQUE OF THE *KULTURPUMPE* MODEL

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Abstract : New radiocarbon dates and results of new analyses from Geissenklösterle (Conard and Bolus JHE, 40: 331-71) were recently used to suggest that the Aurignacian of the Swabian Jura dates back to 40 ka BP and that this evidence supports the *Kulturpumpe* model according to which cultural innovations of the Aurignacian and Gravettian in Swabia predate similar developments in the remainder of Europe. Here we conduct a critical analysis of new and old evidence, discuss the relevance of Conard and Bolus's hypothesis of a "Middle Paleolithic Dating Anomaly" to explain inconsistencies in the ^{14}C determinations for Geissenklösterle, and conclude that the earliest Aurignacian occupation of this site does not predate ca 36.5 ka BP and probably took place between 35 and 33 ka BP. This interpretation is consistent with what we know about the taphonomy and environmental context of the site, with the technology and typology of the bone and lithic assemblages from its Aurignacian levels, and conforms well to the ^{14}C dates on faunal remains modified by humans found therein. This interpretation is also consistent with the pattern of radiocarbon dates for the Aurignacian as a whole suggesting that the emergence of this technocomplex dates to ca 36.5 ka BP ; that the process appears to our eyes as simultaneous is to be expected in the first place due to the poor resolution of available dating methods. Modern behavior as inferred from the use of objects of personal ornamentation is documented in the Châtelperronian and the Initial Upper Paleolithic of the Levant; both predate the Aurignacian chronometrically and stratigraphically. The emergence of the Aurignacian and of modern behavior in Eurasia were considered for a long time as one and the same problem, but it is now clear that these are two independent issues that must be considered separately.

Key-words : Aurignacian, ^{14}C dating, behavioral modernity, anatomically modern humans.

Résumé : ***Un Jardin du Paradis aurignacien en Allemagne du Sud ? Une inteprétation alternative de la séquence de Geissenklösterle et une critique du modèle de la Kulturpumpe***. Sur la base de nouvelles dates ^{14}C et de nouvelles analyses effectuées à Geissenklösterle, Conard et Bolus (JHE, 40: 331-71) ont récemment proposé que l'Aurignacien du Jura Souabe soit daté à 40 ka BP. Ce constat appuierait le modèle de peuplement appelé *Kulturpumpe* selon lequel l'Aurignacien et le Gravettien se seraient développés dans le Jura Souabe et que ce développement précèderait de quelques millénaires la diffusion de ces technocomplexes dans le reste de l'Europe. Nous proposons ici une analyse critique de l'ensemble des informations disponibles pour Geissenklösterle et discutons l'hypothèse de "l'anomalie du Paléolithique Moyen" proposée par Conard et Bolus pour expliquer les contradictions dans les datations ^{14}C de ce site. Nous concluons, en contradiction avec ces auteurs, que la plus ancienne occupation aurignacienne de cette grotte est postérieure à 36,5 ka BP et doit probablement se situer entre 35 et 33 ka BP. Cette interprétation est en accord avec ce que nous savons sur la taphonomie, le contexte environnemental, la technologie et la typologie de l'outillage lithique et osseux des couches aurignaciennes de Geissenklösterle. Elle est également cohérente avec les dates ^{14}C des restes de faune portant des traces de modifications anthropiques découvertes dans ces couches. Elle s'accorde aussi avec l'ensemble des dates disponibles pour l'Aurignacien d'Europe indiquant que ce technocomplexe s'est développé il y a environ 36,5 ka BP. Le fait que son émergence apparaisse à nos yeux comme simultanée à l'échelle européenne est dû à la faible résolution de la méthode du ^{14}C. L'utilisation d'objets de parure, considérée généralement comme un indice archéologique de l'acquisition de comportements modernes, apparaît en Europe (Châtelperronien) et au Proche-Orient (Initial Upper Paleolithic) avant l'Aurignacien. L'origine de l'Aurignacien et l'émergence de la modernité culturelle en Eurasie ont souvent été considérées dans le passé comme deux faces de la même médaille. Il est aujourd'hui clair qu'il s'agit de questions qui doivent être discutées séparément.

Mots-clés : Aurignacien, datations ^{14}C, modernité culturelle, hommes anatomiquement modernes.

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Introduction

The perceived timing of the various cultural and biological events taking place in Europe and in the Near East at the so called Middle-to-Upper Paleolithic transition has played a major role in the elaboration of models for the spread of anatomically modern humans into Europe, the extinction of Neandertals, the nature of the interaction between these two human types, and more generally on theories accounting for the origin of modern behavior. Throughout the 1990s, the debate was based on the assumption that the earliest Aurignacian of northern Spain and central Europe dated to ca.40 ka BP. This chronology was used to suggest possible pathways for the penetration of modern human groups into the continent (e.g. Mellars 1992, 1996 ; Vandermeersch 1997 ; Bar-Yosef 1998), to defend the hypothesis that moderns expanded rapidly westward between ca.43 and ca.35 ka BP (Mellars 1998b ; Stringer and McKie 1996), and to establish correlations between climatic and biocultural changes during OIS 3 (Mellars 1998b ; Davies 2001).

A very early chronology for the Aurignacian has also been the fundamental argument in support of the view that in a number of European regions Neandertals and moderns lived side by side for a long time, during which the latter went throught a process of acculturation (Harrold 1989, 1992 ; Mellars 1989, 1991, 1996, 1998a-b ; Farizy 1990a-b, 1994, 1999 ; Demars and Hublin, 1989 ; Otte 1990, 1996 ; Hublin 1990 ; Hublin *et al.* 1996, 1999 ; Gioia 1990 ; Djindjian 1993 ; Kozlowski 1993, 1996 ; Stringer and Gamble 1993 ; Bar-Yosef 1996a, 1996b, 1998 ; González Echegaray 1997). According to these authors, such transitional technocomplexes as the Châtelperronian of France and Spain, the Uluzzian of Italy or the Bohunician of Moravia, as well as, possibly, the backed-point (Zwierzynician) and leaf-point industries (Szeletian, Lincombian, Jerzmanowician) of central and eastern Europe should be interpreted as the outcome of the long term influence of Aurignacian moderns on local Neandertals. These contacts would have also triggered (through trading, collection of abandoned objects, imitation, or acculturation) the appearence of a bone technology and of personal ornaments among some Neandertal groups, a phenomenon best exemplified by the French Châtelperronian.

This model relied almost entirely on three lines of reasoning :

- the interpretation of the personal ornaments and bone tools associated to Châtelperronian lithic assemblages at Grotte du Renne as tangible evidence of the cultural influence exerted by moderns on the late Neandertals ;
- the interstratifications at Roc de Combe, Le Piage and El Pendo as suggestive of a long contemporaneity between the two populations ;
- the radiocarbon dates for l'Arbreda and El Castillo, in Spain, and Geissenklösterle, in Germany, considered as proof of the precocious penetration of Aurignacian moderns in Europe.

Our reassessment of the stratigraphic, chronological and archaeological features of the Grotte du Renne sequence (d'Errico *et al.* 1998 ; Zilhão and d'Errico 1999 ; d'Errico *et al*. 2003) has shown that, contra Taborin (1998), the numerous bone tools and personal ornaments discovered in its Châtelperronian levels are not displaced from the overlying Aurignacian. They cannot be considered as evidence for the gathering of abandoned objects or for trading with the Aurignacians either (White 1992 ; Hublin *et al.* 1996). In fact, there is no valid reason to question their contemporaneity with the Neandertal human remains (Hublin *et al.* 1996), the lithic assemblages and the habitation features found in those levels; that Neandertals were the makers of the bone tools and ornaments is demonstrated by the presence in the same levels of refittings and byproducts of the manufacture of these objects.

Our comparison of Châtelperronian and Aurignacian technologies, combined with a discussion of the patterns of chronological and geographical distribution of the Aurignacian, Châtelperronian, Uluzzian and late Mousterian sites of western Europe, further supported the conclusion that the acculturation hypothesis was inconsistent with the empirical data. We suggested, instead, that the new trends represented by so-called Transitional technocomplexes should be interpreted as the result of an independent Neandertal "invention" of the Upper Paleolithic, including the elaboration and use of a varied repertoire of personal ornaments clearly indicating a fully symbolic behaviour.

We argued that early datings for the Aurignacian were based on samples of dubious cultural meaning, either because collected in palimpsests containing other archaeological components or because the definition of the artifact suites as Aurignacian was not warranted. Wherever sample context was archaeologically secure, the earliest occurrences of the Aurignacian dated to no more than ca.36.5 ka BP. In accordance with the pattern of succession documented in tens of stratigraphic sequences from Spain, France, Italy, Germany, Moravia, Bulgaria and Greece, such occurrences were later than the Châtelperronian and equivalent technocomplexes of central and eastern Europe, whose emergence is consistently dated by different methods to before ca.38 ka BP.

