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Human Biology

Volume 81
Issue 2 *Special Issue on Demography and Cultural Macroevolution*

Article 10

2009

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Bocquet-Appel, Jean-Pierre and Tuffreau, Alain (2009) "Technological Responses of Neanderthals to Macroclimatic Variations (240,000–40,000 BP)," Human Biology: Vol. 81: Iss. 2-3, Article 10. Available at: http://digitalcommons.wayne.edu/humbiol/vol81/iss2/10

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Keywords
Neanderthals, lithic industry, Paleolithic, climate change, carrying capacity.

Cover Page Footnote
This research was funded by a grant to J.-P. Bocquet-Appel from the National Center for Scientific Research (CNRS) program "Origin of Human, of the Speech and the Languages" (OHLL 2006, directed by Jean-Marie Hombert).

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Technological Responses of Neanderthals to Macroclimatic Variations (240,000–40,000 BP)

JEAN-PIERRE BOCQUET-APPEL[1] AND ALAIN TUFFREAU[2]

Abstract Using a database of 499 archaeological assemblages from 332 sites in Europe, we statistically test a model of the economic reactivity of the hunter-gatherer production system to climatic variations. This model predicts an increase in the diversity of lithic tools during harsh cold periods, in order to maintain carrying capacity, and a reduction during favorable climatic periods. Diversity was measured from the variations in flint tool distributions in traditional Bordes typological categories, using Shannon's derived diversity index (*D*). Reactivity was measured in 190 archaeological assemblages from 103 sites of the Middle Paleolithic in Europe (mainly France). The Neanderthals show technological inertia in the development and use of lithic tools for 200,000 years, despite the four cool to cold macroclimatic periods they experienced.

Several investigators have been struck by the relative continuity of Neanderthal behavior despite the many climatic changes they experienced (Gamble 1999; Mellars 1996; Roebroeks and Gamble 1999). In particular, this stability resulted in the long duration of the Middle Paleolithic, about 200,000 to 250,000 years ago, with the same debitage methods being used and tools that only began to diversify during the last glacial period, most notably with Micoquian tools. This situation contrasts with the behavior of anatomically modern humans who, during the Upper Paleolithic, developed many different cultures with diversified tools. Although the two metapopulations have approximately the same average cerebral volume, the difference observed in their lithic industries has been attributed to a higher rate of innovations among anatomically modern humans than among Neanderthals. This raises questions about the cognitive efficiency of the two metapopulations, to the detriment of the Neanderthals [Wynn and Coolidge 2004; contra see D'Errico et al. (1998) and Finlayson (2004)]. To take the matter further, the speed of technological reactivity of the two metapopulations needs to be measured on the basis of their lithic industries and in terms of their response

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Human Biology, April–June 2009, v. 81, nos. 2–3, pp. 287–307.
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KEY WORDS: NEANDERTHALS, LITHIC INDUSTRY, PALEOLITHIC, CLIMATE CHANGE, CARRYING CAPACITY.

to the highly contrasting environmental conditions in which they lived. This is what we explore in this article with regard to the Neanderthals.

During macroenvironmental variations, did Neanderthals remain technically passive, mainly migrating back and forth periodically (Roebroeks and Tuffreau 1999; Soriano 2005; Tuffreau 2006) between their hunting and gathering areas along a latitudinal geographic axis? If Neanderthal reactivity is observable in their tools, expressing economic aspects, does this simply reflect an underlying technological improvement in lithic industries resulting from the biological evolution of the human lineage? Or, on the contrary, do the tools reflect a Neanderthal response to constraints that were independent of the underlying improvement? If so, in which direction was the response? In this article, we obtain an estimate of Neanderthal economic reactivity from the distributions observed among groups of tools in lithic assemblages. This reactivity is examined in parallel with macroclimatic variations during the Middle Paleolithic (i.e., from isotopic stages 8 to 3) on the one hand and the chronological linearity covering 250,000 years, which is taken to represent underlying improvement, on the other.

Materials and Methods

A Model for Technological Response. The putative impact of environmental constraints on lithic industries is as follows. Periodic environmental variations over several millennia, that is, on a macroscale, affect the edible biomass density, inducing variations in the carrying capacity of the hunter-gatherer production system of the Neanderthals. If this variation tends toward a reduction in the carrying capacity, it will cause the local population density to decrease, through an increase in mortality and a decrease in fertility and/or migration. If the environmental effect occurs on a supraregional scale, thus closing off the migration option that would make it possible to cover food needs elsewhere, then merely maintaining the system's carrying capacity would force the population to innovate or, more accurately, would raise the probability of shifting to innovations (Wood 1998).

Innovation does not necessarily mean invention of new tools; it can also mean an increase or reduction in the use of existing or previously existing tools, even in a relatively remote past. These innovations become necessary to extend the food spectrum to new animal and plant species or to move the cursor on the existing spectrum, that is, to vary the distribution of hunted and collected items, for example, a shift from hunting mainly large ungulates (reindeers, horses) to capturing small animals (hares, or tortoises in the Mediterranean northern basin) (Stiner et al. 2008). When food constraints increase, an effect on stone tools is to be expected in order to maintain the level of food production, resulting in a change in the distribution of the various tool types or in the introduction of innovations that produce greater tool diversity. Conversely, when food constraints diminish, a less varied range of tools is to be expected. In other words, a relative increase in

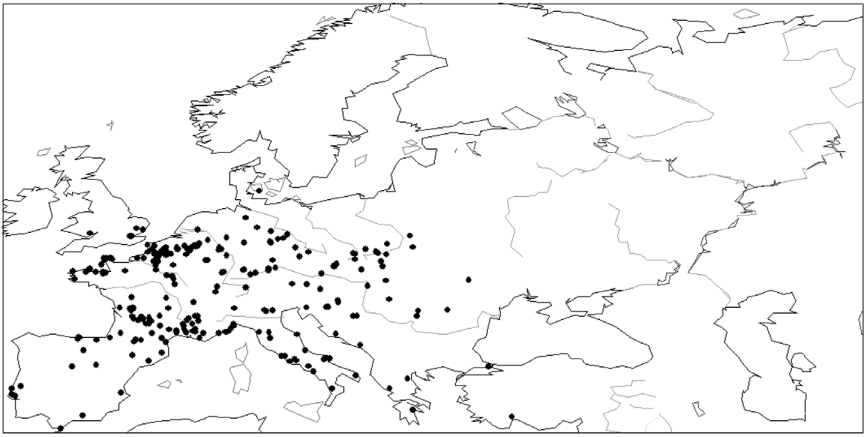

Figure 1. Geographic locations of the 332 archaeological sites where the 499 archaeological layers were found.

lithic cultural variance can be expected during unfavorable environmental periods and a relative reduction can be expected during favorable periods.

