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THE CHRONOLOGY OF THE SOUTH-WEST FRENCH MOUSTERIAN: A REVIEW OF THE CURRENT DEBATE

by

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1. INTRODUCTION

The chronology of the classic sequence of Mousterian industries recorded within the cave and rock-shelter sites of South-western France has been a topic of lively debate for over 20 years. In a series of earlier papers, I have put forward a chronological framework for the major industrial variants of the Mousterian within this region, based primarily on a range of direct stratigraphic observations (MELLARS, 1965, 1967, 1969, 1970, 1986a, 1986b). This chronology has in turn been contested strongly by Henri Laville, on the basis of his general framework of 'chronostratigraphic' correlations for French Mousterian sites, derived primarily from studies of sedimentological and related palaeoclimatic data (LAVILLE, 1973, 1975, 1987; LAVILLE *et al.*, 1980, etc.).

The central feature of this debate concerns the relative and absolute chronology of the various occurrences of Ferrassie, Quina and Mousterian of Acheulian Tradition industries, as defined in the classic studies of François Bordes (BORDES, 1953, 1961, 1968, 1981, 1984, etc.). Whereas my own chronology postulates a relatively high degree of separation and chronological patterning in the occurrences of these three variants, the chronology proposed by Laville implies that all three of these industrial variants were being manufactured within the caves and rock-shelters of South-west France throughout at least the greater part – if not the whole – of the Mousterian succession (see Figure 1; LAVILLE, 1973: 327; 1975: 393; LAVILLE *et al.*, 1980: 212).

The aim of the present paper is to provide a brief review of these current debates over the relative and absolute chronology of the South-west French Mousterian, in the light of the important new evidence which has accumulated over the past few years. Probably the most significant development has been the recent application of absolute dating techniques to the crucially important archaeological and climatic succession in the lower shelter of Le Moustier (VALLADAS *et al.*, 1986; see also MELLARS, 1986a, 1986b; MEIGNEN, 1987). As a result of this dating, Laville has now proposed some important revisions to his general framework of chronostratigraphic correlations for the earlier stages of the last glaciation and, in particular, has revised his earlier correlations between the archaeological and climatic sequences at Le Moustier and Combe Grenal (LAVILLE *et al.*, 1986; LAVILLE, 1987).

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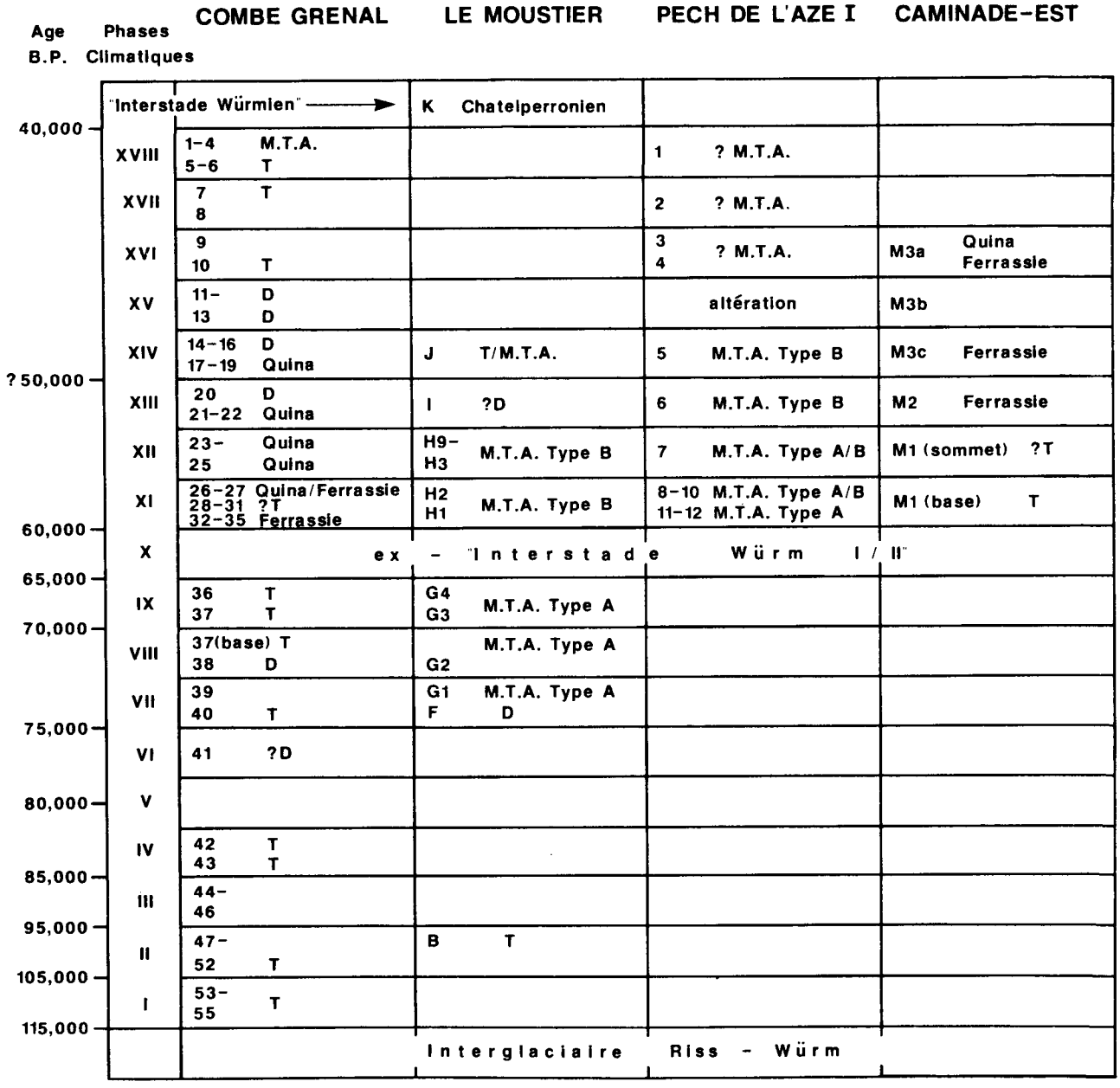

FIGURE 1 – Correlation of Mousterian sequences at Combe Grenal, Le Moustier (lower shelter), Pech de l'Azé I and Abri Caminade-Est, proposed by H. Laville (after LAVILLE et al., *1980, Fig. 7.11; see also LAVILLE, 1973, Fig. 1 and LAVILLE, 1975, Table III). The absolute chronology shown on the left of the diagram is taken from LAVILLE* et al., *1986, Table 4, and LAVILLE, 1987, Table 5 (see Note 1). M.T.A. = Mousterian of Acheulian Tradition; T = Typical Mousterian; D = Denticulate Mousterian.*

Other important developments have come from the excavation of new Mousterian sites (or in some cases the re-excavation of older sites) and from a range of studies of the general patterns of climatic and environmental change during the earlier part of the last glaciation derived from recent analyses of both deep-sea cores and terrestrial deposits (e.g. SHACKLETON *et al.*, 1983; TURON, 1984; WOILLARD and MOOK, 1982; BEAULIEU and REILLE, 1984, etc.).

It should be emphasised that these issues of chronology continue to have a critical bearing on almost all aspects of our current understanding of the behaviour and adaptation of Middle Palaeolithic/Neanderthal populations in Europe (such as the questions of technological change over time, 'functional variability' in assemblage form, 'ethnicity' in artefact manufacture, the relative and absolute chronology of the associated Neanderthal remains etc.), and are therefore directly relevant to the general theme of the present Colloqium. The relevant issues may be summarised, rather briefly, as follows.[1]

2. DATING OF THE LE MOUSTIER (LOWER SHELTER) SEQUENCE

The recent publication of a long series of thermoluminescence dates for the archaeological sequence in the lower shelter of Le Moustier (VALLADAS *et al.*, 1986) has critical implications for the present debates over the relative and absolute chronology of the South-west French Mousterian. In all, 34 samples of burnt flint have been dated, all collected during a recent, controlled excavation on the site, and spanning the greater part of the archaeological succession. The general pattern of the dates obtained for the different levels is generally coherent and internally consistent, and shows close agreement (within the limits of statistical error) with the documented stratigraphic sequence of the samples (see Fig. 2). An important feature of the dating is that the dates obtained for the uppermost level in the sequence (layer K, containing a Chatelperronian industry) can be compared directly with the known age of this level, as documented by radiocarbon dating of other sites in Western France (HARROLD, 1983). On this basis, the TL dates recorded for layer K are perhaps slightly older than one would have expected from the radiocarbon evidence, but are certainly not too young. As LAVILLE *et al.* have recently emphasized (1986: 40) the general coherence and internal consistency of the dates secured for the different levels inspires a high degree of confidence in the absolute chronology proposed for the Le Moustier sequence as a whole.