The reality of the interstatifications has been also repetedly called into question. The evidence from El Pendo had already been conclusively dealt with by Hoyos and Laville (1982), and recent work at the site (Montes *et al.* 2001) confirmed that the stratigraphic sequence upon which the interstratification had been suggested corresponds entirely to an accumulation of eroded deposits, each containing a highly diverse mix of bones and artifacts derived from the many different occupations that took place at the site over the last 100 000 years. The unconvincing nature of the Le Piage and Roc de Combe interstatifications was highlighted by d'Errico *et al.* (1998), Rigaud (1998), and Zilhão and d'Errico (1999). That no "interstratifications" and no Aurignacian earlier than the Châtelperronian exist at these sites is now exhaustively demonstrated by the methodologically innovative taphonomic work of J.-G. Bordes (2002, 2003).

The fact that the Châtelperronian and equivalent European technocomplexes of local Mousterian ancestry are stratigraphically and chronometrically earlier than the Aurignacian throughout the whole continent rejects explanations of their emergence as triggered by the arrival of the first modern human populations. Throughout most of Europe, the ultimate replacement of Neandertals by moderns is better understood, therefore, as the outcome of a process of interaction between two different, separate populations, which, at the time of contact, were both fully Upper Palaeolithic in material culture as well as in behavior. This observation has wide implications as it supports the multiple species model for the origin of behavioral modernity (d'Errico *et al.* 1998 ; Zilhão 2000, 2001 ; d'Errico 2003 ; Zilhão and d'Errico 2003), i.e., the view that advanced features such as modern cognitive abilites, symbolic thinking, and language are not peculiar to our species and arose gradually among different human populations, including Neandertals.

This model and our view of the archaeological evidence has been recently called into question by scholars working on central European early Upper Paleolithic sites (Conard and Bolus 2003). These authors believe that our revision (Zilhão and d'Errico 1999) of the Geissenklösterle record was erroneous and that the new radiocarbon dates and the results of new analyses conducted at this site demonstrate that the Swabian Aurignacian (and, hence, the presence of modern humans in central Europe) dates back to ca.40 ka BP. In their view, this finding is consistent with the Danubian Corridor and the *Kulturpumpe* models, according to which cultural innovations of the Aurignacian and Gravettian in Swabia predate similar developments in the remainder of Europe.

The results reported by Conard and Bolus represent a significant contribution to the scientific understanding of a site that has yielded stratigraphic and archaeological evidence unanimously considered as crucial for the Middle-Upper Paleolithic debate. However, we find a number of contradictions in their interpretations of those results, and little support in them for their conclusions. The aim of the present paper is to highlight these contradictions and propose an alternative interpretation that, in our view, is a better fit for the empirical evidence. According to our interpretation, the earliest Aurignacian occupation of the site does not predate ca.36.5 ka BP, and probably took place between ca.35 and ca.33 ka BP.

In order to avoid any source of ambiguity in the argument, we wish to stress from the outset that the chronological horizons we suggest are expressed in uncalibrated ^{14}C years. Conard and Bolus (2003: 303) claim that the TL measurements on burnt flint of ca.40 ka BP reported by Richter *et al.* (2000) for the earliest Aurignacian of the Geissenklösterle are independently confirmed by their new radiocarbon results. This is not correct; with current knowledge (Weninger and Jöris 2003), a radiocarbon age of ca.40 ka BP corresponds to a calendar age of ca.43 ka BP, significantly earlier than that indicated by the TL results. The latter are fully compatible with our reassessment of the site's ^{14}C dating record, not with Conard and Bolus's.

Background

The stratigraphic succession of the Geissenklösterle is given in the composite profile of fig. 1, which we reproduce from Hahn (1988). Sedimentologically, the succession is divided into Geological Horizons (GH), numbered 1 to 19 from top to bottom. The different levels of human occupation recognized in these sediments were designated by the excavator as Archeological Horizons (AH), and numbered I to V from top to bottom, with subdivisions. Of relevance for this discussion is the Aurignacian section of the deposits, comprised between geological horizons 11 and 16, in which archeological horizons IIn, IIa, IIb, IId, III, IIIa and IIIb were differentiated during excavation. This section, ca.60 cm thick in Hahn's (1998) Profile E, is separated from the underlying Middle Paleolithic (GH18, containing AHIV) by the largely sterile GH17, which, in that same profile, is ca.40 cm thick.

On the basis of extensive refitting work, Hahn recognized that the sequence was affected by significant post-depositional disturbance processes. However, the dispersion of the refitting complexes, in many cases conjoining items scattered through the entire thickness of the Aurignacian deposits (fig. 2), was mainly vertical. According to Hahn, this explained why, notwithstanding the disturbance, latent horizontal structures as well as evident features such as hearths, red ochre and ash lenses had been preserved. The taphonomic analysis of the deposits also led Hahn to conclude that, in fact, IIn, IIa and IIb should be lumped together as a single archeological horizon, AHII; and that IId, III, IIIa and IIIb should be lumped together separately as AHIII. IIn and IIa would have been derived from IIb by cryoturbation and roof collapse, IId and III were assumed "similarly to be secondary upwardly displaced parts of IIIa", and IIIb "in reality consists of low parts of IIIa, which may have sunk down because of cultural factors like trampling" (Hahn 1988 : 253-4). In sum, the seven different horizons recognized during excavation corresponded in fact to the post-depositional sorting of the archeological refuse abandoned at the site in the framework of only two principal moments of human occupation. The latest, which Hahn associated with the classical Aurignacian I, was that represented by the extensive ash and bone lens forming I/b ; the earliest, which Hahn called Proto-Aurignacian, was that represented by the hearth found in IIIa.

Zilhão and d'Errico's (1999) review of the site accepted these premises and in no way implied that this part of its deposits was disturbed to the extent that no internal subdivision was warranted. We simply argued that, given the patterns of vertical dispersion documented by Hahn, one could not be sure that the two ivory beads found in AHIII did in fact belong there originally, given that another 12 were reported from AHII. We further suggested that such could also be the case with the few carinated scrapers, and that the latter were not sufficient to warrant Hahn's classification of AHIII as Aurignacian, because (1) carinated scrapers were also known, even if rare, in the inventories of such Transitional industries of central Europe as the Szeletian or the Bohunician, and (2) the assemblage lacked

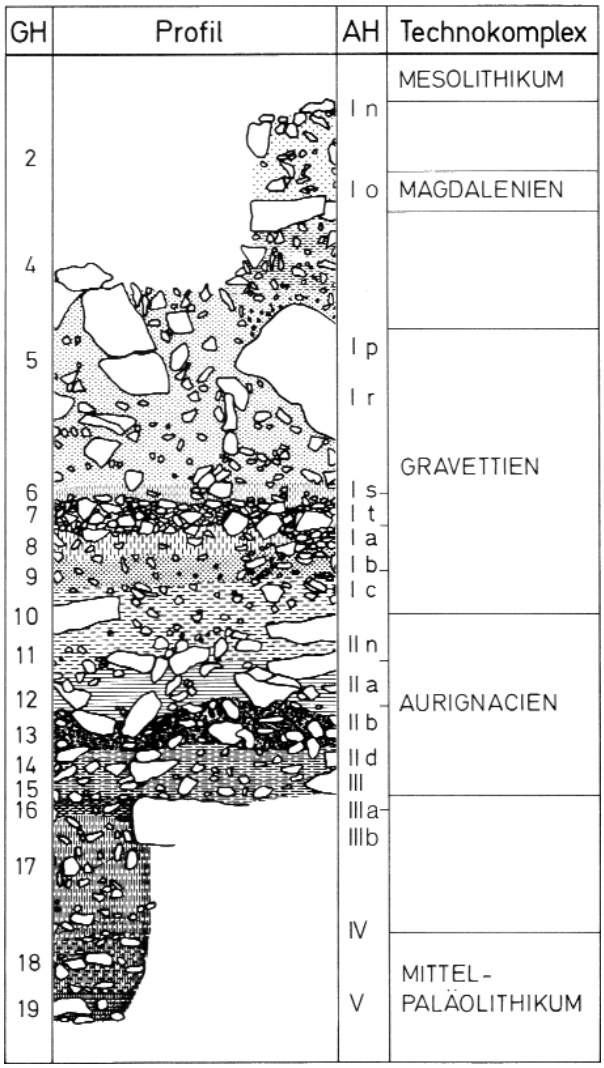

Figure 1 - Stratigraphic profile of Geissenklösterle (modified after Hahn 1988 : fig. 11).