A proxy measurement of variation in carrying capacity during a period of worsening or improving climatic conditions could be the negative or positive difference in benthic oxygen-18 between the last climatic minimum or optimum and a given date (period). It is expected that the larger the difference, in negative terms, the higher the probability of innovation, although no proposal for a joint statistical distribution family for the two event categories can be readily put forward.

Data and Techniques. The data are represented by the distributions of lithic industries obtained from an exhaustive search of the literature concerning 499 archaeological layers from 332 sites in Europe, located at the geographic coordinates shown in Figure 1; each layer is called a record in the remainder of this article.

The data were subdivided into two groups. The first, called the large data set, contains 455 lithic assemblages from 314 archaeological sites. The large data set is intended to measure the variation in the density of the number of Middle Paleolithic lithic assemblages by chronology. The second group, called the reduced data set, contains 190 lithic assemblages from 103 archaeological sites with distributions of apparently complete lithic industries. These are mainly located in France, with some in Italy, eastern and central Europe, and Israel (Figure 2).

The reduced data set is intended to measure variation in the diversity of lithic tools. Each record represents the number of artifacts in the essential groups according to the Bordes method, using so-called reduced counting (Bordes 1950, 1984), that is, without technical items such as pseudo-Levallois points and knives

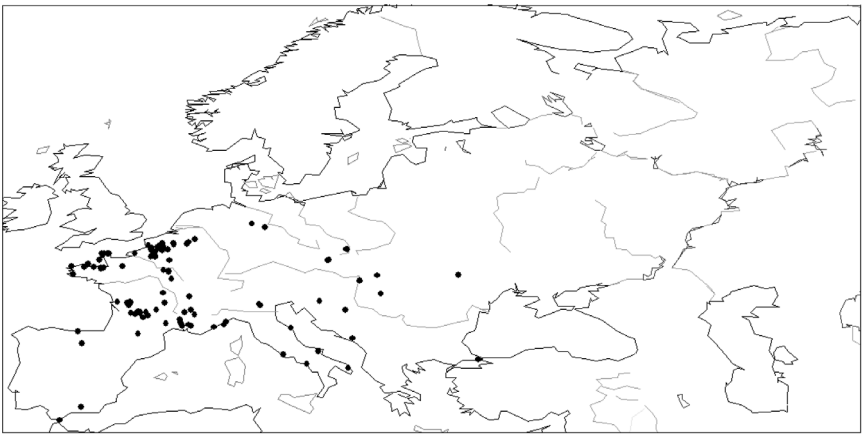

Figure 2. Geographic locations of the 103 archaeological sites where the 190 archaeological layers that provided the sample distributions of lithic tools were found.

with a natural back. These artifacts are classified in the following flint tool categories: scrapers (reduced IR), tools of the Upper Paleolithic type (group III), encoches (nos. 42 and 54 in Bordes's typological list), denticulates (group IV), bifaces, foliates, choppers and chopping tools, and cleavers.

The bifaces have been divided into two categories: bifaces of the Acheulean type and those of Micoquian morphology or that occur more frequently during the Middle Paleolithic [flat triangular Mousterian bifaces of the Acheulean tradition (MAT) and bifaces on flakes]. Because items in the second category are not always easy to recognize explicitly in the literature, the bifaces from the lithic industries that are present from isotopic stage 5 were classified, in doubtful cases, with the Micoquian types and MAT bifaces.

A further category was added, corresponding to the numerical difference between the calculated values of flint tool categories (our data) and the total number of tools cited in the literature. This category corresponds to various tools not taken into account in the mentioned indexes. The noninformed values of tool categories in distributions where some items have been informed were given a value of 0. In the literature, besides quantitative information, values are frequently expressed as qualitative appreciations, such as "low," "very few," "rare," and "frequent." To avoid the loss of associated quantitative information, we replaced the adjectives expressing scarcity or abundance with the values 5% and 20% of the tool total (either indicated or calculated, respectively). In all, the lithic data are distributed into 10 typological categories. The reduced data set is given in the Appendix.

The chronological data, expressed in terms of isotopic stages, were obtained from the literature, from transposing the ancient glacial periods into terms of their

corresponding isotopic stages, and/or from a team member's personal knowledge of the sites (A. Tuffreau). In all, the data represent 64,823 tools distributed into 13 isotopic stages or substages (3, 4, 5, 5.1, 5.2, 5.3, 5.4, 5.5, 6, 7, 7.1, 7.3, 8). Note that there are isotopic stages for which no additional substage can be obtained or estimated from the original publication. In that case, the average date of the stage has been taken.

The tool distribution in an archaeological layer can be regarded as a closed information system of mutually exclusive items, with a multinomial statistical distribution. The tool distribution can be considered a random sample of the distribution (observed localities) of a large archaeological layer on a regional or subcontinental scale, which records traces of the metapopulation's activity. The Shannon index (H) was used to quantify the lithic cultural diversity of an archaeological layer. With $p_i = n_i/n$, the Shannon index is written as

$$H = -\sum_{i=1}^{s} p_i \ln p_i, \tag{1}$$

where the n_i are the observed numbers of the ith tools ($i = 1, \ldots, s$), n is the total number of tools, and the p_i are their frequency, with $\sum p_i = 1$. By convention, if $n_i = 0$, then $p_i \ln p_i = 0$. This index expresses the total diversity of a set of items as a sum of frequencies weighted by (the natural logarithm of) their respective abundance. When the diversity of the items increases (i.e., tends toward a uniform distribution), the value of the index increases, and conversely, when the diversity decreases, the distribution tends to be unimodal. Many publications discuss the Shannon diversity index, which will not be discussed here (see, e.g., Krebs 1989; Lecointre and Le Guyader 2001; Magurran 1998). To measure the difference between the index values in terms of the proportion of diversity, it is better to take the value $D = \exp(H)$ (Jost 2006).