This new dating of the Le Moustier sequence however reveals some major conflicts with the earlier interpretations of the relative and absolute chronology of the Le Moustier deposits, proposed by Laville on the basis of his general framework of climatic and 'chronostratigraphic' correlations (see LAVILLE, 1973, 1975; LAVILLE *et al.*, 1980, 1986). Essentially, these conflicts are as follows (see Fig. 3):

[1] *Note added in Press* : While the present paper was in press, Laville has proposed an entirely new framework of absolute chronology for the climatic and archaeological sequence at Combe Grenal, based on a revision of his earlier system of correlations with the sequence of oxygen-isotope stages in deep-sea cores (cf. LAVILLE *et al.*, 1986, Table 4; LAVILLE, 1987, Table 5). This new chronology was presented verbally by Laville at the Colloqium on *Paléolithique Moyen Récent et Paléolithique Supérieur Ancien en Europe* in Nemours in May, 1988, and has now (I understand) been incorporated into the paper contributed by Laville to Volume 2 of the published proceedings of the present Symposium.
This new chronology now corresponds almost exactly with that which I proposed for the correlations between the Combe Grenal sequence and the oxygen-isotope record in ocean cores in *Nature* in July 1986 (MELLARS, 1986a, Fig. 1; see Figure 6 of the present paper). Unfortunately, these revisions in Laville's chronology were not available when the present article was written and submitted to press.

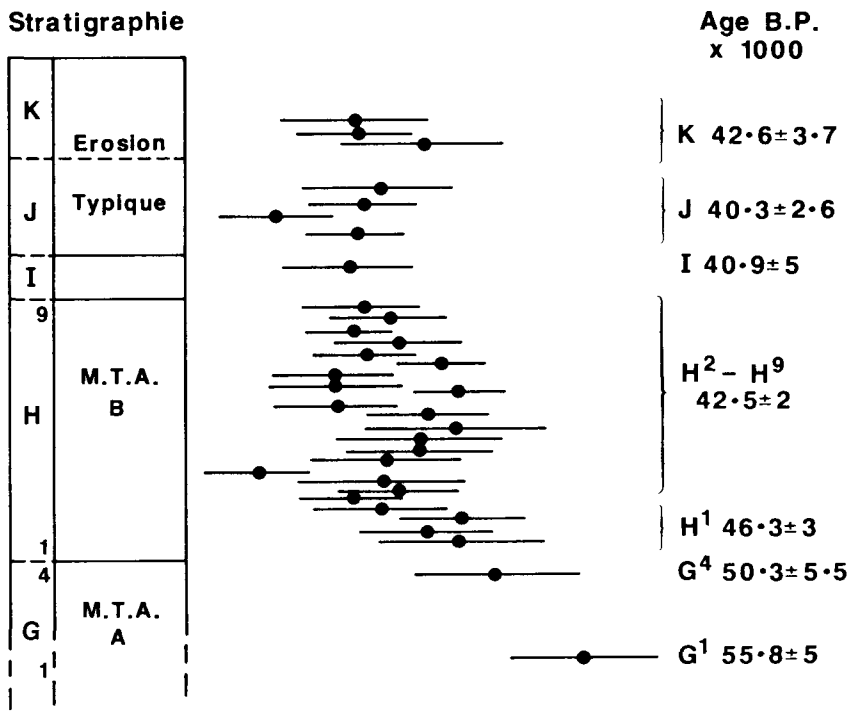

FIGURE 2 – *Thermoluminescence dates for the archaeological sequence in the lower shelter of Le Moustier, after VALLADAS et al., 1986, Fig. 1.*

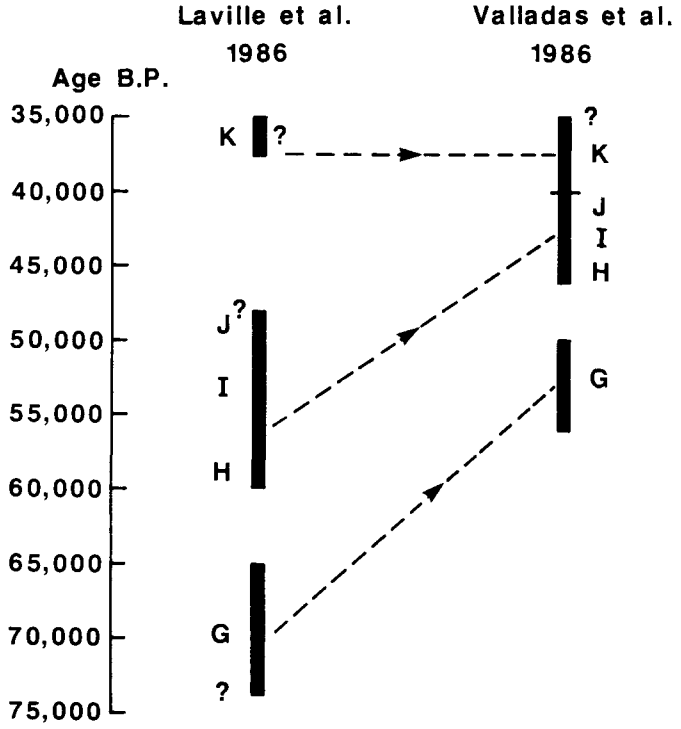

FIGURE 3 – *Revised dating of the Le Moustier (lower shelter) sequence implied by the recent TL dating of VALLADAS* et al. *(1986). The chronology originally proposed by H. Laville for the sequence is shown on the left (after LAVILLE* et al., *1986, Table 4, and LAVILLE, 1987, Table 5). The chronology shown on the right is based on the average of the TL measurements for each layer, which have standard deviations ranging from 2,000 to 5,500 years (see Figure 2).*

1. The earlier correlations of Laville have postulated a major stratigraphic and chronological hiatus within the uppermost part of the Le Moustier sequence, between the Mousterian levels in layers G-J, and the early Upper Palaeolithic horizons (Chatelperronian and Aurignacian) in layers K and L. In all of the earlier correlations (e.g. LAVILLE, 1973: 325; 1975: 370; LAVILLE *et al.*, 1980: 180; 1986: 40) this hiatus has been assumed to span the last four major climatic phases of the early Würm (i.e. phases XV-XVIII of the present climatic scheme) and has been equated chronologically with the total sequence of layers 1-13 at Combe Grenal (see Fig. 1). In absolute terms, the duration of this hiatus has been estimated at around 10-15,000 years (LAVILLE *et al.*, 1986: 40). The results of the TL dating now show that there is in fact no significant stratigraphic hiatus at this point in the Le Moustier sequence (Figs. 2 and 3). The dates recorded on either side of the supposed hiatus are indistinguishable in statistical terms, and clearly point to essentially continuous deposition on the site throughout this interval.

2. The new thermoluminescence dates similarly indicate a very much shorter time-span for the formation of layers G-K at Le Moustier than has been assumed in all of the earlier geological interpretations of the site. Previous estimates have consistently suggested a total duration for this part of the sequence of the order of 35-40,000 years (LAVILLE *et al.*, 1983: 223-5; 1986: 40). The recent TL dates, by contrast, point to a **maximum** time-span for these deposits in the region of 15-20,000 years (Fig. 3). Evidently, the accumulation of sediments and occupation levels over this part of the sequence was much more rapid than the earlier interpretations have assumed.

3. The combination of these new data clearly requires a major revision of all of the earlier published correlations between the total climatic and geological succession at Le Moustier and that represented at Combe Grenal (Fig. 1). The most significant aspect of this revision relates to the position of the traditional 'Würm I-II interstadial' in the two sites. At Combe Grenal, the position of the 'Würm I-II' interstadial (defined by a thin weathering horizon between layers 35 and 36 (LAVILLE, 1975: 163; LAVILLE *et al.*, 1980: 192) has been equated consistently with the transition from stage 4 to stage 3 in the oxygen-isotope record in deep-sea cores, and accordingly dated in the region of 60-65,000 BP (LAVILLE *et al.*, 1983: 223-5; 1987: 38-40) (see Note 1). At Le Moustier, on the other hand, the horizon which was **originally** equated with the Würm I-II interstadial at Combe Grenal (i.e. the interface between layers G and H, marked by a much deeper weathering horizon: LAVILLE, 1975: 184; LAVILLE *et al.*, 1980: 174-8, 196) has now been dated to ca. 45-50,000 BP – that is, at least 10-15,000 years **later** than the previously inferred correlation between these two events. The clear implication of this revised dating is therefore that the major weathering horizon recorded between layers G and H at Le Moustier must now be seen to represent an entirely separate – and very much later – climatic event within the total climatic sequence of the early Würm (LAVILLE *et al.*, 1986: 40).