Figure 1- Profil stratigraphique de Geissenklösterle (modifié d'après Hahn 1988 : fig. 11).

the abundant component of retouched Dufour bladelets that, typologically, is a key component of the Proto-Aurignacian as defined in Fumane or l'Arbreda. Where the dating was concerned, we proposed that the best explanation for the scatter and inversions of the then available AMS results lay in the disturbance diagnosed by Hahn on the basis of the lithic artifact component of the deposits. This was all the more so since, in a cave sequence with a very low sedimentation rate and where the fauna is dominated by cave bear, some degree of post-depositional disturbance was to be expected in the first place.

Research carried out at the site since 1999 by the Tübingen research team under the direction of Conard clarified many of these questions. Further refitting work and technological and typological analyses by Liolios and Teyssandier (2003) (who could use all of the material recovered up to 1991, whereas Hahn's monograph and, hence, our own assessment, had taken into account only the results of excavation until 1984) confirmed that the diagnostic elements in AHIII are indeed Aurignacian. These new analyses also confirmed, however, that, as we had argued, the assemblage is clearly not like the Proto-Aurignacian of Mediterranean regions. Liolios and Teyssandier found close parallels for AHIII in the classical Aurignacian of southwestern France and suggest that, in fact, AHII and AHIII are quite similar from the technological point of view and that the differences between the two assemblages "may well be due to functional and economic factors, hinging on distinct subsistence-related on-site activities", accounting for "the similarity between the operative concepts identified for the lithic and organic productions" as well as for "the differences in the frequency of tool-types and in the completeness of reduction sequences"; in sum, what separates the Aurignacian in AHIII from that in AHII is the mode of site occupation, not the culture or the technology. The classical Aurignacian of southwestern France is dated to ca.33-35 ka BP and Liolios and Teyssandier conclude that AHIII, considering the spread of dates for it (between ca.33 and ca.40 ka BP), "could therefore arguably be relatively close in time to classical early Aurignacian assemblages".

We believe that, upon detailed inspection and critical consideration, the new radiocarbon evidence is indeed consistent with these techno-typological indicators. In our view, the seemingly random distribution of the 33 radiocarbon dates reported by Conard and Bolus (2003) for the Aurignacian of

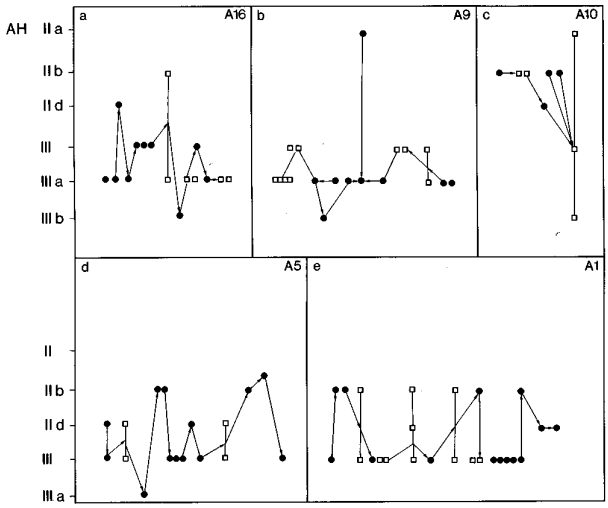

Figure 2 - Vertical spread of multiple refittings and number of refittings between lithic artifacts from the different subunits of archeological horizons AHII and AHIII of the Geissenklösterle (after Hahn 1988 : fig. 20 and table 4).

Figure 2 - Distribution verticale et nombre de remontages multiples de pièces lithiques identifiés entre les couches appartenant aux horizons archéologiques AHII et AHIII de Geissenklösterle (d'après Hahn 1988 : fig. 20 et tableau 4).

Lab. Number	Method	AH	Material	Modification	Date BP	Age calBC
H 4147-3346	Conventional	IIa	mixed bone sample	-	30625±796	32550±950
H 4279-3534	Conventional	IIa	mixed bone sample	-	31525±770	34210±1610
OxA-5707	AMS	IIa	horse scapula	impact + cutmarks	33200±800	35610±1320
OxA-5160	AMS	IIa	hare tibia	-	33700±1100	36320±1880
OxA-4594	AMS	IIa	reindeer? humerus	-	36800±1000	38440±980
KIA 8960	AMS	IIb	mammoth rib	impact	29800±240	31470±520
Pta-2361	Conventional	IIb	charred bone	-	31070±750	33160±910
KIA 8958	AMS	IIb	horse humerus	impact	31870+260/-250	34530±1530
Pta-2270	Conventional	IIb	charred bone	-	31870±1000	34420±1650
OxA-5708	AMS	IIb	mammoth cranium	-	32300±700	34780±1390
PtA-2116	Conventional	IIb	charred bone	-	32680±470	35210±1060
OxA-5162	AMS	IIb	hare pelvis	-	33200±1100	35800±1760
H 4751-4404	Conventional	IIb	mixed bone sample	-	33700±825	36440±1820
OxA-6256	AMS	III	reindeer tibia	impact	30100±550	31640±670
KIA 8963	AMS	III	long bone	impact	31180+270/-260	32920±460
H 5118-4600	Conventional	III	mixed bone sample	-	34140±1000	36610±1720
H 5316-4909	Conventional	III	mixed bone sample	-	36540±1570	38160±1220
OxA-5163	AMS	III	ibex mandible	-	37300±1800	38530±1380
OxA-4595	AMS	III	horse femur	-	40200±1600	41000±1120
OxA-6629	AMS	IIIa	reindeer metatarsal	-	30300±550	31860±800
OxA-6628	AMS	IIIa	reindeer metatarsal	-	30450±550	32150±840
ETH-8268	AMS	IIIa	bone	-	33100±680	35460±1140
OxA-5705	AMS	IIIa	reindeer metatarsal	-	33150±1000	35690±1600
ETH-8269	AMS	IIIa	bone	-	33500±640	36400±1830
OxA-6255	AMS	IIIa	rhino humerus	-	32900±850	35260±1280
KIA 13075	AMS	IIIa	reindeer tibia	impact	34330+310/-300	37660±900
KIA 13074	AMS	IIIa	reindeer tibia	impact	34800+290/-280	37650±640
ETH-8267	AMS	IIIa	bone	-	37800±1050	39480±420
KIA 8962	AMS	IIIb	rib	impact	28640+380/-360	30710±720
KIA 8961	AMS	IIIb	reindeer humerus	fresh break	33210+300/-290	35520±990
KIA 13076	AMS	IIIb	reindeer tibia	impact + cutmarks	34080+300/-290	37160±1400
KIA 8959	AMS	IIIb	femur	fresh break	34220+310/-300	37620±940
KIA 16032	AMS	IIIb	roe deer	metacarpal impact	36560+410/-390	38660±600

Table 1 - Radiocarbon dates for the Geissenklösterle accepted by Conard and Bolus (2003) ; cal BC ages calculated with CalPal calibration software (Weninger and Jöris, 2003).

Tableau 1 - Datation ^{14}C pour les couches aurignaciennes de Geissenklösterle considérées comme fiables par Conard et Bolus (2003). Les dates calibrées BC ont été calculées avec le logiciel CalPal (Weninger and Jöris, 2003).

the Geissenklösterle, listed here in our table 1, is best explained by the post-depositional processes and by the palimpsest nature of the deposits. Conard and Bolus (2003), however, argue that the overall stratigraphic integrity of the site precludes interpreting the dating anomalies as related to post-depositional disturbance; instead, they believe that such anomalies must be caused by major fluctuations in atmospheric ^{14}C during the time interval comprised between ca.30 and ca.40 ka BP.

Dating anomalies or logical inconsistencies ?

Conard and Bolus's (2003 : 356, 358) explanation for the numerous stratigraphic inversions in the dates for AHII and AHIII is that, in the period under consideration, short peaks exist during which radiocarbon ages may be off calendar ages by as much as six to ten thousand years. This explanation is inconsistent with their claims of broader anthropological significance (Conard and Bolus, 2003 : 360, 362, 363, 366) : that a full-blown Aurignacian exists in the Swabian Alb from ca.40 ka BP, that the western European Aurignacian postdates similar and analogous developments, and that the Swabian Alb was a region of Early Upper Paleolithic colonization and cultural innovation. In fact, if their explanation is accepted, all dates between ca.30 and ca.40 ka BP are the same date, which carries the implication that any claim of precedence is unwarranted because, given such a lack of temporal resolution, no assessment of what sites or processes are earlier or later is possible, and all that happened in those long ten millennia becomes contemporaneous to our eyes.