To express the climatic impact, we used the values corresponding to the isotopic stages (and substages) of the benthic Foraminifera curve, estimated from 57 curves on a worldwide scale, but with a higher frequency from the Atlantic (Lisiecki and Raymo 2005, Figure 4, p. 6). This curve, besides its broad sampling and its weighting in favor of the Atlantic, provides continuous values throughout the chronological period, which is not the case with other curves that are more centered on Europe.

To test the model of Neanderthal cultural reactivity, we used two routine statistical techniques. The first is a simple linear regression of the lithic diversity index D of the sample of the archaeological layers on the explanatory variables $y = a + bx' + e$, where y is the index of lithic diversity D, a is a constant, b is the vector of the regression coefficients, x' is the vector of the transposed data, with x_1 being the chronology that expresses underlying technological progress and x_2 being the benthic value that expresses the effect of climate as a continuous variable and not simply as stage and substage, and e is an unexplained residual. This test is intended to measure the lithic cultural reactivity of the series of archaeological layers and benthic values on a continuous basis.

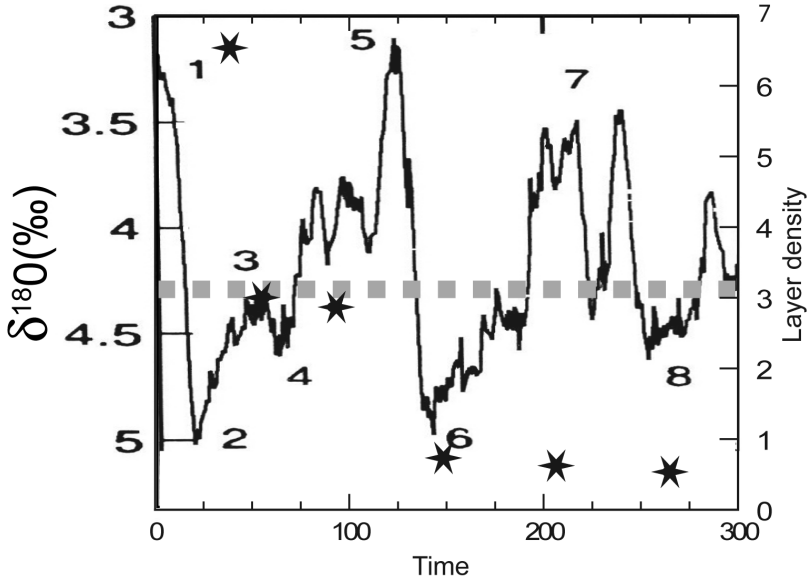

Figure 3. Variation in the density of the archaeological assemblages (stars, right-hand scale), superimposed on temperature variations represented by benthic foraminifer records of $\delta^{18}O$ (continuous line, left-hand scale). Hatched gray line: boundary of the cool isotopic stage 3.

Results

Variation in the Density of Middle Paleolithic Archaeological Assemblages over Time. Figure 3 shows the variation in the density of the archaeological assemblages across isotopic stages 8 to 3 (stars) superimposed on temperature variations, represented by benthic foraminifer records of $\delta^{18}O$ (continuous line). To compare these two variations, their units of measurement (ordinate values) were forced onto the same vertical axis. The distribution of the density of the archaeological assemblage shows, as one would expect, a steady reduction over time. Although the degree of information definition is temporally broad, about 40,000 years, two noncontradictory interpretations of this distribution of the assemblage density per unit of time are possible.

The first interpretation is taphonomic: Preserved archaeological information becomes degraded over time. But the degradation function and its intensity are unknown (linear? asymptotic?). The observed assemblage density is the residue of this degradation. As an example, Figure 4 shows the observed density along with three simulated corrected densities, using the assumption that out of the number of observed sites, a linear degradation of information has occurred in 0.5, 1, and 2 sites per millennium, which must be added. The second interpretation of the assemblage density is demographic, using the assumption that the density is roughly

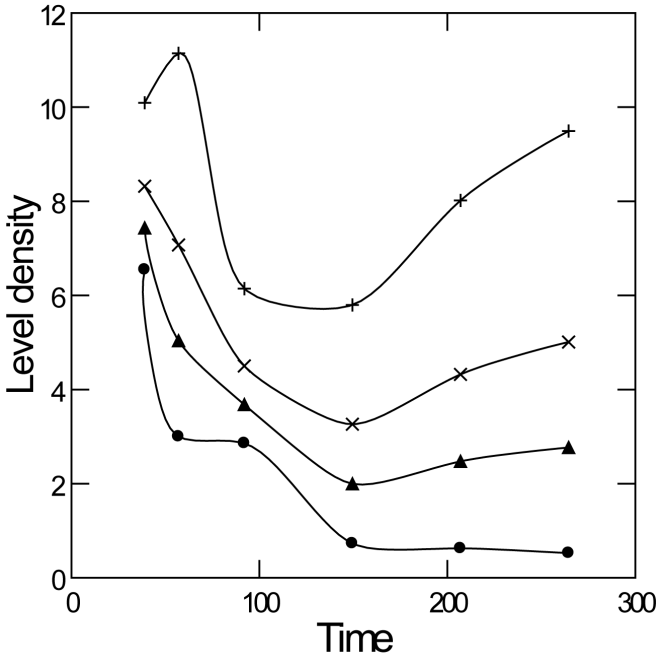

Figure 4. Observed density (circles) and three simulated corrected densities under the assumption that other sites must be added to the number of observed sites, representing a linear degradation of information of 0.5 site (triangles), 1 site (crosses), and 2 sites (pluses) per millennium.