The reality of these conflicts has now been frankly acknowledged by Laville, and summed up in the following terms:

> 'Les dates TL tendent à rajeunir l'ensemble des couches H1 à J en les plaçant entre 45.000 et 39.000 B.P. environ, soit à la fin du Würm ancien. On est donc conduit à mettre en question les corrélations précédemment proposées et à envisager l'existence d'un hiatus de quelques millénaires entre les couches G4 et H1 (quel que soit l'âge de ces dernières). Ce hiatus pourrait être la conséquence des processus d'érosion que porte le sommet de G4, primitivement attribués à l'une des manifestations de la phase X, mais qui pourraient être bien postérieurs et contemporains par exemple de l'un des épisodes de plus forte humidité que sont les phases XIII et XV du Würm ancien; les associations végétales définies dans les couches H1 à J ne

s'opposent pas à un tel 'rajeunissement'.

> La série cohérente de dates TL obtenue au Moustier apporte donc des éléments de réflexion constructifs et stigmatise la difficulté d'apprécier l'ampleur des lacunes dans les séquences stratigraphiques'. (LAVILLE *et al.*, 1986: 40).

The critical importance of this new dating for Le Moustier, therefore, is that it implies a radical departure from all of the earlier correlations between the geological and archaeological sequences at Le Moustier and Combe Grenal, proposed by Laville on the basis of sedimentology and other forms of palaeoenvironmental data. This in turn has critical implications for any discussion of Mousterian chronology since (as noted in Section 1 above) the earlier correlations have been cited repeatedly as demonstrating a direct synchronism between the main sequence of Ferrassie and Quina Mousterian industries at Combe Grenal, and the long sequence of Mousterian of Acheulian Tradition industries (comprising both 'Type A' and 'Type B' variants) represented at Le Moustier (see Fig. 1). In all of the publications by Laville over the past 15 years, these two sequences have been cited as the crucial, keynote sequences in demonstrating the essential chronological parallelism of the Mousterian of Acheulian Tradition and Ferrassie-Quina variants of the Mousterian within South-west France, and as categorically refuting any hypothesis of a chronological succession within these variants (e.g. LAVILLE, 1973: 324-7; 1975: 393; LAVILLE *et al.*, 1980: 210). As a result of the new dating of Le Moustier, this correlation has now been formally withdrawn by Laville, and he now acknowledges that the sequence of M.T.A. horizons at Le Moustier is entirely **later** than the sequence of Ferrassie and Quina Mousterian levels at Combe Grenal (LAVILLE, 1987) [2]. Inevitably, one must now pose the question: if this critical correlation between the climatic and archaeological sequences at Combe Grenal and Le Moustier has now, in effect, collapsed, what implications does this have for any of the other correlations – proposed by Laville on the basis of precisely similar climatological reasoning – for other Mousterian sequences within South-west France?

In the light of this radically revised dating of the Le Moustier sequence, it is hardly possible to argue that corresponding revisions are not required in the climatic correlations proposed by Laville for many other sites in the Périgord region. As discussed above, the horizon in the Le Moustier sequence which was originally correlated with the 'Würm I-II interstadial' at Combe Grenal has now been shown to represent an entirely separate, and much later, event in the climatic succession of the early Würm. In a sense there are now, in effect, two separate 'Würm I-II interstadials' within the Périgord sequence. It follows automatically from this that all of the climatic correlations which were previously proposed between layers G-J at Le Moustier and layers 39-14 at Combe Grenal must be changed in the light of these new correlations (see Fig. 1). In other words, the entire sequence of climatic fluctuations which immediately follows the 'Würm I-II interstadial' at Combe Grenal can now be seen to be repeated – at Le Moustier – at a much later stage in the Würmian sequence. Inevitably, this must now allow at least two **alternative** correlations for the climatic records in any other sites which were previously correlated with this part of the climatic sequence. For example, in all of the earlier correlations of Laville, the sequence of climatic and environmental fluctuations recorded in layers H , I and J at Le Moustier has been correlated

[2] A series of three thermoluminescence dates has been obtained recently by Hélène Valladas for the site of Fonseigner (Dordogne) currently under excavation by J.-M. Geneste (VALLADAS, 1985). The date of 50,200 ± 5300 BP obtained for the uppermost level in the sequence (containing a Mousterian of Acheulian Tradition industry) compares very closely with the dates obtained for the similar levels of Mousterian of Acheulian Tradition at Le Moustier (VALLADAS *et al.*, 1986). Two further dates of 52,800 ± 5500 and 56,400 ± 6800 BP were obtained for levels provisionally described as 'Typical Mousterian' in the lower part of the sequence.

directly with a supposedly identical pattern of fluctuations recorded in layers 5-12 at Pech de l'Aze site I (LAVILLE, 1973: 325; 1975: 370; LAVILLE *et al.*, 1980: 181, 201) (Fig. 1). If the chronology of these levels at Le Moustier – and their correlation with the Combe Grenal sequence – has now been changed, then this must automatically imply that corresponding changes in the dating and correlation of the sequence at Pech de l'Azé I are at least **possible** , if not essential [3]. Similar arguments can be applied to the correlations originally proposed between the climatic and sedimentological sequences at Le Moustier and the Abri Caminade (LAVILLE, 1973: 325; 1975: 370: LAVILLE *et al.*, 1980: 181, 202), which must presumably also be revised. Clearly, we are now confronted by major ambiguities and contradictions in the whole scheme of climatic and geological correlations proposed by Laville between these different sites, which must inevitably cast doubt on the whole of the current structure of 'chronostratigraphic' correlations for the overall climatic sequence of the early Würm (see FREEMAN, 1983; KLEIN, 1983; MELLARS, 1982; REYNOLDS, 1985).

Finally, it should be emphasized that any reluctance to revise the dating of sites such as Pech de l'Azé sites I and IV in accordance with the revised chronology of the Le Moustier sequence, would create a further range of inconsistencies and contradictions in the interpretation of the archaeological data. As BORDES frequently emphasized (e.g. 1975: 303-5; 1981: 77-8; 1984: 149) the archaeological sequences at all three of these sites reveal an almost identical pattern in the typological evolution of the Mousterian of Acheulian Tradition industries, from 'Type A' in the lower levels of the sequences to 'Type B' in the upper levels. In each case the sequences are marked by a sharp decrease in the frequencies of hand-axes and racloirs, and a simultaneous increase in the frequencies of denticulates and backed knives. Closely similar sequences have been recorded in at least two other sites in the same region – notably at La Rochette (DELPORTE, 1962; DELPORTE and DAVID, 1966) and the Abri Blanchard (BOURGON, 1957). Bordes consistently maintained that this represented a **general** pattern of technological evolution within the Mousterian of Acheulian Tradition industries of Western France, and indeed regarded this as the only clearly defined case of chronological patterning which could be recognized within the Mousterian succession as a whole (BORDES, 1959: 103; 1961: 804; 1968: 105; 1972: 79-88; 1981: 77-8; 1984: 137-49). But of course this interpretation demands that the relative and absolute chronology of the Mousterian of Acheulian Tradition sequences are at least **broadly** similar in the different sites. To suggest that these identical patterns of industrial development could have occurred at widely separated periods within the early Würm would seem to call for a remarkable degree of coincidence and convergence in the patterns of technological development within the Mousterian of Acheulian Tradition industries within the different sites.

3. STRATIGRAPHIC OBSERVATIONS

The central core of the evidence for a clear chronological structure within the South-west French Mousterian rests on a large body of direct stratigraphic observations (see MELLARS, 1965, 1967, 1969, 1970, 1986a). The evidence relates to the Ferrassie, Quina and Mousterian of Acheulian Tradition variants which, as BORDES has emphasized (1961: 804-6; 1968: 98-106; 1981: 77-9) represent by far the most typologically distinctive and

[3] I am **not** suggesting that the correlations which Laville originally proposed between the climatic sequences at Le Moustier and Pech de l'Azé I are correct. I would suggest, in fact, that the greater part of the sequence of M.T.A. horizons represented at Pech de l'Azé I (layers 5 to 12) most probably dates from the major hiatus within the Le Moustier sequence which is represented by the deep weathering horizon – and associated erosion – between layers G and H (LAVILLE, 1975: 184-6; LAVILLE *et al.*, 1980: 196) (see Fig. 7). This correlation was suggested specifically in my Doctoral dissertation, based on the typological features of the M.T.A. industries (MELLARS, 1967, Fig. 17).