On the other hand, the only anomaly in ^{14}C production before ca.30 ka BP with the order of magnitude mentioned by Conard and Bolus is that identified by Beck *et al.* (2001) in their study of a stalagmite from the Bahamas; this anomaly implies a rejuvenation of up to 8000 years in the radiocarbon age of samples with a calendar age of 41-42,000 years. On the basis of that study, Conard and Bolus propose a general "Middle Paleolithic Dating Anomaly" to

explain the fact that the two results obtained for the Mousterian levels underlying the Aurignacian sequence of the Geissenklösterle are in the range of ca.32-34 ka BP. Whether that proposition can stand as a general model is an issue we will not deal with here[3]. But we must point out that (1) because it impacts an earlier time interval, that anomaly, even if validated by future research, is not directly relevant to the chronology of the Aurignacian of the Geissenklösterle, and (2) if that anomaly is the explanation for the Mousterian results, then it is inconsistent with Conard and Bolus's conclusions on the Aurignacian.

In fact, the two results for the Mousterian levels of the Geissenklösterle come from samples in "uppermost Middle Paleolithic horizon IV", which is separated from "lowermost Aurignacian horizon III" by "largely sterile geological layer 17" (Conard and Bolus 2003: 353). Conard *et al.* (2003) are emphatic in describing a sharp discontinuity "between geological horizons GH15, the main unit at the base of AHIII, and the underlying archeologically nearly sterile layer GH17", and they suggest that "the unconformity may well result from solifluction or gelifluction between the depositions of the two units". Thus, the beginning of the deposition of the lowermost geological unit included in AHIII is separated from the end of the deposition of the Middle Paleolithic by the time interval corresponding to the occurrence of two major geological processes: the accumulation of GH17 and the subsequent erosion of the extant sequence of deposits by solifluction or gelifluction. If we extrapolate from the ca.40 cm thickness of GH17 and from a rate of sedimentation for the site, derived from the dates for the Aurignacian sequence, of 4 to 8 cm/millennium, that time interval may be in the range of 5000 years or more (particularly if we bear in mind that GH17 is sterile and these values were derived from archeological deposits where, by comparison, the ratio is inflated by the volumetric impact of their important anthropic component). Thus, if the Middle Paleolithic in GH18 dates to 41-42,000 calendar years ago, as implied by Conard and Bolus's (2003) explanation of the anomalous results obtained for it, then the lowermost Aurignacian in GH15 cannot possibly begin as early as ca 40,000 radiocarbon years ago (i.e., see below, ca 43,000 calendar years ago).

In fact, there is a growing consensus in the community of dating experts that, in the time period under consideration, a significant offset exists between calendar ages and radiocarbon ages. Because of the unresolved issues, no universally agreed upon calibration curve exists for that period, but the CalPal software (Weninger and Jöris 2003) is widely used and provides the basis for the calculation of all calendar ages mentioned in this paper. Under the assumptions of CalPal, and given the thickness of the sterile level separating the Middle Paleolithic from the Aurignacian at Geissenklösterle, Conard and Bolus's "Middle Paleolithic Dating Anomaly" thus carries the implication that the site's Aurignacian must be significantly later than ca.38 ka BP (the equivalent, in the radiocarbon time scale, of ca.41-42,000 calendar years), and, probably, later than ca.36.5 ka BP, the chronological horizon suggested by Zilhão and d'Errico (1999) for the emergence of the technocomplex in Europe.

A third inconsistency is apparent in the crucial point of Conard and Bolus's (2003 : 353) argument: "Six 14C dates from three accelerator and one conventional lab fall in the range between 36-40 ka BP. (…) These early dates are roughly consistent with the mean age of 40.2±1.5 ka BP based on Richter et al.'s (2000) six thermoluminescence dates on burnt flints from horizon III. (…) Based on the taphonomic and archeological arguments mentioned above, we find no basis, at present, to reject these six radiocarbon dates." One of those six results, however, comes from AHII. Moreover, Conard and Bolus accept as valid another 15 results for level III (table 1). So, the issue here is not that six results should not be rejected. The issue here is why do Conard and Bolus exclude from further consideration all the other results; if all 20 samples and measurements for AHIII are equally reliable, as they contend, why is the chronology of that horizon based on only five ? If we accept that there are only two Aurignacian occupations and that all 13 results from AHII and all 20 results for AHIII are equally valid, it seems reasonable, regardless of which is the preferred explanation for the observed scatter, to consider that the age of those two occupations must be given by the average of all the valid results obtained for each. If so, then AHII would date to 32,488 BP, and AHIII to 33,825 BP. Put another way, the beginning of the Aurignacian of the Geissenklösterle would have to be placed ca.34 ka BP, not ca.40 ka BP, as Conard and Bolus claim.

An alternative view of the Aurignacian of the Geissenklösterle

Another way, and perhaps a more realistic one, to look at the evidence, is to assume that the Aurignacian deposits of the Geissenklösterle are a palimpsest of multiple occupations as, in fact, Hahn (1988 : 254) had cautioned: "The evident features … indicate two major occupations. Each may of course have been constituted by several events, following closely on each other". This view can be reconciled with Hahn's and Conard and Bolus's recognition of only two archeological "horizons" by postulating that, of the two functional modes of occupation diagnosed by Liolios and Teyssandier (2003), the first of the many different uses of the cave recorded in AHIII and AHII would all have featured the "earlier Aurignacian" mode, whereas subsequent ones would all have featured the "later Aurignacian" mode. The earliest of the dates for AHIII, therefore, would mark the first appearance of that "earlier Aurignacian" mode in the site's sequence.

If we look at the results on a one by one basis, however, we verify that there are only three with mid-points in

(3) After the submission of our manuscript to Paléo*, Hughen* et al. *(2004) reported a high resolution calibration of the radiocarbon time scale back to 50 ka BP based on marine data from the Cariaco Basin, Venezuela. These authors could not identify Beck* et al. *(2001)'s large variation in* $^{14}C/^{12}C$ *ratios upon which Conad et Bolus rely to support their hypothesis of a «Middle Paleolithic Dating Anomaly». Hughen* et al. *convincingly demonstrate that the results of Beck* et al. *are difficult to explain with available geomagnetic records and plausible carbon cycle changes. Thus, the idiosyncratic values obtained by Beck* et al. *likely relate the inadequacy of analyzed record, as is further suggested by preliminary measurements conducted by Bard* et al. *(2004) on deep-sea cores from the Iberian Margin that provide results comparable to those of Hughen* et al.

excess of 37 ka BP: OxA-5163 (37,300±1800 BP), ETH-8267 (37,800±1050 BP), and OxA-4595 (40,200±1600 BP). The standard deviations of the first two are such that they are in fact within the chronological horizon of ca.36.5 ka BP postulated by Zilhão and d'Errico (1999) for the earliest Aurignacian. Thus, Conard and Bolus's notion that the Aurignacian of the Swabian Alb begins significantly earlier, ca.40 ka BP, may at best rest on one, and only one, of the 20 results for AHIII, the OxA-4595 date on a horse femur. In our view, this result, obtained on a bone with no evidence of anthropic modification, is more likely to reflect the presence of carnivores at the site prior to the Aurignacian occupation, at the time the package of sediments making up AHIII began to accumulate. We feel that this interpretation is at least a more parsimonious reading of the evidence than that proposed by Conard and Bolus, which implies giving more weight to one sample (5 % of the evidence) than to the remaining 19 (95 % of the evidence).

Another implication of the palimpsest assumption is that the post-depositional vertical displacement of individual items becomes an issue of crucial importance when assessing the meaning of AMS dates. In such a context, it is easy to see how the spread of dating results may well be primarily a reflection of the palimpsest, compounded by post-depositional disturbance. Conard and Bolus (2003 : 350) state that post-depositional vertical displacement is minimal based on three plots presenting the distribution of items in refitting groups A9, A11 and A16, which they believe "demonstrate the outstanding context of the Aurignacian finds from Geissenklösterle and show that only a small portion of the finds underwent significant vertical displacement". It must be borne in mind, however, that these groups are only a small fraction (10 %) of the 30 refitting complexes examined. As shown by Teyssandier *et al.* (2002), many of the other refitting groups display the pattern of connections across the whole of the Aurignacian sequence already documented by Hahn (1988 : fig. 20 ; *cf*. fig. 2).

Hahn estimated the quantitative impact of the disturbance in the following terms: some 60 % of the items remained *in situ*, some 40 % were displaced from their original subunit of deposition, and some 7 % had moved between AHII and AHIII. We agree with Conard and Bolus (2003) and Conard *et al.* (2003) that this level of disturbance, which they also accept as a good estimate of what went on at the site, is perfectly compatible with the recognition of global assemblage patterns, and that it allows legitimate between-level comparisons and assessments of overall differences and similarities such as those in Liolios and Teyssandier's (2003) analyses. The point of contention, however, is not the quantitative assessment of the amount of disturbance that occurred at the site, but rather the qualitative impact that even a quantitatively small amount may have at certain scales and for certain kinds of analyses.