proportional to that of the metapopulation (see Bocquet-Appel and Demars 2000; Bocquet-Appel et al. 2005; Gamble 1983; van Andel et al. 2003). Figure 3 shows demographic density remaining roughly stationary from isotopic glacial stage 8 (275,000 years) to stage 6 (150,000 years), after which the demographics of the metapopulation expanded rapidly up to isotopic stage 5.3 (100,000 years), stabilizing until the middle of isotopic stage 3 (50,000–55,000 years), when they took off once more, coming to an abrupt end toward 30,000 years, which coincided with the arrival of anatomically modern humans. But whatever the density distribution, whether observed or corrected using various hypotheses for the linear degradation of information (see Figure 4), we do not see the expected covariation between climate change (the proxy for secondary biomass) and demographic change (see Figure 3)—such as that observed by van Andel et al. (2003) with the number of Mousterian sites between 70,000 and 25,000 years—except, partly, for the correction of the highest density (simulated density 2 in Figure 4). But, in Figure 4, if temperature and density coincide roughly in the 250,000–150,000-year segment, then they no longer coincide afterward. If the climatic variation validates the demographic model of interpretation of the density of archaeological assemblages by their expected covariation, then, even if a possible linear degradation of

Table 1. Parameter Estimates of the Linear Model Expressing the Index of Lithic Cultural Diversity (Shannon's D) by Chronological Technological Progress (Chronology) and the Impact of Climatic Variation (Benthic)

Effect	*Coefficient*	*Standard Error*	*Standard Coefficient*	*t*	*P*
Constant	2.675	0.636	0.000	4.209	0.000
Chronology	0.004	0.001	0.269	3.798	0.000
Benthic	0.147	0.148	0.070	0.992	0.322

$R^2 = 0.073$, $P = 0.001$.

information is taken into account, the demographic interpretation of the density of Mousterian sites is rejected.

Variation in the Diversity of Lithic Tools. Before giving the test results, we must first state that we did not detect any effect of climatic conditions on the geographically sampled data. Correlations between the geographic coordinates of the sites (layers) and their estimated benthic values, although they tend toward the intuitively expected direction, are nil (benthic, with latitude $\cong 0.141$, $P = 0.32$; with longitude $= 0.012$, $P = 1.0$). The result of the regression of the lithic diversity index D on chronology and climate is given in Table 1, which shows a highly significant chronology effect and a nil climatic effect.

Figure 5 shows the distribution of the diversity index D by chronology. The average tendency is obtained through a local loess fit ($\alpha = 0.30$). This average tendency can be subdivided into two segments. The first, lasting from 260,000 to 150,000 years, shows a drop in the diversity index D from 4.2 to 3.5. This reduction of the diversity index is probably the expression of the reduction in the number of Acheulean bifaces during stages 8 to 6 and of their replacement by Micoquian shapes. MAT bifaces appear later, mainly in stage 5. The second segment, lasting from 150,000 to 40,000 years, shows an absence of average change despite the presence of MAT bifaces.

We interpret Figure 5 as representing technological inertia among Neanderthals for both lithic tools and derived perishable products during the four cool to cold macroclimatic periods they experienced. The Neanderthal panoply of lithic tools was very much all-purpose, capable of adapting to all Neanderthal situations of food gathering, whether direct or indirect, from their natural environment. At the current stage of observations, it is difficult to make the link with the classic debate on the meaning of the Mousterian variability of lithic industries (cf. Binford and Binford 1966; Bordes and Sonneville-Bordes 1970; Dibble and Rolland 1992; Mellars 1969). It can be observed, however, that this variability, which is mainly ascribable to geographic conditions (access to raw materials) and cultural factors (development of stylistic traditions and specific debitage techniques), does not seem to be directly linked to demographic factors and carrying capacity.

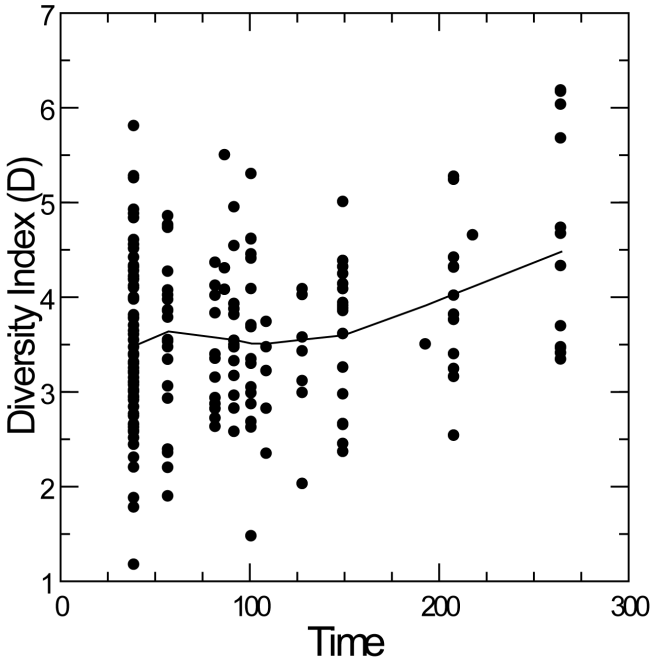

Figure 5. Distribution of the diversity index D according to the chronology of 190 lithic assemblages from 103 sites. The average trend is obtained with a local loess fit ($\alpha = 0.30$).

Discussion and Concluding Remarks

Some difficulties were encountered with the collection of qualitative and quantitative data on the distribution of the tools in the lithic assemblages, as a result of changes in study methods in the last 20 years and the limitations of the Bordes method, which does not take the diversity of debitage methods in Middle Paleolithic assemblages into account. Developments in technology analyses have brought considerable progress by allowing a dynamic view of lithic material (Inizan et al. 1999; Tixier et al. 1980). However, an undesired consequence has been a considerable increase in the number of publications that do not always take the lithic industries fully into consideration and offer quantitative data that are only partial or scattered in different papers. In addition, where debitage methods are concerned, the Bordes counts focus on the Levallois method, so that the diversity observable in the Middle Paleolithic assemblages is not apparent. It is impossible to identify laminar debitage, recognized since the 1980s (Révillion and Tuffreau 1994), and the now better-known discoid method (Boëda 1993). With the development of the technological approaches and the use of the concept of reducing sequence (*chaîne opératoire*), we now have detailed publications that give us more data about the behavior of the Neanderthals, especially for the socioeconomic

aspects in relation to environmental constraints, since the procurement of the raw material until it is discarded. It is unfortunately impossible to take account of these data in a Bordian count.