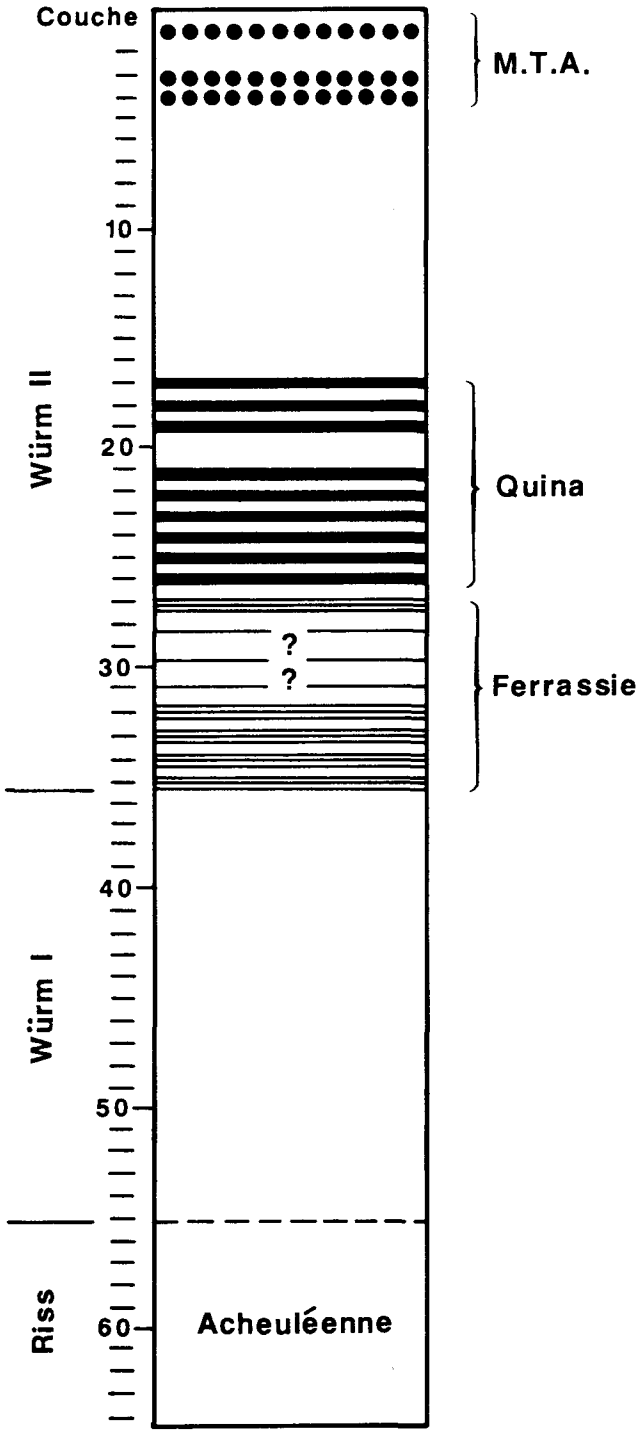

FIGURE 4 – Stratigraphic distribution of Ferrassie, Quina and Mousterian of Acheulian Tradition industries within the Mousterian sequence at Combe Grenal (after BORDES, 1972: 110-113, and LAVILLE et al., *1980: 181). The industries from layers 28-30 have recently been described as 'Typical' Mousterian, but were classified in Bordes' original account of the site as 'attenuated Ferrassie' (BORDES, 1955: 428).*

clearly characterized of the five major industrial variants defined in his original taxonomic scheme (For a discussion of the very different issues raised by the various occurrences of the so-called 'Denticulate' and 'Typical' Mousterian industries, see MELLARS, 1969: 158-161). It is hopefully unnecessary to emphasize that stratigraphic observations – unlike those based on climatic correlations – are totally empirical in character, and involve no assumptions or interpretative procedures, other than the assumption that archaeological levels recorded in the upper part of occupation sequences are generally later than those recorded in the lower parts! The relevant observations may be summarized briefly as follows:

1. The most direct and explicit evidence for a chronological separation of the Ferrassie, Quina and M.T.A. industries is provided by the exceptionally long and detailed Mousterian sequence recorded at Combe Grenal (see Fig. 4). The archaeological sequence at this site spans a total of almost 13 metres of rich cultural deposits, and incorporates 55 levels of Mousterian occupation, underlain by 9 further levels with late Acheulian industries – one of the longest sequences of Middle Palaeolithic industries so far recorded in Europe (BORDES, 1955; 1972: 98-137; LAVILLE *et al.*, 1980: 148-56). The stratigraphic distribution of the Ferrassie, Quina and M.T.A. industries within this sequence is clear and unambiguous. As shown in Figure 4, each variant is confined to a relatively narrow span of the stratigraphic sequence, and the three variants occur in a simple stratigraphic succession – i.e. six levels of Ferrassie Mousterian, overlain by nine levels of Quina Mousterian, overlain (in the uppermost part of the sequence) by at least three levels of Mousterian of Acheulian Tradition. It should be noted that despite the apparent interruption of the sequence of Ferrassie Mousterian industries in layers 35 to 27 by three levels of 'Typical Mousterian' (layers 28-30), the three industries which are now classified as Typical Mousterian (essentially on the basis of a slight decrease in racloir frequencies) were classified in Bordes' original description of the site as representing simply an 'attenuated Ferrassie' form (BORDES, 1955: 428).

The sequence at Combe Grenal therefore reveals a clear separation of the Ferrassie, Quina and M.T.A. industries, in a simple stratigraphic succession. Exactly how this sequence can be reconciled with the hypothesis of a strict synchronism of the Ferrassie, Quina and M.T.A. industries over the whole of the last-glacial sequence has never been clearly explained. If M.T.A. industries were being manufactured within the Périgord region throughout the whole of the period spanned by the Combe Grenal deposits, then why is there no trace of these industries (nor even the occurrence of isolated, typical hand-axes) throughout all except the uppermost four levels of the archaeological sequence? Similarly, why are the levels of Ferrassie and Quina Mousterian confined entirely to the middle part of the succession (layers 35-27 and 26-17 respectively)? The character of the industrial sequence at Combe Grenal alone would seem to provide a powerful – if not conclusive – argument against the hypothesis of a close synchronism in the occurrences of these three variants within South-western France over the whole of the early Würm.

2. At Combe Grenal, therefore, the M.T.A. industries occur at the top of the stratigraphic sequence, clearly overlying a long sequence of Ferrassie and Quina Mousterian industries. Essentially the same industrial succession has been recorded in at least 14 other cave and rock-shelter sites within South-west France (see Table 1). In all of these sites, layers containing typical cordiform hand-axes have been found clearly stratified above levels containing either Quina or Ferrassie industries [4]. So far, no site in South-west France has

[4] The possibility has recently been discussed that the relatively small assemblages recovered from layer 2 at Pech de l'Azé II might be reclassified as 'Typical Mousterian' (BORDES, 1975: 307; LAVILLE *et al.*, 1980: 161, 212). In all of the earlier publications of Bordes, however, these levels have been classified consistently as either 'Ferrassie' type Mousterian, or as 'Quina/Ferrassie' type (e.g. BORDES and BOURGON, 1951: 521; BORDES, 1959: 101; BORDES and PRAT, 1965: 42; BORDES, 1972: 75, 139-42) – based on the high frequencies of racloirs in these levels, and the presence of many racloirs with characteristic Quina-type retouch.

revealed a clear reversal of this stratigraphic sequence. It has occasionally been suggested that a reversal of the M.T.A.-over-Quina succession may have been recorded in the early excavations of D. Peyrony in the upper shelter at Le Moustier (LAVILLE, 1973: 323; 1975: 188), but the totality of the published evidence provides no clear evidence to support this claim. Peyrony himself provided no clear evidence to substantiate the existence of a level of M.T.A. at the base of the sequence (see PEYRONY, 1930), and the detailed reports of the much more extensive excavations carried out by M. Bourlon on the site emphasized that hand-axes were totally lacking from the lower levels of the sequence. By contrast, Bourlon recorded a level containing at least 15 characteristic cordiform hand-axes in the *uppermost* part of the Mousterian sequence, directly overlying a level Quina-type Mousterian, and immediately underlying the Upper Palaeolithic levels on the site (see BOURLON, 1905: 198; 1906: 317-8; 1910: 160-1; 1911: 289, 299).

Once again, it is difficult if not impossible to see how these observations can be reconciled with the hypothesis of a strict parallelism of the M.T.A. and Ferrassie/Quina variants, over the whole of the early Würm. In statistical terms, the probability of recording a consistent sequence of M.T.A. levels above Quina/Ferrassie levels in at least 15 different sites entirely by chance – that is, on the null hypothesis that the two variants were distributed over essentially the same spans of time – is approximately 1 in 30,000. To account for the available stratigraphic sequences in these terms would seem to require almost a conspiracy on the part of the archaeological evidence!

3. The chronological implications of these sequences are emphasized further by the frequency with which M.T.A. industries have been found stratified directly beneath levels containing Upper Palaeolithic indutries in the cave and rock-shelter sites. At least ten well documented occurrences of this kind were recorded in my 1969 publication (MELLARS, 1969: 144), and at least four further sequences of the same kind have been recorded in excavations during the past 20 years (at Grotte XVI, Grotte Marcel Clouet, Roc de Combe and La Grande Roche, Quincay). Of course, direct stratigraphic super-positioning of this kind need not automatically reflect close proximity in time, since major stratigraphic hiatuses are well known to occur in many cave and rock-shelter sequences. Nevertheless, the frequency with which these sequences have been recorded in Western France provides strong additional support for the hypothesis of a relatively late position for the M.T.A. industries within the Mousterian succession as a whole.