For instance, in the context of Hahn's estimates, and once we learn (Liolios and Teyssandier 2003) that there are six carinated or thick-nosed scrapers in AHII, but 40 in AHIII, it becomes unreasonable to sustain that the presence of carinated and thick-nosed scrapers in the latter may be explained by downward displacement from the former. At this level of analysis (i.e., the level of assessing the technological relevance that carinated reduction schemes have in AHIII), and assuming the validity of Hahn's estimates, the possibility that 7 % (i.e., three) of those 40 carinated and thick-nosed scrapers may actually derive from AHII obviously is of no relevance.

The opposite is true when the exact original stratigraphic position of individual items is at stake, i.e., when items have a meaning in themselves (as is the case with samples of individual bone fragments selected for AMS radiocarbon dating) and not simply as singular manifestations of a certain category of finds. If Hahn's estimates are correct, we would expect post-depositional movement to have little impact where conventional bulk samples are concerned, because the opposite effects of the potentially displaced items contained in such samples (towards aging, or towards rejuvenating) would more or less cancel each other out in the end. For instance, if a few bones accumulated ca.40 ka at the bottom of AHIII are mixed in a bulk sample where 90% of the material is ca.35 ka old, their effect on the measured age of the sample is nil; given the non-linearity of the 14C time scale and the fact that we are working so close to the limit of the method, the result will still be of ca.35 ka in spite of the mix. But if one of those ca.40 ka bones is individually dated by AMS, the measured age of the sample will indeed be of ca.40 ka, not of ca.35 ka BP. Thus, if only some 60 % of items remained in situ, and if some 7 % of items moved between AHII and AHIII, then two things are to be expected when attempting to date these deposits by AMS: that a small percentage of the samples will give results for II instead of III, or for III instead of II; and that a significant percentage of the samples in II and III will be out of order in terms of the internal stratification of the different subunits making up each of those reconstructed archeological horizons (IIn, IIa, and IIb for level II; IId, III, IIIa, and IIIb, for level III).

Both expectations are confirmed by fig. 3, where the 95 % confidence intervals of the 33 samples (25 AMS and eight conventional — Table 1) from the Aurignacian levels of the Geissenklösterle accepted by Conard and Bolus (2003) were plotted against their stratigraphic provenience. The conventional results are in the expected order, and they present a clear and gradual pattern of increasing age with increasing depth. The opposite is true with AMS results, a significant proportion of which, moreover, fall outside the age interval to be expected on the basis of the conventional results. Fig. 3 also makes it clear that, as discussed above, with the single exception of the ca.40 ka BP OxA-4595 date, even the earliest AMS results are entirely within, or significantly intersect, the interval around ca.36.5 ka BP postulated by Zilhão and d'Errico (1999) as the lower limit for the age of the Aurignacian in Europe (and this is even more clear when calibrated results are used). Thus, and regardless of the preferred interpretation for the scatter in the dates, the results reported by Conard and Bolus (2003) do not affect the validity of that limit, if that validity is considered, as it should be, with the appropriate margin of statistical uncertainty.

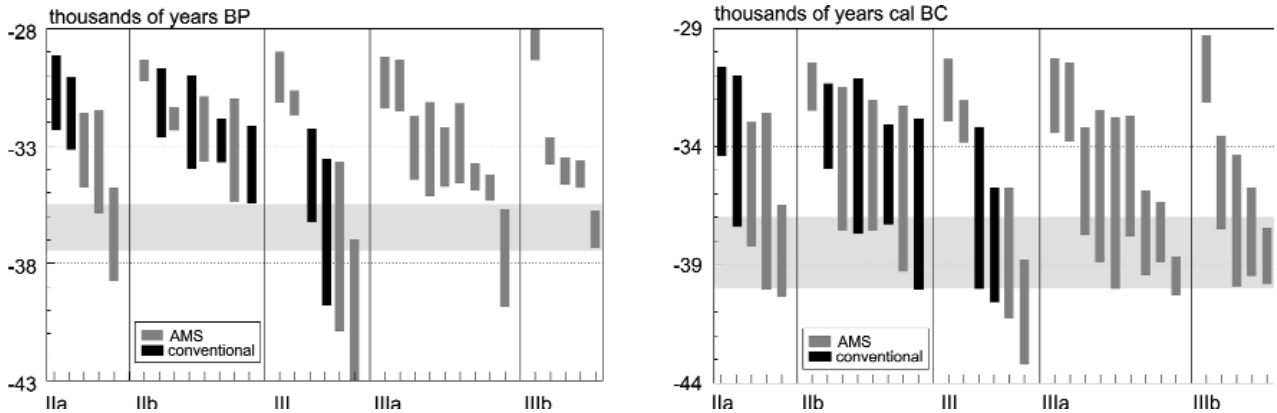

Figure 3 - ^{14}C dates (95 % confidence intervals) accepted by Conard and Bolus for the Aurignacian levels of the Geissenklösterle. Left: uncalibrated BP ages. Right: CalPal (Weninger and Jöris 2003) calibrated BC ages. In this and subsequent graphs, the light grey band represents the 95% confidence interval (35.5-37.5 ka BP; 37.0-40.0 ka cal BC) of the 36.5±0.5 ka BP (38.5±0.75 ka cal BC) lower limit of the Aurignacian proposed by Zilhão and d'Errico (1999).

Figure 3 - Dates ^{14}C (avec 95 % d'intervalle de confiance) pour les couches aurignaciennes de Geissenklösterle acceptées comme valables par Conard et Bolus. Gauche: dates non calibrées BP. Droite: dates BC calibrées avec CalPal (Weninger et Jöris 2003). Dans ce graphique et dans les suivants la bande grise horizontale représente l'intervalle de confiance à deux sigmas (35,5-37,5 ka BP ; 37,0-40,0 ka cal BC) de la date de 36,5±0,5 ka BP (38,5±0,75 ka cal BC), proposée par Zilhão et d'Errico (1999) pour le début de l'Aurignacien.

The other implication of looking at the Aurignacian levels of Geissenklösterle as a palimpsest is that other agents of bone accumulation besides humans may be responsible for the faunal assemblage contained in the deposits, as Conard and Bolus also acknowledge (2003 : 335). The cave bear remains, for instance, are clearly naturally-accumulated items (even if a few cut-marked specimens indicate some exploitation of this species by humans at the site — Münzel 2002). Remains of carnivores known to be accumulators of animal bones in cave sites, such as wolf and hyaena, are also present in the faunal inventories from both archeological horizons (Münzel 1999). Finally, it cannot be excluded either that anthropically-accumulated animal bones unrelated to the main human use of the cave reflected in the artifact assemblage of AHIII are also present in the different levels lumped together to form that unit of analysis.

Given that the ensemble of the site's dated items is entirely made up of animal bone, it is to be expected that its composition will reflect the diverse provenience of the faunal material whence it was sampled. Thus, only samples of anthropically-modified bones (transformed into tools, cut-marked, impacted, or with breaks in fresh) can be considered as unquestionable evidence of human activity, as also argued by Richter *et al*. (2000). In fig. 4, we plotted all the results for the Geissenklösterle derived from such samples in decreasing order of stratigraphic provenience. The following facts appear :

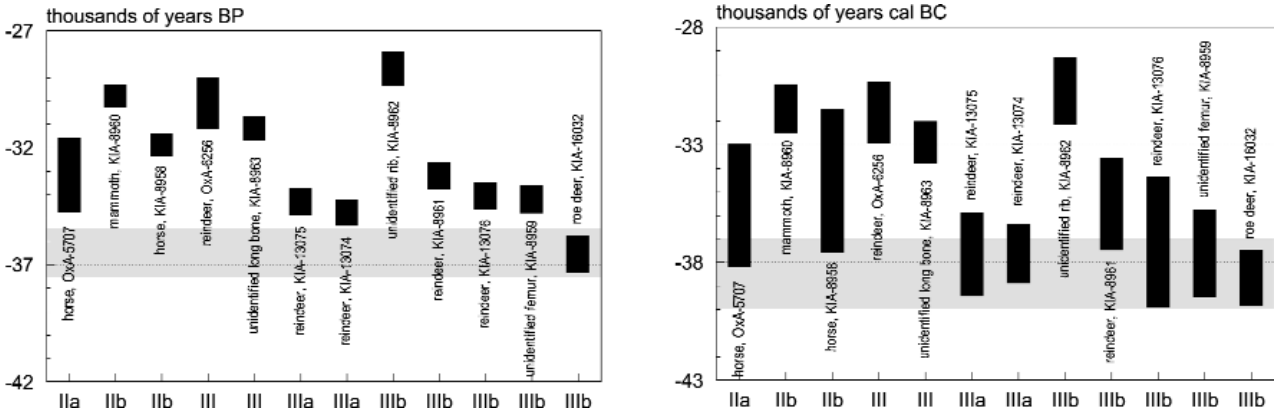

Figure 4 - ^{14}C dates (95 % confidence intervals) on anthropically-modified bones accepted by Conard and Bolus for the Aurignacian levels of Geissenklösterle. Left : uncalibrated BP ages. Right : CalPal (Weninger and Jöris 2003) calibrated BC ages.