It would have been interesting to measure the technological reactivity of early European modern humans to the climate and to compare it with that of Neanderthals. But besides the impossibility of expressing this lithic typological variability with the same set of items common to both metapopulations, it should also be borne in mind that one of the major technological innovations of early European modern humans was the use of raw animal materials (bone and ivory), which were used by groups of Neanderthals only when their metapopulation was close to extinction.

The recent analytical approaches to Middle Paleolithic technology with the use of the reducing sequence concept and detailed functional studies provide more information for a better knowledge of Neanderthal behavior. Nevertheless, these new approaches are of little use for the purpose of this paper, which was the technological responses of the Neanderthals to macroclimatic variations. In many recent publications, we can see a lack of standardization in the presentation of the results contrary to the Bordian method, whose limits are, however, clear. It would be useful to find a way to quantify all the aspects of the new Middle Paleolithic data so that we could progress to a better understanding of the economic reactivity of the Neanderthals to climatic variations. Doubtless, the need for multiregional studies will probably have repercussions on the presentation of studies in Middle Paleolithic industries.

With the current representation of the data, at least two noncontradictory hypotheses can be put forward to explain the apparent technological inertia of Neanderthal stone tools: The first calls on cognition, the second on demography.

As the metapopulation of *Homo erectus*, after *Homo antecessor*, evolved toward the Neanderthal and became isolated in Europe from the remainder of the *H. erectus* territory for some 500,000 years, its average cerebral volume was nevertheless similar to or even larger than that of anatomically modern humans at the time of contact. Although brain size was about 1,100–1,400 cm^3 at Atapuerca SH (Sima de les Huesos) (crania 4 and 5; Arsuaga 2009), it had enlarged to 1,200–1,900 cm^3 in the last Neanderthals, as against only 1,350 cm^3 on average in anatomically modern humans (Stanyon et al. 1993). To produce a similar increase in the cerebral volume of the two reproductively isolated metapopulations over the same duration, we must consider a selective mechanism favoring intelligence, also similar. But the contradiction is that the large Neanderthal brain does not seem to have reacted cognitively in the same efficient direction as that of anatomically modern humans of the Upper Paleolithic. Alternatively, the so-called transitional cultures must be regarded as a demonstration of the cognitive capabilities and potential of the Neanderthals to bring themselves rapidly up to the mark (Hublin et al. 1996).

It should be remembered that the production of innovations does not depend solely on the biological cognitive capacities of a population. For the same cognitive capacity, using the simple assumption that innovations are produced at a low

frequency in any population, the most demographically numerous population in absolute terms will produce the greatest number of innovations (Kuznets 1973; Simon 1977). Therefore, along with the assumption of cognitive efficiency, we can also put forward the assumption of a Neanderthal metapopulation that might have been trapped in a hunter-gatherer production system that determined a low carrying capacity, about a few thousand individuals, and maintained the Neanderthal metapopulation in a state of demographic equilibrium but restrained its potential technical creativity precisely because of the smallness of its number: a Malthusian trap. The technical and social characteristics of the Neanderthal production system might have been strong residential mobility, following animal herds; direct and dangerous contact with prey animals by killing with lances, rather than by delivering death from a distance using projectiles (spears) (Gamble 1999), with the aid of beaters; and no division of labor by sex (or by age?) (Kuhn and Stiner 2006) between hunting and gathering, as observed ethnographically (i.e., with both males and females working as hunters and beaters). The example of Australian hunter-gatherer demography at the time of Western contact, with 900,000–1 million individuals (Lourandos 1997: 38) being invaded across a continent of approximately 7,600,000 km^2, and the advantages, on the side of the Western invaders, of technological production from tens of millions of individuals, gives an idea of the impact of numbers on technological development.

In this study we have attempted to model and quantify the Neanderthal response to macroenvironmental variations using the traditional Bordes lithic attributes over a coefficient of lithic diversity. Work still remains to be done to distinguish between the causes of the Neanderthals' disappearance that can be attributed to their cognition and those that can be assigned to the consequences of their demography.

Acknowledgments This research was funded by a grant to J.-P. Bocquet-Appel from the National Center for Scientific Research (CNRS) program "Origin of Human, of the Speech and the Languages" (OHLL 2006, directed by Jean-Marie Hombert).

Received 12 January 2009; revision accepted for publication 22 April 2009.

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Appendix. Distribution of 190 Lithic Assemblages from 103 Middle Paleolithic Archaeological Sites Divided into 10 Bordes Typological Categories, Representing the Reduced Data Set