4. Lastly, the evidence for a clear chronological sequence within the Ferrassie and Quina industries is substantiated by all of the available sites which show stratified, multi-layered successions of one or both of these two variants (see Fig. 5). Well documented sequences of Quina Mousterian horizons overlying Ferrassie Mousterian levels have so far been recorded in at least four sites within Western France – Combe Grenal, the Abri Chadourne, Abri Caminade-Est, and Roc-en-Pail (see MELLARS, 1969: 151). Further sequences of the same kind may well exist at several other sites in the region (for example at Chez Pourrez, Pech de Bourre and the Roc de Marsal) but the published evidence from these sites is not yet sufficient to document these sequences in detail [5].

[5] The industries from layers 5 to 7 at the Roc de Marsal were classified initially by Bordes as 'Typical Mousterian' (BORDES and LAFILLE, 1962) but in fact contain exceptionally high percentages of racloirs (ca. 60-70 percent) which fall entirely within his published definitions of the Quina/Ferrassie grouping (e.g. BORDES, 1953: 460-1; 1961: 805; 1968: 101). The combination of high racloir frequencies and high frequencies of Levallois flakes would suggest an industry which is very similar, if not identical, to the Ferrassie variant, stratified immediately beneath the rich and typical levels of Quina Mousterian on the site (F. BORDES and J. LAFILLE, personal communication).
A similar situation has been recorded in the excavations of Bordes at Pech de l'Azé site IV (BORDES, 1975). The industries from levels I2, H2, H1 and G show racloir frequencies ranging from 52.6 to 69.4 percent, and contain many typical specimens of 'Quina-type' racloirs (BORDES, 1975: 298-301,307).

Equally if not much more significant is the evidence for a clear pattern of technological evolution which can be documented within the stratified sequences of Ferrassie and Quina industries at these sites. As BORDES has repeatedly emphasized (e.g. 1961: 805-6; 1968: 101-2; 1981: 78-9), the Quina and Ferrassie variants are closely related in **typological** terms (i.e. in terms of the presence and relative frequencies of the principal tool forms – collectively defining his broader, 'Charentian', grouping), but differ essentially in the degree of reliance on Levallois as opposed to non-Levallois techniques for flake manufacture. The stratified sequences summarized in Figure 5 point unambiguously to a progressive shift in this technological parameter of the Ferrassie and Quina industries over the course of time. It should be emphasized that this decrease in Levallois technology can be seen not only **between** the individual blocks of Ferrassie and Quina industries, but also **within** the stratified sequences of Ferrassie Mousterian levels recorded at La Ferrassie (3 levels), the Abri Caminade (3 levels), Combe Grenal (2 main levels), the Abri Chadourne (2 levels) and Roc en Pail (2 levels), and **within** the sequences of Quina Mousterian levels at Combe Grenal (4 main levels) and Petit Puymoyen (2 levels). In other words, this pattern of a progressive, step-by-step decrease in Levallois technology is reflected repeatedly and consistently in all of the stratified sequences of Ferrassie and Quina Mousterian levels in South-west France and reveals – in effect – a gradual technological 'evolution' from one form to the other [6]. Expressed in statistical terms, the probability of this situation arising purely by chance is similar to that calculated for the stratified sequences of M.T.A. over Ferrassie/Quina levels discussed earlier – i.e., approximately 1 in 30,000. In this situation it might perhaps be more realistic to regard the idea of a gradual technological 'evolution' from the Ferrassie to the Quina variants within Western France more as an 'observation' than as a hypothetical proposition ... ?

In summary, it seems unnecessary to offer any further arguments for the significance of the stratigraphic observations outlined above, since the data largely speak for themselves. The stratigraphic evidence is clear, unambiguous and internally consistent. Clearly, the evidence as a whole is in direct conflict with the hypothesis of a strictly parallel, synchronous pattern of development of the Ferrassie, Quina and M.T.A. industries over the whole of the Mousterian succession – that is, over a period of around 70-80,000 years. In particular, any attempt to maintain this hypothesis would need to address three major questions:

1. Why is there such clear separation of the Ferrassie, Quina and M.T.A. industries within the 55 levels of Mousterian occupation at Combe Grenal?

2. Why has no clear reversal of the M.T.A.-over-Quina succession so far been recorded within Western France?

3. Why is there such a clear and consistent pattern of technological 'evolution' discernible within all of the stratified sequences of Ferrassie and Quina industries within this region?

5 (continuation) These assemblages reveal a clear decrease in the Levallois indices between the lower and upper levels (from 25.5 to 10.6 percent), similar to that recorded in other, stratified successions of Ferrassie and Quina industries. These levels are overlain by a rich succession of Mousterian of Acheulian Tradition industries.

6 The greater part of this technological development is of course apparent during the earlier stages of the Charentian succession – i.e. during the 'Ferrassie' phase and the initial stages of the 'Quina' sequence. During the later stages of the Quina development, the frequencies of Levallois flakes have fallen to such low levels (generally less than 2-3 percent) that any further 'evolution' in this direction is hardly possible. Thus it will be seen that there is relatively little change in the Levallois index in the **uppermost** Quina levels at Combe Grenal, between layers 21 and 17 (see Fig. 5). The same pattern is apparent in the sequences of late Quina assemblages at Roc de Marsal, and, apparently, Marillac (A. TURQ and L. MEIGNEN, personal communication).

TABLE 1

Sites showing levels of Mousterian of Acheulian Tradition (represented by typical cordiform hand-axes) overlying levels of either Ferrassie or Quina-type Mousterian in South-west France.
For details of these sequences, see MELLARS, 1969, pp. 164-5. Information on the recently-excavated sequences at Combe Saunière, Grotte XVI and La Quina were provided respectively by J.-M. Geneste, J.-P. Rigaud and A. Jelinek. For further information on the sequences from Pech de l'Azé I and II, see BORDES, 1959: 101; 1972: 75, 139-142; BORDES and PRAT, 1965: 42 (see also Note 4); for the sequence at Pech de Bourre, see BOURGON, 1957: 80.

1.	Combe Capelle Bas	(Dordogne)
2.	Combe Grenal	"
3.	Combe Sauniére	"
4.	La Gane	"
5.	Grotte XVI	"
6.	Les Merveilles	"
7.	Le Moustier (upper shelter)	"
8.	Pech de l'Azé I/II	"
9.	Pech de Bourre	"
10.	Roc de Marsal	"
11.	La Rochette	"
12.	Abri du Chasseur	(Charente)
13.	Hauteroche	"
14.	La Quina	"
15.	Chez Pourrez	(Corrèze)