Figure 4 - Dates ^{14}C (avec 95 % d'intervalle de confiance) pour les couches aurignaciennes de Geissenklösterle, reconnues comme valables par Conard et Bolus et réalisées sur des restes de faune avec des modifications anthropiques. Gauche : dates non calibrées BP. Droite : dates BC calibrées avec CalPal (Weninger et Jöris 2003).

- the earliest signs of human occupation in the deposits making up AHIII are no older than ca.36.5 ka BP (i.e., ca.38.5 ka cal BC) ;
- only two of the results are clearly inverted relative to the stratigraphy and may well represent vertically displaced items, but the picture that emerges is one of broad positive correlation between stratigraphic depth and age ;
- the other ten results cluster into two chronological groups, one bracketed between 29 and 32 ka BP (30 and 34 ka cal BC) and another bracketed between 33 and 37 ka BP (35 and 40 ka cal BC) ;
- this pattern does not change if the two inverted results are replaced in their presumed original position and incorporated in the comparison.

When uncalibrated results are used, a single result, ca.36.5 ka BP, seems to represent a separate moment of occupation inside this second cluster, where all other dates fall in the interval between 33 and 35 ka BP. However, when calendar ages are used, that earlier result cannot be distinguished from the others. One must also bear in mind that it comes from a sample of roe deer bone. This species is so rare in the Aurignacian of southwest Germany that it is not even listed in the inventory of the region's fauna provided by Niven (2003), but Münzel (personal communication) confirms that a few roe deer bones were indeed found in the Middle Paleolithic and lower Aurignacian levels of the site in the 1999 field season. Since Niven (2003) and Münzel (1997, 1999 ; Münzel *et al.* 2001) describe the Aurignacian use of Vogelherd and Geissenklösterle as focused on the exploitation of mammoth, horse and reindeer, the introduction in the deposits of the dated roe deer bone cannot be related to that use; roe deer are a temperate forest species which does not seem compatible with the steppe-tundra environments implied by the mammoth-horse-reindeer association. Thus, this dated roe deer bone would confirm that the deposits making up Geissenklösterle's AHIII are indeed a palimpsest which not only contains different occupations by humans, cave bear, and other carnivores, but also accumulated over an extended period of time comprising climatic oscillations of opposite signal — stadials with reindeer and mammoth, at least one interstadial with roe deer. Moreover, two of the three dates on unmodified bones with mid-points in excess of ca.37 ka BP mentioned above — OxA-5163 (37,300±1800 BP) and ETH-8267 (37,800±1050 BP) — are statistically identical to the roe deer date. OxA-5163 is on an unidentified bone fragment, ETH-8267 is on an ibex mandible. If the latter were also anthropically-accumulated, it might relate to the same episode of human use of the site documented by the dated roe deer. In any case, given the regional topography, the ecological signature of ibex is compatible with the presence of roe deer in the global environment of humans using the site.

Assuming, on the basis of the uncalibrated ^{14}C results, that the dated roe deer bone with impact marks does represent a separate epoch of human use of the Geissenklösterle, is it also related to the earlier of the two functional modes of occupation diagnosed by Liolios and Teyssandier (2003) ? This cannot be excluded, in which case the emergence of "typical" Aurignacian lithic and bone technology would have to be placed ca.36.5 ka BP. Once we accept that we are working with a palimpsest, however, we also have to admit the possibility that the bone in question relates instead to an episodic human use of the site during a milder episode of OIS 3 that may not have left behind any diagnostic lithic or osseous artifacts. We believe the latter is more likely, because, on the basis of the lithic technology, AHIII correlates well with the "typical Aurignacian" of southwestern France dated to ca.33-35 ka BP, i.e., to the time interval indicated by the four anthropically-modified dated reindeer bones from that horizon (fig. 4). In fact, AHIII virtually replicates the Aurignacian in level 7 of Roc de Combe and levels G-I of Le Piage (Bordes 2002, 2003), characterized by the use of carinated "burins" and carinated "scrapers" to produce mid-sized bladelet blanks with a curbed profile that for the most part remain unretouched. This system (Bon 2002) apparently post-dates and, at Isturitz (Normand and Turq, in press) and Le Piage (Bordes 2002), stratigraphically overlies the earliest Aurignacian of the Aquitaine basin, dated at Isturitz to ca.35-37 ka BP and characterized by the use of prismatic cores and nucleiform burins to produce large-sized bladelet blanks with a straight profile that for the most part are intensively retouched into Dufour bladelets of the Dufour subtype (Bordes 2002, 2003) — as in the true "Proto-Aurignacian" of l'Arbreda and Fumane, dated to that same time interval.

Our view of the chronological significance of the dated roe deer bone is also consistent with the stratigraphic evidence; that bone comes from the very bottom of the geological package containing the Upper Paleolithic occupations of the cave — level IIIb, located below the main concentration of remains used to define the "earlier Aurignacian" of the Geissenklösterle (level IIIa). Moreover, our view also conforms well with what we know about the timing of the climatic events taking place during OIS 3, as well as to the dating and environmental context of the classical Aurignacian. The fauna found in AHIII suggests that the earliest Aurignacian occupation of the Geissenklösterle took place during a cold phase (Münzel 1997, 2001). The time interval we propose for this occupation (ca.33-35 ka BP) corresponds to the global climatic deterioration known as Heinrich 4 event, dated in a number of marine cores between ca.35.3 and 33.9 ka BP (Elliot *et al*. 2002; Auffret *et al.* 2002). Correlation of AMS dated Aurignacian sites from France and Northern Iberia with the Dansgaard-Oeschger climatic curve has recently shown (d'Errico and Sánchez Goñi 2003) that most of these occupations, featuring assemblages characterized by a technology similar to that observed at Geissenklösterle and associated with cold faunas, have AMS dates falling within the time span of that climatic event.

In such a context, the presence, at the very bottom of the package of deposits lumped together to form AHIII, of a roe deer bone modified by humans and dated to 36,560/+410/-390 BP (KIA-16032), suggests sporadic incursions of humans in the cave during the interstadials (Is 9-10) which immediately preceded the Heinrich 4 event. We argued above that this temperate-climate human

occupation of the cave ca.36.5 ka BP is unlikely to be related to the Aurignacian occupation responsible for the bulk of the remains forming Geissenklösterle's AHIII. Could it be related to an earlier form of the Aurignacian akin to the "Proto-Aurignacian" of l'Arbreda and Fumane? Even if the archeological individualization within AHIII of the ca.36.5 ka BP occupation does not seem feasible with currently available evidence, such a possibility cannot be excluded. Bon (2002) and Bordes (2002, 2003) have suggested that Aurignacian level VII of the Grotte du Renne, at Arcy, is of the "Proto-Aurignacian" kind, which would imply a chronology of ca.35-37 ka BP for that level (and an even earlier age for the underlying Châtelperronian levels, confirming the extremely problematic nature of the Arcy dating record — Zilhão and d'Errico 1999, 2003 ; David *et al*. 2001). If the view of Bon and Bordes is accepted, this "Proto-Aurignacian" system would not have been restricted to circum-Mediterranean areas and, given its presence in northern Burgundy, might well have been present at the same time in southwestern Germany as well.

Level 3 of Willendorf II (even if a categorical diagnosis cannot be reached because of the small size of the assemblage recovered therein — Haeserts and Teyssandier 2003), is another possible manifestation of that earliest Aurignacian in Central Europe. As shown in fig. 5, its ^{14}C chronology compares well with that for sites of the earliest Aurignacian also dated on charcoal samples (table 2) — Isturitz, Romaní, and La Viña. El Castillo and l'Arbreda are not considered in the comparison due to the reasons explained before (Zilhão and d'Errico 1999); in fact, the excavators of El Castillo have since accepted that the industry associated with the ca.39.5 ka BP dates in level 18 is not a true Aurignacian (they now designate it "Transitional Aurignacian of Castillo 18b- and 18c-type", and consider it to be the equivalent of the Châtelperronian, the Uluzzian, and the Bachokirian — Cabrera *et al.* 2001). The three conventional measurements on a single charcoal sample of between ca.37.5 and ca.38.6 BP for the open air site of Keilberg-Kirche, near Regensburg, Germany (Uthmeier 1996), also fall in the same time range. Thus, even if Keilberg-Kirche, level 3 of Willendorf II, and the "roe deer occupation" of the Geissenklösterle are all accepted as genuine evidence for the Aurignacian and modern humans in central Europe, the chronological horizon proposed by Zilhão and d'Errico (1999) for the emergence of the technocomplex stands and the claims of precedence for the Swabian Alb are unwarranted.