Site	*Level*	*Culture*	*Maximum Isotopic Stage*	*Minimum Isotopic Stage*	$\delta^{18}O$ *Max.*	$\delta^{18}O$ *Min.*
Salzgitter-Lebenstedt	B1	Micoquian	3	3	4.29	4.29
Sclayn	IA	Charente Mousterian	3	3	4.29	4.29
Carigüela	1, unit 7b	Mousterian	3	3	4.29	4.29
Cueva Morin	17 sup.	Denticulate Mousterian	3	3	4.29	4.29
Gorham Cave	G	Denticulate Mousterian	3	3	4.29	4.29
Arcy-sur-Cure Cave	F	Mousterian	3	3	4.29	4.29
	E	Mousterian	3	3	4.29	4.29
	H	Denticulate Mousterian	3	3	4.29	4.29
	G	Denticulate Mousterian	3	3	4.29	4.29
	XII	Denticulate Mousterian	3	3	4.29	4.29
Baume de Gigny	XX	Mousterian racloirs	3	3	4.29	4.29
Baume des Peyrards	9–5	Ferrassie Mousterian	3	3	4.29	4.29
Bois-du-Rocher	Ser. I	Mousterian, Acheulean	3	3	4.29	4.29
	Ser. II	Mousterian, Acheulean	3	3	4.29	4.29
Caminade-Est	M2	Ferrassie Mousterian	3	3	4.29	4.29
Combe-Capelle bas	I-1B	Denticulate Mousterian	3	3	4.29	4.29
	I-1C1	Denticulate Mousterian	3	3	4.29	4.29
	I-1D	Denticulate Mousterian	3	3	4.29	4.29
	I-1E	Mousterian	3	3	4.29	4.29
	II-4A	Denticulate Mousterian	3	3	4.29	4.29
	II-4C	Denticulate Mousterian	3	3	4.29	4.29
	III-1B	Denticulate Mousterian	3	3	4.29	4.29
	II-3A	Denticulate Mousterian	3	3	4.29	4.29
	I-2A	Mousterian racloirs	3	3	4.29	4.29
Corbehem	Terrassement	Mousterian	3	3	4.29	4.29
Esquicho-Grapaou	Br2	Quina Mousterian	3	3	4.29	4.29
Ferrassie (large shelter)	M2e	Ferrassie Mousterian	3	3	4.29	4.29
	M2c	Ferrassie Mousterian	3	3	4.29	4.29
Ferrassie (small shelter)	Mousterian	Ferrassie Mousterian	3	3	4.29	4.29
Goaréva	2	Mousterian	3	3	4.29	4.29
Hermies. le Tio Marché	Section 12	Mousterian	3	3	4.29	4.29
Ioton	Ag	Ferrassie Mousterian	3	3	4.29	4.29
Jiboui	3	Ferrassie Mousterian	3	3	4.29	4.29
Kervouster	2	Mousterian, Acheulean B	3	3	4.29	4.29
	3	Mousterian, Acheulean B	3	3	4.29	4.29
	4a	Mousterian, Acheulean B	3	3	4.29	4.29
	4c	Mousterian, Acheulean B	3	3	4.29	4.29
	5	Mousterian, Acheulean B	3	3	4.29	4.29
La Quina	3	Quina Mousterian	3	3	4.29	4.29
La Rochette	7	Mousterian, Acheulean B	3	3	4.29	4.29
Le Moustier	G	Mousterian, Acheulean B	3	3	4.29	4.29
Maras	3	Ferrassie Mousterian	3	3	4.29	4.29
Marillac	10	Quina Mousterian	3	3	4.29	4.29
Mauran	II	Mousterian	3	3	4.29	4.29
Pech de l'Azé IV	J3a	Asinipodien	3	3	4.29	4.29
	F4	Mousterian, Acheulean A	3	3	4.29	4.29

Average Age (ky BP)	Calculated Flint Tool Total	Stated Flint Tool Total	Residual Flint Tools	Number of Scrapers	Number of Upper Paleolithic Tools	Number of Encoches	Number of Deniticulates	Number of Acheulean Bifaces	Number of Micoquian MTA Bifaces	Number of Foliates	Number of Choppers and Chopping Tools	Diversity Index
39	407	320	128	142	11	36	3	0	87	0	0	4.09
39	27	26	26	0	0	0	0	0	1	0	0	1.17
39	248	248	49	156	13	12	18	0	0	0	0	3.01
39	373	373	48	90	73	56	106	0	0	0	0	5.27
39	31	31	4	13	3	0	11	0	0	0	0	3.39
39	77	76	1	39	4	16	16	0	1	0	0	3.54
39	54	54	1	31	1	9	12	0	0	0	0	3.00
39	77	77	2	6	13	27	29	0	0	0	0	3.78
39	86	86	4	11	1	29	41	0	0	0	0	3.25
39	492	492	7	101	68	30	286	0	0	0	0	3.14
39	118	118	8	93	10	4	3	0	0	0	0	2.20
39	315	201	16	115	11	28	31	0	0	0	0	3.47
39	201	110	12	55	10	22	11	0	91	0	0	4.19
39	371	191	42	77	11	28	33	0	180	0	0	4.21
39	76	76	0	55	8	7	6	0	0	0	0	2.44
39	171	171	0	59	14	15	85	0	0	0	0	3.10
39	124	124	4	44	4	12	60	0	0	0	0	3.21
39	235	235	2	84	14	13	122	0	0	0	0	2.94
39	179	179	42	80	8	23	26	0	0	0	0	3.99
39	67	67	0	29	3	18	31	0	0	0	0	3.29
39	104	104	0	36	9	33	48	0	0	0	0	3.54
39	52	52	0	17	8	11	20	0	0	0	0	3.77
39	31	31	21	0	0	10	0	0	0	0	0	1.88
39	159	159	23	63	9	41	23	0	0	0	0	4.21
39	95	95	9	37	9	24	16	0	0	0	0	4.31
39	118	118	16	79	1	8	14	0	0	0	0	2.76
39	335	335	0	213	24	35	72	0	0	0	0	2.84
39	69	69	0	46	1	12	14	0	0	0	0	2.62
39	193	193	4	137	15	9	28	0	0	0	0	2.57
39	158	158	12	48	23	47	28	0	0	0	0	4.51
39	218	218	0	8	45	102	63	0	0	0	0	3.19
39	200	200	31	140	8	9	12	0	0	0	0	2.65
39	134	134	15	75	12	14	18	0	0	0	0	3.64
39	155	154	11	35	42	53	13	0	1	0	0	4.41
39	140	135	0	39	36	48	22	0	5	0	0	4.27
39	58	57	0	20	9	18	26	0	1	0	0	3.97
39	96	89	0	17	29	0	43	0	7	0	0	3.38
39	113	108	0	22	22	0	64	0	5	0	0	3.00
39	505	505	0	397	15	53	78	0	0	0	0	2.30
39	305	305	0	258	38	28	40	0	0	0	0	2.51
39	1217	831	25	201	85	200	320	0	386	0	0	4.83
39	58	58	8	31	11	8	0	0	0	0	0	3.31
39	133	133	0	70	5	25	37	0	0	0	0	3.09
39	135	110	16	18	3	24	49	0	0	0	25	4.92
39	144	144	20	30	26	40	28	0	0	0	0	4.88
39	683	674	49	235	62	153	175	0	9	0	0	4.55