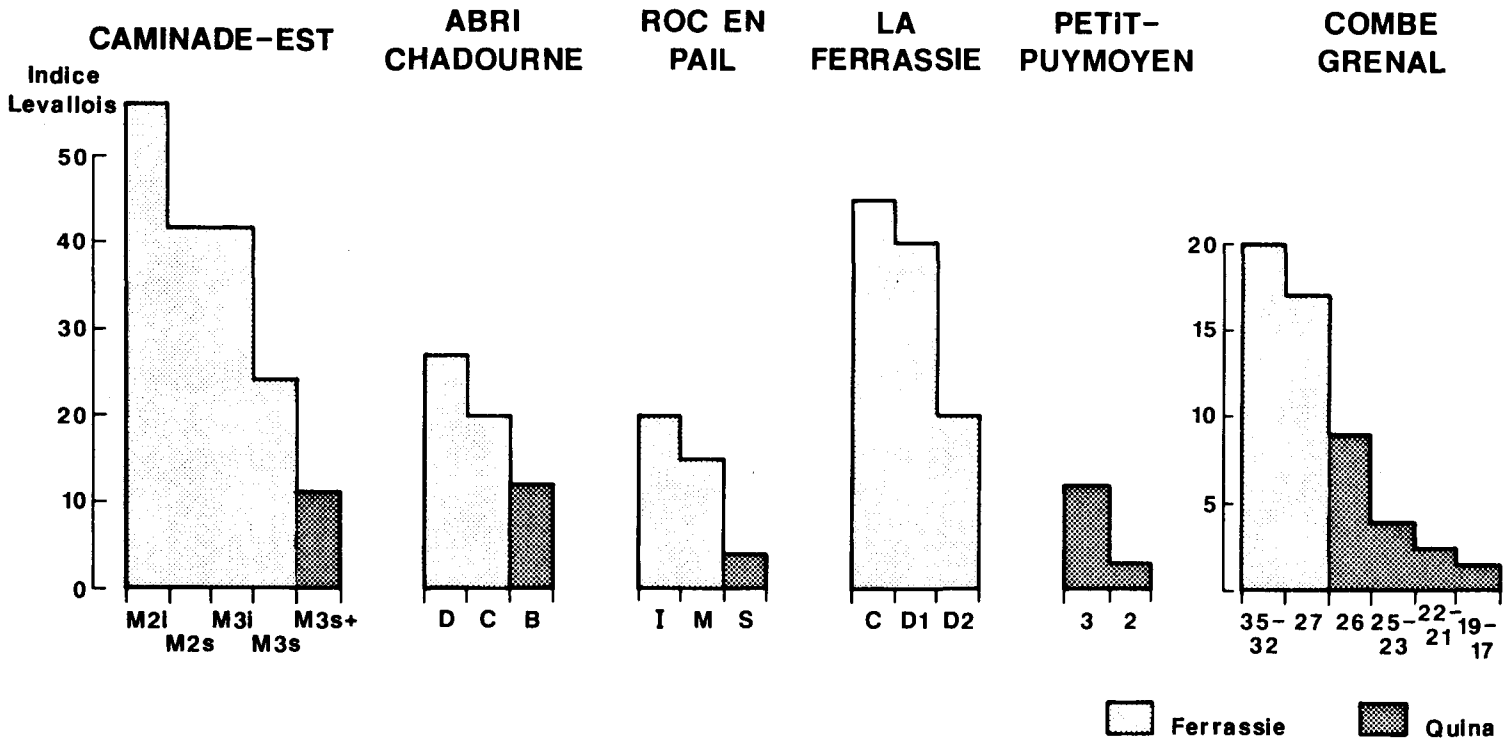

FIGURE 5 – Progressive reduction in Levallois indices (I.L.) recorded in stratified sequences of Ferrassie and Quina Mousterian industries at Abri-Caminade-Est, Abri Chadourne, Roc-en-Pail, La Ferrassie, Petit Puymoyen and Combe Grenal. For further details of these sequences, see MELLARS, 1969: 153-155, and SONNEVILLE-BORDES, 1969. Unpublished details of the industries from Combe Grenal and Roc-en-Pail were kindly provided by F. BORDES and M. GRUET respectively.

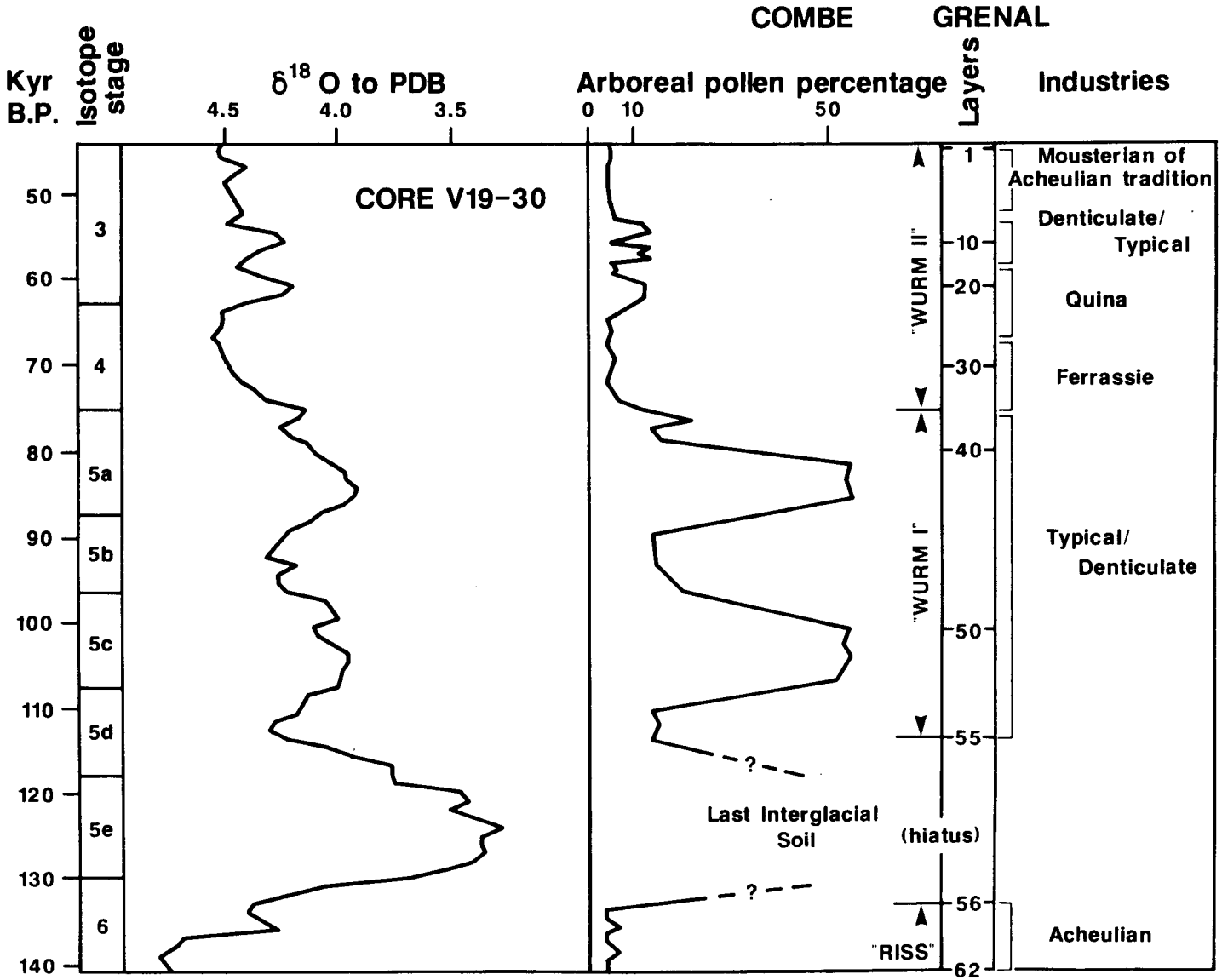

FIGURE 6 – Proposed correlation between the climatic sequence at Combe Grenal (after BORDES et al., *1966) and the oxygen-isotope record in deep-sea cores (after SHACKLETON* et al., *1983, and N. SHACKLETON, personal communication). The correlations proposed for the uppermost part of the sequence remain tentative, and incorporate some minor revisions from those shown in MELLARS, 1986a, Fig. 1. For further details of the archaeological sequence at Combe Grenal, see Figures 1 and 4.*

How these stratigraphic observations can be accounted for without accepting some kind of clear chronological structure within the South-west French Mousterian has not, as yet, been clearly explained.

4. CONCLUSIONS

The general chronology which I would propose for the distribution of the Ferrassie, Quina and Mousterian of Acheulian Tradition industries within the cave and rock-shelter sites of the Périgord region is indicated in Figures 6 and 7, together with a tentative correlation with the overall climatic sequence for the early Würm. The climatic correlations proposed here are of course based primarily on the long and detailed sequence of industries and climatic phases represented at Combe Grenal. The **exact** correlation of the climatic sequence at Combe Grenal with the **general** pattern of climatic fluctuations recorded in recent oxygen-isotope studies of deep-sea cores must inevitably remain tentative, in the absence of reliable absolute dating for the Combe Grenal deposits [7]. My own climatic correlations correspond closely with those proposed by LAVILLE *et al.*, (1983: 225; 1986: 39-41) for the lower part of the Combe Grenal sequence (layers 64 to 40 – corresponding essentially with stages 5 and 6 of the oxygen-isotope record) but differ in the upper part of the sequence (see Note 1). In contrast with Laville, I have suggested that the period of extremely cold, full glacial climate represented by stage 4 of the isotopic record should be correlated with the whole of the climatic sequence represented by layers 37 to 23 at Combe Grenal, in which both the pollen evidence and the associated faunal assemblages (characterised by very high frequencies of reindeer) indicate a similar period of very severe, full glacial climate (BORDES and PRAT, 1965; BORDES *et al.*, 1966; LAVILLE, 1975: 164-5; LAVILLE *et al.*, 1980: 197-201; 1986: 34-41). The evidence for this correlation has been discussed briefly elsewhere (MELLARS, 1986a, 1986b), and will be set out more fully in a later publication. The uppermost part of the Combe Grenal sequence (layers 1 to 20) evidently corresponds with **some** part of stage 3 of the oxygen-isotope sequence, but is at present impossible to correlate in detail with the isotopic record in the absence of precise and reliable absolute dates for these levels [8]. Any correlations for this part of the Combe Grenal sequence must therefore remain approximate and tentative for the present time.