How do we then explain the single ca.40 ka BP date (40,200±1600 BP) for the unmodified horse femur sample OxA-4595 ? In several cases, we argued before (Zilhão and d'Errico 1999) that, when discrepant ^{14}C results existed for different Châtelperronian levels, the earlier ones should be retained because of the impact that even a very small amount of undetected chemical contamination has on samples whose age is near the practical limit of the radiocarbon method. This applies in particular to the Grotte du Renne, where there is clear evidence that modern contaminants affected bone chemistry, as was to be expected given that, after the collapse of the cave's roof during the Gravettian, the site stayed in the open, and an important forest soil developed on top of the previously accumulated deposits, significantly altering them, throughout at least the entire Holocene. The impact this factor must have had on the rejuvenated results obtained for the Grotte du Renne sequence is made apparent by the systematic differences between samples collected in exterior and interior areas of the same levels that have been reported from the cave sites of Fumane, Italy (Broglio and Improta, 1994-95), and Sesselfels, Germany (Richter 2002). In Fumane, dates for basal Aurignacian level A2 collected in the porch range between 32,100±500 BP (UtC-2047) and 32,800±400 BP (UtC-2051), whereas those collected inside the cave range between 34,200/+900/-1000 BP (UtC-2690) and 36,800/+1200/-1400 BP (UtC-2688). In Sesselfels, dates for the sequence of Micoquian levels G1-G4a/5 range, from top to bottom, between 30,770/+250/-240 BP (GrN-20305) and 36,030/+1180/-1030 BP (GrN-20312) for samples collected in the porch; for samples col-

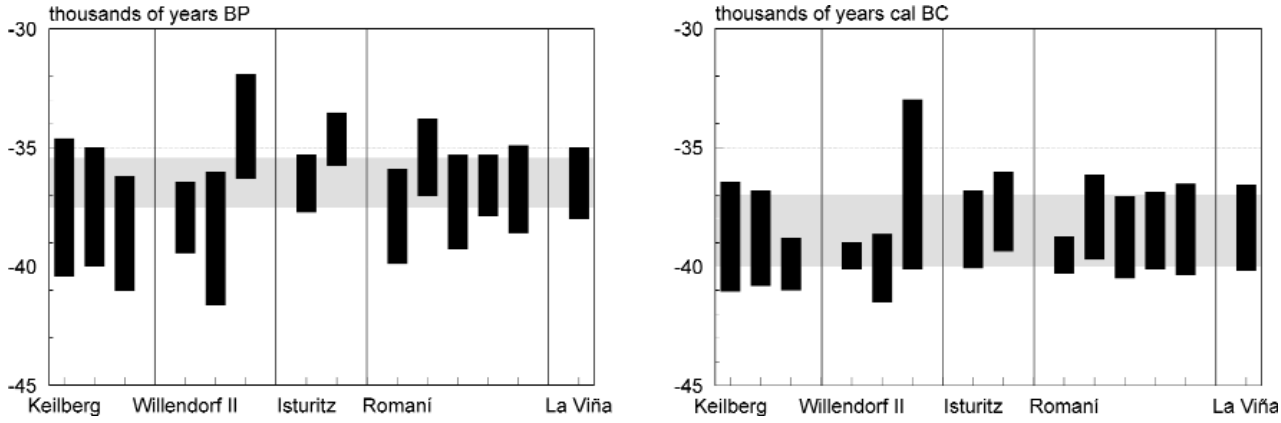

Figure 5 - ^{14}C dates on charcoal for the early Aurignacian levels of Keilberg-Kirche, Willendorf II, Isturitz, Romaní and La Viña. Left: uncalibrated BP ages. Right : CalPal (Weninger and Jöris 2003) calibrated BC ages.

Figure 5 - Dates ^{14}C sur charbon pour les couches de l'Aurignacien ancien de Keilberg-Kirche, Willendorf II, Isturitz, Romaní et La Viña. Gauche : dates non calibrées BP. Droite : dates BC calibrées avec CalPal (Weninger et Jöris 2003).

Site	Level	Lab no.	Method	Date BP	Age calBC
Keilberg-Kirche	-	KN-4690	Conventional	37500±1450	38750±1150
	-	KN-4691	Conventional	37500±1250	38810±1000
	-	KN-4692	Conventional	38600±1200	39890±550
Willendorf II	layer 3	GrN-17806	Conventional	37930±750	39540±290
	layer 3	GrN-17805	Conventional	38800±1405	40060±710
	layer 3	GrN-11192	Conventional	34100±1100	36530±1780
Isturitz	U27, 4d	GifA-98232	AMS	36510±610	38440±820
	V1 26	GifA-98233	AMS	34630±560	37680±840
Romaní	2, AR-2	AA-8037B	AMS	37900±1000	39530±390
	2, AR-2	AA-8037A	AMS	35400±810	37930±890
	2, AR-5	AA-7395	AMS	37290±990	38780±860
	2, AR-5	NZA-2311	AMS	36590±640	38480±820
	2, CVN-2	AA-6608	AMS	36740±920	38430±950
La Viña	XIIIinf	Ly-6390	Conventional	36500±750	38360±910

Table 2 - Earliest radiocarbon dates on charcoal securely assiociated with the Aurignacian in Central Europe and the Franco-Cantabrian region (sources : Bischoff et al. 1994 ; Fortea 1995 ; Uthmeier 1996 ; Svoboda 2003 ; Turq n.d.) ; cal BC ages calculated with CalPal calibration software (Weninger and Jöris, 2003).

Tableau 2 - Les plus anciennes dates ^{14}C sur charbon associées de façon sûre à l'Aurignacien de l'Europe centrale et de la région franco-cantabrique (sources : Bischoff et al. 1994 ; Fortea 1995 ; Uthmeier 1996 ; Svoboda 2003 ; Turq n.d.) ; Les dates calibrées BC ont été calculées avec le logiciel CalPal (Weninger and Jöris, 2003).

lected inside the cave, however, the range is between 39,950/+970/-870 BP (GrN-20302) and 47,860/+960/-860 BP (GrN-20314). These examples show how likely it is that the dates for the Grotte du Renne, all from samples collected in porch deposits, similarly underestimate the true age of its Châtelperronian occupations.

No such evidence exists at Geissenklösterle, and we agree with Conard and Bolus (2003) that the AMS dates for this site, all obtained quite recently, should be considered valid from the points of view of chemical pre-treatment and precision of the physical measurements. Moreover, unlike at many other sites, the Aurignacian sequence of the Geissenklösterle is AMS dated by 25 samples, not simply two or three. This makes it legitimate to consider that the problem here is one of association, i.e., taphonomical and archeological, not one of technical accuracy. And, given the major hiatus in human occupation between the Middle Paleolithic in AHIV and the ca.36.5 ka BP "roe deer incursion" documented in the basal levels of AHIII, we feel justified in believing that the most parsimonious explanation for that "too early for the Aurignacian" ca.40 ka BP result is that the horse bone which produced it was accumulated by carnivores using the cave during the time period of that hiatus. We believe that using this single date to counter not only the technological and typological evidence but also the other 19 ^{14}C results for AHIII is methodologically unsound and empirically unrealistic.

One must also bear in mind that, ca.39-40 ka BP, Germany was still inhabited by Neandertals manufacturing late Middle Paleolithic tool-kits such as those which, in the Feldhofer cave type-site, were associated with the two individuals directly dated to that time range by ^{14}C AMS (Schmitz *et al*., 2002). Since we do not know what was the exact time of extinction of these populations, we must also consider the possibility that any sporadic human incursions into German cave sites associated with dates whose mid-points are in the ca.39-35 ka BP interval but that did not leave behind any diagnostic artifacts may have been by late Middle Paleolithic or Transitional Neandertals. Assuming the calendar validity of its separateness in the uncalibrated ^{14}C time scale, we have discussed above two different possibilities of interpretation for the Geissenklösterle's "roe deer occupation": that it could have been part of the same technocultural system as that ca.33-35 ka BP, in which case it would represent a typical Aurignacian earlier than usual; or that it could represent a Proto-Aurignacian incursion leaving behind no diagnostic items. But, given that its cultural nature is speculative, that Neandertals are present in Germany at least until ca.39 ka BP, and that elsewhere in central and western Europe Neandertal-related technocomplexes such as the Châtelperronian, the Uluzzian or the Szeletian (Zilhão and d'Errico 1999 ; Churchill and Smith 2000) are dated to ca.39-35 ka BP, a relation with regional Neandertal activity of the sporadic incursion into the site which we hypothesize as the best explanation for that anthropically-modified dated roe deer bone cannot be excluded either.