Appendix. (*continued*)

Site	*Level*	*Culture*	*Maximum Isotopic Stage*	*Minimum Isotopic Stage*	*$\delta^{18}O$ Max.*	*$\delta^{18}O$ Min.*
	Z	Ferrassie Mousterian	3	3	4.29	4.29
	I2	Ferrassie Mousterian	3	3	4.29	4.29
	X	Mousterian racloirs	3	3	4.29	4.29
	J2	Mousterian racloirs	3	3	4.29	4.29
	F2	Mousterian, Acheulean B	3	3	4.29	4.29
Prélétang	I	Ferrassie Mousterian	3	3	4.29	4.29
Saint-Cézaire	Egpf	Denticulate Mousterian	3	3	4.29	4.29
Combe-Grenal	11	Denticulate Mousterian	3	3	4.29	4.29
Erd	e	Quina Mousterian	3	3	4.29	4.29
Szeleta	2	Szelet ancien	3	3	4.29	4.29
	3	Szelet récent	3	3	4.29	4.29
Amud	B2	Mousterian	3	3	4.29	4.29
Rosh Ein Mor	Unique	Mousterian	3	3	4.29	4.29
Fumane	A9	Mousterian racloirs	3	3	4.29	4.29
Guattari	2	Quina Mousterian	3	3	4.29	4.29
	1	Quina Mousterian	3	3	4.29	4.29
Mezzena	III	Ferrassie Mousterian	3	3	4.29	4.29
	II	Ferrassie Mousterian	3	3	4.29	4.29
Romanelli	G	Quina Mousterian	3	3	4.29	4.29
Dzierzyslaw (site I)	Unit 4	Bohunic	3	3	4.29	4.29
Ripiceni Izvor	VI	Mousterian	3	3	4.29	4.29
Brno-Bohunice	Briqueterie	Bohunic	3	3	4.29	4.29
Külna	6a	Micoquian	3	3	4.29	4.29
Omal	13	Ferrassie Mousterian	4	4	4.55	4.55
Beauvais	2	Mousterian	4	4	4.55	4.55
Brugas	4	Quina Mousterian	4	4	4.55	4.55
Combe-Grenal	35	Ferrassie Mousterian	4	4	4.55	4.55
	22	Quina Mousterian	4	4	4.55	4.55
Fitz-James	Section 1	Mousterian	4	4	4.55	4.55
Hamel	10	Mousterian, Acheulean B	4	4	4.55	4.55
Haute-Roche	3	Mousterian	4	4	4.55	4.55
Lailly Beauregard	I	Mousterian, Acheulean A	4	3	4.55	4.29
Mirefleurs	6 and 4	Quina Mousterian	4	3	4.55	4.29
Pech de l'Azé I	4	Mousterian, Acheulean A	4	4.3	4.55	4.30
Riencourt-lès-Bapaume	B1	Micoquian	4	4	4.55	4.55
	C (partial)	Ferrassie Mousterian	4	4	4.55	4.55
	B2	Mousterian	4	4	4.55	4.55
Saint-Brice-sous-Rânes	Parcel 6-T1	Micoquian	4	3	4.55	4.29
VaufreyCave XVI	C	Mousterian, Acheulean A	4	4	4.55	4.55
Tor Faraj	A	?	4	4	4.55	4.55
Guattari	5	Quina Mousterian	4	4	4.55	4.55
	4	Quina Mousterian	4	4	4.55	4.55
Ripiceni Izvor	IV	Micoquian	4	4	4.55	4.55
Külna	7a	Micoquian	4	4	4.55	4.55
Bérigoule	I (partial)	Ferrassie Mousterian	5.1	5.1	3.82	3.82
Bettencourt-Saint-Ouen	N2b	Laminar Mousterian	5.1	5.1	3.82	3.82
Etoutteville	4a	Laminar Mousterian	5.1	5.1	3.82	3.82
Gouy-Saint-André	Unit 4	Laminar Mousterian	5.1	5.1	3.82	3.82