[7] The series of six thermoluminescence dates reported by BOWMAN and SIEVEKING (1983) for the sequence at Combe Grenal have already been discussed by myself (MELLARS, 1986b) and LAVILLE *et al.* (1986: 38-40). In this case, we are both in agreement that the TL dates are impossible to reconcile with either the climatic or archaeological sequence on the site. The two dates of 105,000 ± 14,000 and 113,000 ± 13,000 BP obtained for the Acheulian levels at the base of the sequence (layer 60) are demonstrably too young by at least 10-20,000 years, since these layers are demonstrably earlier than the last interglacial (isotope stage 5e) and must therefore date from at least 130-140,000 BP (isotope stage 6). Dating of a further series of samples by the same laboratory from the nearby site of Pech de l'Azé IV has been described by the laboratory itself as 'too young to be acceptable' (BOWMAN *et al.*, 1982: 368) and produced a date of 19,600 ± 1600 BP for one of the upper (but not final) layers in the Mousterian sequence. The samples from Combe Grenal were collected during the excavations of F. Bordes in the early 1960's, were almost certainly exposed to strong sunlight at the time of collection, and were stored for almost 20 years with the archaeological collections at Bordeaux prior to the dating of the samples in the British Museum Laboratory. In addition, the levels of background radioactivity in some of the levels involved in the dating were not measured directly (BOWMAN and SIEVEKING, 1983: 254; LAVILLE *et al.*, 1986: 39-40). These are not ideal conditions for the TL dating of burnt flint samples (see WAGNER *et al.*, 1983: 23; AITKEN, 1985).

[8] Two radiocarbon dates have been published for the upper part of the Combe Grenal sequence (layer 12) of respectively 30,300 ± 350 BP (GrN-4311) and 39,000 ± 1500 BP (GrN-4304) (BORDES, 1972: 132; VOGEL and WATERBOLK, 1967: 112). The former date is clearly impossible for a Mousterian level, and

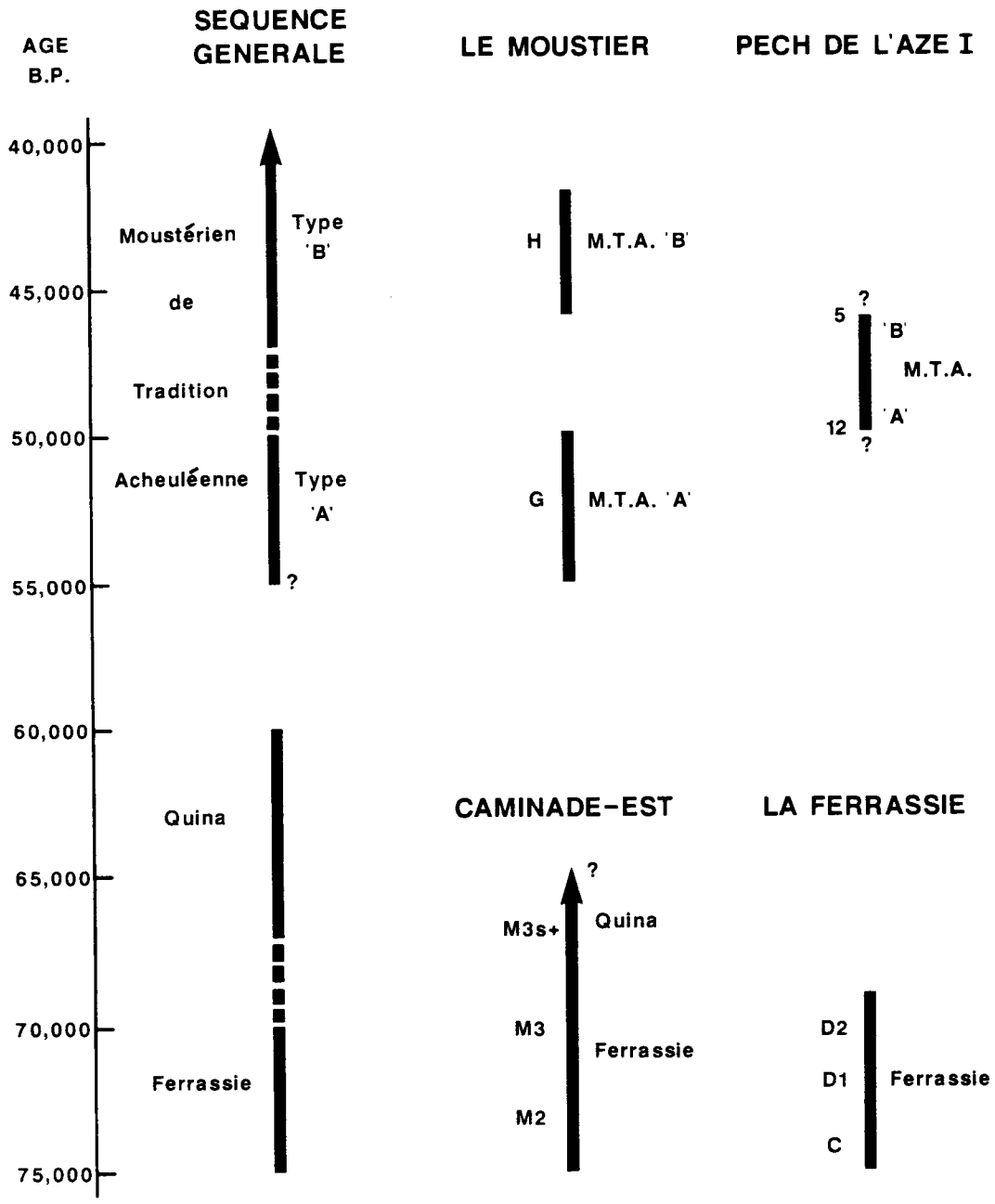

FIGURE 7 – Suggested general chronology of the Ferrassie, Quina and Mousterian of Acheulian Tradition industries within the cave and rock-shelter sites of the Périgord region. All the dates shown here should be understood to have margins of error of ca. ± 1,000-2,000 years, in view of the imprecision of current absolute dating techniques.

As I have emphasized in earlier publications (e.g. MELLARS, 1965; 1969: 136, 161; 1970: 76; 1986a: 410) the chronology proposed here is related specifically to the sequence of industries recorded within the cave and rock-shelter sequences of the Périgord and immediately adjacent areas of South-west France, and should not be applied automatically to other regions. Quite clearly, there is no reason why one should expect to observe exactly the same sequence and chronology of Mousterian industries in all areas of France – especially in regions such as Northern France or the Mediterranean region, which belong to entirely separate geographical and ecological provinces. The main point to emphasize in this context is that, at present, typical Mousterian of Acheulian Tradition industries would appear to be totally absent from most areas of Eastern and South-eastern France (COMBIER, 1967: 215-8; LUMLEY, 1969; TAVOSO, 1976: 1046; BORDES, 1981: 81). Clearly, if Mousterian of Acheulian Tradition industries never extended into these areas, it is inevitable that the later stages of the Mousterian sequence in these regions must be occupied by entirely different industries, which persisted throughout the period occupied by the M.T.A. industries within the Périgord area. In these regions it is entirely possible that certain industries of broadly 'Charentian' type (i.e. broadly of Ferrassie/Quina form) persisted until a comparatively late stage of the Mousterian succession, quite possibly up to the beginning of the Upper Palaeolithic period (see LUMLEY, 1969; 1976; COMBIER, 1967).

Similarly, it should be emphasized that the present discussion has been concerned purely with industries dating from the 'classic' phase of the Mousterian, corresponding with the earlier stages of the last glaciation (i.e. the 'Würm ancien' of the present climatic nomenclature). The character and chronological patterning of the various forms of 'pre-Mousterian' industries dating from the preceding 'Rissian' stage is an entirely separate question. One major problem in this context relates to the current system of nomenclature for these pre-Würmian industries. For example, if the concept of 'Quina' or 'proto-Quina' Mousterian is applied in a very broadly-defined sense to refer to any industries which include relatively high frequencies of racloirs manufacured on thick, non-Levallois flakes, then it is certainly true that certain assemblages of broadly 'Proto-Quina' form can be identified in several contexts which are much earlier than the classic sequence of Quina industries recorded within the last-glacial sequence of the Périgord region. Assemblages conforming broadly to this 'Proto-Quina' or 'Proto-Charentian' form have been recorded, for example, in some of the early 'Rissian' levels at La Micoque (BORDES, 1984: 57-62), and in other sites of either Rissian or pre-Rissian age in Provence (e.g. Baume Bonne) and Southern England (e.g. High Lodge) (LUMLEY, 1969: 242-68; BORDES, 1968: 101; 1984: 72-6). The crucial question, of course, is whether these 'Proto-Quina' or 'Proto-Charentian' industries have any **direct** connection with the classic sequence of Quina industries as represented within the last-glacial sequence of the Périgord region. In the preceding sections I have argued that within the cave and rock-shelter sites of the Périgord and adjacent areas, these assemblages are not only confined to a relatively narrow time-span of the total Mousterian sequence but – more importantly – would appear to have 'evolved' (in a

8 (continuation) the latter date was published by the laboratory itself strictly as a **minimum** date for the level in question (see VOGEL and WATERBOLK, 1967). It is now generally accepted that all radiocarbon dates beyond ca. 30-35,000 BP must be regarded essentially as minimum dates, owing to the serious effects of contamination by small quantities of modern carbon in samples in this age range (see WATERBOLK, 1971: 17-19; MOOK and WATERBOLK, 1985: 50-52; GOWLETT and HEDGES, 1986: 65-9). Contamination by only one percent of modern carbon would be sufficient to reduce the **apparent** age of a radiocarbon sample from 50,000 to ca. 35,000 BP within this time range (WATERBOLK, 1971: 18). Unfortunately, samples of bone are known to be especially prone to contamination of this kind (WATERBOLK, 1971: 17-19; MOOK and WATERBOLK, 1985: 31, 41, 52; GOWLETT and HEDGES, 1986).