The fact that Conard and Bolus (2003) do not consider the possibility of Neandertal involvement in the accumulation of at least part of Geissenklösterle's AHIII is most puzzling. Given the direct dates for the Neandertals from the type-site, and given that there are no early modern human fossils in Europe dated in excess of ca.35 ka BP (see below), arguing that the Aurignacian of the Swabian Alb dates to ca.40 ka BP should have led them to follow Richter's (1996) suggestion that the earliest Aurignacian and the cultural innovations it is supposed to stand for are the work of the last Neandertals. Instead, they credit them to modern humans whose osteological remains are simply non-existent, at that time, anywhere in the region. Our view of the site's dating record effectively resolves this problem. By showing that the bulk of the human occupation documen-

ted in AHIII must be associated with the anthropically-modified bones dated to ca.33-35 ka BP, we bring the Aurignacian of Geissenklösterle to a time range when modern humans are known to be around on the basis of the "hard" evidence provided by their skeletons.

Conclusion

The following points summarize our conclusions on Geissenklösterle. We agree with Conard and Bolus (2003) that the diagnostic items of lithic and osseous technology present in AHIII are related to the Aurignacian, but we believe that the bulk of the Aurignacian remains in that horizon dates to ca.33-35 ka BP, the time interval indicated by all results obtained for it on samples of anthropically-modified reindeer bones. One roe deer bone with impact marks is dated to ca.36.5 ka BP, and may well be related to an earlier Aurignacian occupation of the site, but that is at present speculative, and all the more so since, using calibrated ages, the two time intervals cannot be differentiated. There is no secure evidence of Upper Paleolithic human activity, Aurignacian or other, at the site, before ca.36.5 ka BP. The ca.40 ka BP age indicated by Conard and Bolus is supported by a single date on a non-modified horse bone that is more likely to represent carnivore activity at the site prior to the Aurignacian. Zilhão and d'Errico (1999) had concluded that the earliest recognizable Upper Paleolithic occupation of the Geissenklösterle could well date to ca.37 ka BP or beyond, but might not have been Aurignacian. Thus, we seem to have been wrong on two counts : the earliest recognizable Upper Paleolithic occupation of the Geissenklösterle occupation is indeed Aurignacian, but no earlier than ca.33-35 ka BP.

This occupation is, therefore, at best contemporaneous with the earliest Aurignacian of the rest of central and western Europe, and its dating provides no support for the Danubian corridor and the *Kulturpumpe* models. This contemporaneity should come as no surprise. Given the large standard deviations of radiocarbon dates in this time period, we propose that the emergence of the Aurignacian inevitably must be archeologically perceived as instantaneous throughout its range (the Iberian Peninsula south of the Ebro excepted, as well as other peripheral regions of Europe, because of the large time lags involved — *cf.* Zilhão 2000). This is simply because, in the absence of unsurmountable natural or cultural barriers, new people, as well as new objects and new ideas, will spread across such a small continent as Europe (over the extensive exchange networks characteristic of hunter-gatherer societies) much faster than the two or three millennia which are the minimum unit for counting time allowed by the resolution of available dating methods.

Claims of an Aurignacian "earlier-than-everywhere-else" based on chronometric results have been proposed before, for instance for northern Spain, mainly on the basis of the evidence from El Castillo (e.g. Cabrera and Bischoff 1989). We suggested (Zilhão and d'Errico 1999) that such claims were based on illusory patterns of association between dated samples and the events they were supposed to date, and we believe the same applies to Conard and Bolus's (2003) view of the Geissenklösterle's ^{14}C record. The magnitude of this association problem is further illustrated, for southwest Germany, by the radiocarbon data provided by Conard and Bolus (2003) for the other site in the region with samples from modern excavations, the Höhle Fels. Level IIc, Gravettian, yielded two AMS dates on bone of ca.29 ka BP ; immediately underlying levels IId and IIe, already Aurignacian, yielded three AMS dates on bone of ca.29.5-30.5 ka BP ; below, level III yielded another three AMS dates on bone of ca.30-31 ka BP, and level IV two AMS dates on bone of ca. 31-33 ka BP ; all, therefore, internally consistent and in stratigraphic order. However, one AMS charcoal date for level III of ca.28 ka BP and another AMS charcoal date for level IV of ca.29 ka BP are in disagreement with the sequence. As in the Geissenklösterle, no simple explanation exists for these results and it is clear that none will be found unless the vertical displacement of items is duly accounted for as part of the problem. As is the case with the Aurignacian, we are confident that continued research will eventually show that this factor explains the proposed anteriority of the Gravettian of the Swabian Alb better than the *Kulturpumpe* model.

It is increasingly clear that the twin issues of the emergence of modern human anatomy and modern human behavior in Europe must be decoupled from the issue of Aurignacian chronology. We agree that an association between even the earliest Aurignacian and modern humans makes sense and is quite likely (*cf*. for extensive discussions of this issue, Churchill and Smith 2000 ; Zilhão and Trinkaus 2001 ; Zilhão and d'Errico 2003). Other possibilities remain, however, even if the results of recent research would seem to bring a demonstration of that association closer to us.

The modern human mandible with archaic features reported by Trinkaus *et al*. (2003) from the Oase cave, in Romania, dated to ca.34-36 ka BP, is at present the earliest secure evidence for anatomical modernity in Europe; its cultural-archaeological context and background, however, remain unknown. Svoboda *et al*. (2002) report radiocarbon dates on stalagmitic crusts from Mladec I that suggest an age of ca.34-35 ka BP, or slightly earlier, for the human remains found therein with typical Aurignacian bone tools. However, as the authors note, radiocarbon dating of stalagmite is problematic, and, therefore, these results need independent corroboration through direct dating of the human bone itself before they can be fully accepted. Conard and Bolus (2003) interpret the new dates from Aurignacian layer V of Vogelherd as suggesting that the modern human remains found therein could be as early as ca.36 ka BP. Four of the five dates they report, however, are in the range of ca.32-33 ka BP. Moreover, as they acknowledge, the fact that these samples come from old excavations make the establishment of the archeological associations of AMS dates even more problematic than is usually the case. Since AMS samples from Aurignacian level IV yielded Magdalenian and Gravettian dates, it cannot be excluded that the "Aurignacian" human remains from Vogelherd relate instead to intrusive burials from later occupations of the site. That caution is in order here is also implied by the results reported by Smith *et al.* (1999), Svoboda *et al*. (2002), and Terberger

and Street (2003) for the direct dating of human remains of presumed Early Upper Paleolithic age coming from geological contexts or from old excavations of a number of localities in Croatia, Moravia and Germany : all (Velika Pecina, Zlaty kun, Svitávka, Hahnöfersand, Paderborn-Sande) turned out to be significantly later. Recent dating of ornaments associated with the Cro-Magnon burials (Henry-Gambier 2003) has also indicated that these are Gravettian, not Aurignacian.

In any case, whether the earliest Aurignacian is or is not solely the work of anatomically modern humans, modern human behavior, if defined on the basis of symbolic reasoning materialized as ornaments or art, unquestionably predates the Aurignacian in Europe and neighboring regions of Asia (cf. also Bar-Yosef 002 ; Stringer 2002). This is demonstrated not only by the Châtelperronian of Grotte du Renne, at Arcy (d'Errico *et al*. 1998), but also by the Initial Upper Paleolithic of such Near Eastern sites as Ksar 'Akil or Uçagizli (Kuhn *et al.* 2001). We know that Neandertals were responsible for the Chatelperronian of Arcy, and we suggested that, hence, the Upper Paleolithic and behavioral modernity are not biologically determined and exclusive of *Homo sapiens sapiens* (Zilhão 1997, 2001 ; d'Errico *et al*. 1998 ; Trinkaus *et al*. 2001 ; Zilhão and Trinkaus 2001; d'Errico 2003).

Even for those working under the paradigm that modern anatomy explains modern behavior, it is clear that the weight of the evidence now goes to suggest that finding an Aurignacian as early as can be is no longer a viable strategy to explain the emergence of modern behavior in Europe. If the latter is related to the presence of anatomically modern humans in the landscape, and explains, through acculturation or other mechanisms, the Grotte du Renne "oddity", then those modern humans could not be Aurignacian. They may well have been Bachokirian, as implied by Otte and Kozlowski (2003), or Bohunician, as suggested by Svoboda (2003), in which case they would certainly have been around before ca.36.5 ka BP. But positive evidence to that effect, so far, has been simply lacking, and, in our view, the dates for the Aurignacian of the Geissenklösterle in no way contribute to fill the void.

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