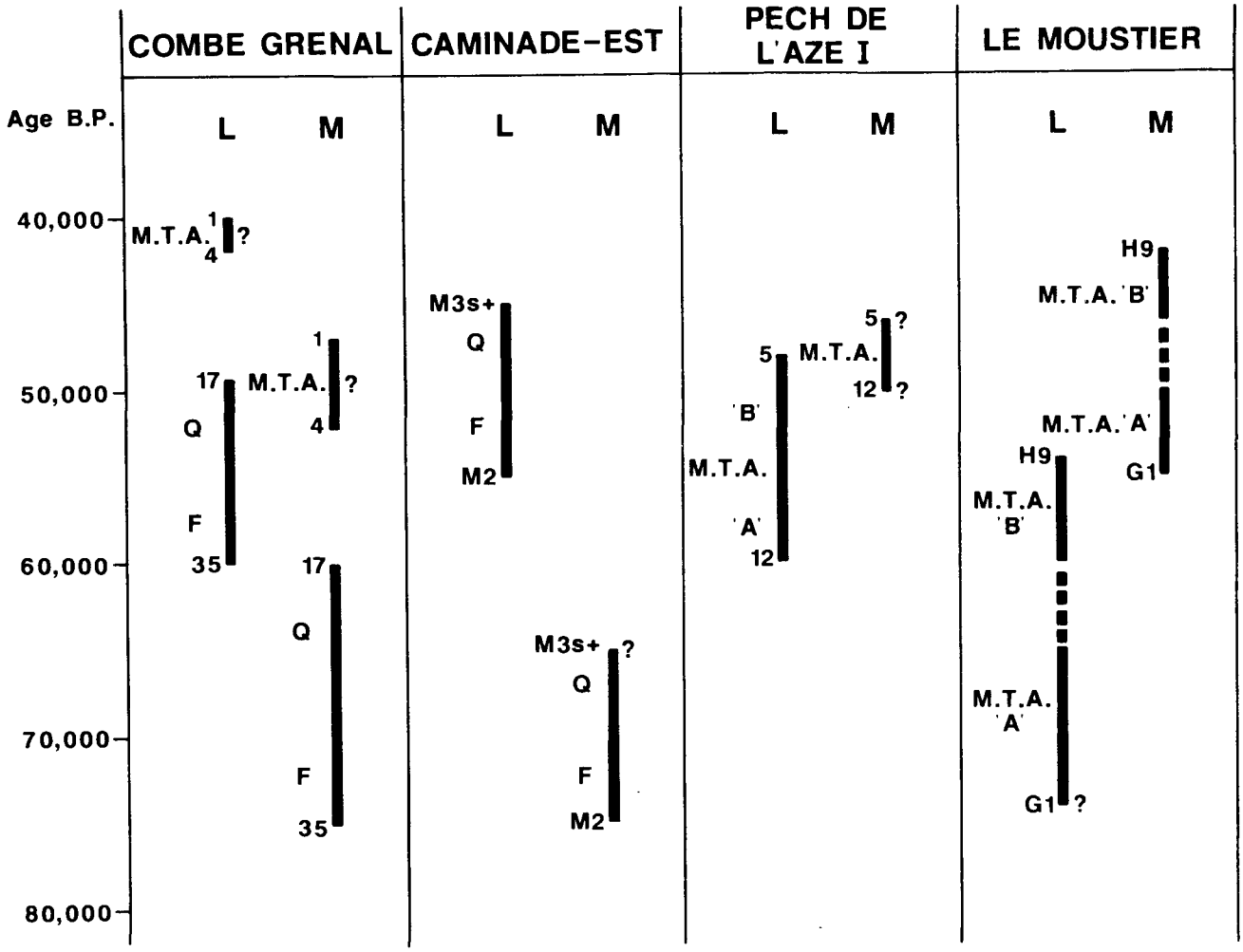

FIGURE 8 – *Comparison of the relative and absolute chronology of the Mousterian sequences at Combe Grenal, Caminade-Est, Pech de l'Azé I and Le Moustier (lower shelter) proposed by H. Laville (L) and myself (M) (see Figures 1 and 7).*
F = Ferrassie Mousterian; Q = Quina Mousterian; M.T.A. = Mousterian of Acheulian Tradition. As noted in Figure 7, all the suggested dates should be understood to have margins of error of ca. 1,000-2,000 years (see note 1).

technological sense) from assemblages of the Ferrassie type. This pattern of gradual technological evolution from the Ferrassie to the Quina form can be observed directly in many of the Périgord sites (Combe Grenal, Abri Chadourne, La Ferrassie, Abri Caminade, etc.), and clearly reflects a progressive reduction in the use of Levallois flaking techniques over the course of time (see Fig. 5). Other features of the industries – including the increasing application of 'Quina' retouch, the increasing percentages of transverse racloirs, and a general increase in tool thickness – were almost certainly related directly to this simple technological shift (see BORDES, 1961: 806; 1972: 124; 1981: 79; 1984: 164). If this conclusion is valid – as all of the available stratigraphic sequences suggest – then the assemblages of classic Quina form (as represented for example at La Quina itself) can hardly have any **direct** connection with any of the earlier, pre-Würmian assemblages of 'Proto-Quina' or 'Proto-Charentian' form. Whether or not these assemblages could form part of a much longer technological tradition which fluctuated at different times between Levallois and non-Levallois techniques of flake production is of course an entirely separate question which perhaps deserves closer attention in future research (see LUMLEY, 1969: 258) (For a discussion of the analogous problems posed by the relationships between the Mousterian of Acheulian Tradition and the earlier Acheulian industries, see MELLARS, 1969: 147-50).

In conclusion, I would re-emphasize the crucial importance of **absolute** dating techniques in any future discussions of the relative and absolute chronology of the South-west French Mousterian succession. The potential importance of thermoluminescence dating of burnt flint has already been clearly demonstrated in the recent analyses of Hélène Valladas at Le Moustier, and will hopefully be applied in the near future to many other sites. Similarly, work by Schwarcz and others has emphasized the importance of Uranium-series methods in the dating of calcite and related deposits in cave sites (e.g. SCHWARCZ and BLACKWELL, 1983). In this context, I would make a specific proposal. Now that the chronology of the Le Moustier sequence has been clearly resolved, it is clear that remaining conflicts between my own interpretations and those of Henri Laville rest on a small number of critical sites (see Fig. 1). The most direct and obvious way of resolving these differences would be to obtain a series of absolute dates for these sequences, employing exactly the same techniques as those employed at Le Moustier – that is, by means of TL dating of burnt flint samples. Of course, in order to obtain these dates it could be necessary to conduct further excavations at the sites, in order to collect new samples of burnt flint, and to obtain accurate measurements of the background radioactivity of the deposits. However, it would hopefully be possible to obtain these samples (as in the recent dating of the Le Moustier samples) by very small-scale excavations – presumably by simply cutting back the stratigraphic sections exposed in the earlier excavations. The most crucial sequences where this dating is required are:

1. Pech de l'Azé site I – to date the long sequence of Mousterian of Acheulian Tradition industries (Type A and Type B)(BORDES, 1954-55; 1972: 79-97). Alternatively (or in addition) the dating of the similar sequence in Pech de l'Azé IV would be equally useful (BORDES, 1975).

2. Abri Caminade Est – to date the sequence of Ferrassie and Quina Mousterian levels (SONNEVILLE-BORDES, 1969).

3. If possible, to obtain dates for at least some of the crucial Mousterian levels in the sequence at Combe Grenal sequence.

In the preceding sections I have indicated the relative and absolute chronology which I would predict for these sites, based on my own interpretations of the Mousterian sequence (see Fig. 7). Laville has also indicated the very different chronology that he would predict for the same sites, derived from his current framework of 'chronostratigraphic' correlations (see

Figures 1 and 8 and note 1). At the present stage of research it would seem rather pointless to devote any further time to speculation and arguments, when it is possible to subject these different interpretations to a direct experimental test.

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