Average Age (ky BP)	*Calculated Flint Tool Total*	*Stated Flint Tool Total*	*Residual Flint Tools*	*Number of Scrapers*	*Number of Upper Paleolithic Tools*	*Number of Encoches*	*Number of Denticulates*	*Number of Acheulean Bifaces*	*Number of Micoquian MTA Bifaces*	*Number of Foliates*	*Number of Choppers and Chopping Tools*	*Diversity Index*
39	191	191	11	124	24	17	15	0	0	0	0	3.07
39	920	920	77	664	53	73	53	0	0	0	0	2.65
39	867	867	70	474	87	116	120	0	0	0	0	3.69
39	161	181	13	123	18	12	15	0	0	0	0	2.91
39	167	160	4	19	22	50	65	0	7	0	0	4.33
39	39	39	6	18	7	3	5	0	0	0	0	4.11
39	290	290	0	12	21	78	179	0	0	0	0	2.65
39	65	65	0	3	2	35	25	0	0	0	0	2.59
39	808	808	193	512	66	23	14	0	0	0	0	2.74
39	369	256	98	28	33	45	52	0	113	0	0	5.25
39	88	23	23	0	0	0	0	0	65	0	0	1.78
39	72	72	22	16	31	1	2	0	0	0	0	3.38
39	3723	3723	1458	219	930	752	364	0	0	0	0	4.18
39	86	86	6	47	6	12	15	0	0	0	0	3.60
39	258	158	38	91	9	8	12	0	0	0	100	3.99
39	69	69	16	45	1	3	4	0	0	0	5	3.19
39	1344	1344	88	935	64	76	181	0	0	0	0	2.74
39	454	454	28	300	20	42	64	0	0	0	0	2.94
39	162	162	35	83	8	15	21	0	1	0	0	3.81
39	66	66	23	9	13	14	7	0	0	0	0	4.60
39	36	36	6	9	1	13	7	0	0	0	0	4.18
39	348	324	83	55	87	38	61	0	14	10	0	5.80
39	311	296	52	131	39	41	33	0	15	0	0	4.83
57	333	324	7	263	30	0	24	0	7	0	2	2.19
57	0	92	7	25	43	8	9	0	1	0	0	4.02
57	248	248	21	162	18	17	30	0	0	0	0	3.06
57	719	716	29	612	22	32	21	0	0	0	3	1.89
57	716	716	0	633	56	61	111	0	0	0	0	2.35
57	51	51	0	12	0	21	18	0	0	0	0	2.93
57	288	272	45	125	39	28	35	0	15	0	1	4.85
57	102	102	1	36	9	42	14	0	0	0	0	3.54
57	270	253	91	110	33	0	19	0	17	0	0	3.86
57	378	378	132	225	6	0	15	0	0	0	0	2.39
57	2222	2081	495	788	73	233	492	0	141	0	0	4.76
57	942	950	169	453	29	160	139	0	0	0	0	3.85
57	386	386	21	166	30	99	70	0	0	0	0	3.97
57	277	277	11	97	9	43	117	0	0	0	0	3.53
57	43	20	3	12	3	2	0	0	23	0	0	3.34
57	130	111	0	42	19	30	20	0	19	0	0	4.73
57	90	90	44	4	28	8	6	6	0	0	0	4.07
57	125	125	21	83	2	12	7	0	0	0	50	3.78
57	247	247	39	175	12	9	12	0	0	0	50	3.47
57	1621	1364	297	842	56	74	95	0	200	57	0	4.27
57	1120	1049	121	495	174	165	94	0	71	0	0	4.74
82	313	313	7	214	13	41	38	0	0	0	0	2.72
82	67	67	0	35	13	8	11	0	0	0	0	3.35
82	37	37	0	28	0	9	11	0	0	0	0	2.63
82	9	9	0	3	2	2	4	0	0	0	0	3.83

Appendix. (*continued*)

Site	*Level*	*Culture*	*Maximum Isotopic Stage*	*Minimum Isotopic Stage*	*$\delta^{18}O$ Max.*	*$\delta^{18}O$ Min.*
La Roche-Tonnerre		Ferrassie Mousterian	5.1	5.1	3.82	3.82
La Trinité	Series south	Ferrassie Mousterian	5.1	5.1	3.82	3.82
	Series north	Mousterian	5.1	5.1	3.82	3.82
Les Canalettes	2	Mousterian racloirs	5.1	5.1	3.82	3.82
Pech de l'Azé II	4B	Denticulate Mousterian	5.1	5.1	3.82	3.82
Saint-Just-en-Chaussée	Superior	Mousterian, Acheulean A	5.1	5.1	3.82	3.82
Spagnoli (cavity B)	Rp	Quina Mousterian	5.1	5.1	3.82	3.82
Crvena Stijena (Rou Shelter)	XXIII to XII	Mousterian racloirs	5.1	5.1	3.82	3.82
Lailly Beauregard	B, layer 3	Mousterian, Acheulean	5.2	5.1	4.17	3.82
Molinons/Le Grand Chante	A, layer 4	Mousterian, Acheulean	5.2	5.1	4.17	3.82
Villeneuve l'Archevèque	B, layer 3	Mousterian	5.2	5.1	4.17	3.82
Zobiste	B, layer 2	Ferrassie Mousterian	5	5	3.70	3.70
Krapina	7–8	Mousterian	5	5	3.70	3.70
Busigny	Unique	Mousterian	5	5	3.70	3.70
Grainfollet	Series I	Micoquian	5	5	3.70	3.70
	Series II	Micoquian	5	5	3.70	3.70
Karreg-ar-Yellan	7 (rock base)	Denticulate Mousterian	5	5	3.70	3.70
	7 (shore)	Ferrassie Mousterian	5	5	3.70	3.70
La Borde	IIIb	Denticulate Mousterian	5	5	3.70	3.70
Meillers	1/Bt	Denticulate Mousterian	5	5	3.70	3.70
Barma Grande	4	Mousterian racloirs	5	5	3.70	3.70
	3	Mousterian racloirs	5	5	3.70	3.70
Spagnoli (cavity B)	Ar-Ne	Quina Mousterian	5	5	3.70	3.70
Zwolen	L	Micoquian	5	5	3.70	3.70
Königsaue	A	Micoquian	5.3	5.3	3.75	3.75
	C	Micoquian	5.3	5.3	3.75	3.75
	B	Mousterian	5.3	5.3	3.75	3.75
Visoko Brdo		Ferrassie Mousterian	5.3	5.3	3.75	3.75
Bourgeois-Delaunay	9	Ferrassie Mousterian	5.3	5.3	3.75	3.75
Les Fieux	K	Mousterian	5.3	5.1	3.75	3.82
Briqueterie Debus	Unique	Mousterian, Acheulean A	5.3	5.1	3.75	3.82
Mont-Dol	10	Ferrassie Mousterian	5.3	5.3	3.75	3.75
Riencourt-lès-Bapaume	II	Ferrassie Mousterian	5.3	5.3	3.75	3.75
	CA	Ferrassie laminar Mousterian	5.3	5.3	3.75	3.75
Sains-en-Amienois	Series A	Denticulate Mousterian	5.3	5.3	3.75	3.75
Saint-Just-en-Chaussée	Atelier Kelley	Mousterian	5.3	5.3	3.75	3.75
Seclin	Unit 7	Laminar Mousterian	5.3	5.3	3.75	3.75
Vinneuf/Les Hauts Massou	1, layer 2	Micoquian	5.3	5.3	3.75	3.75
Maastricht-Belvédère	J	Mousterian racloirs	5.3	5.3	3.75	3.75
Ripiceni Izvor	III	Ferrassie Mousterian	5.3	5.3	3.75	3.75
Külna	11	Taubac	5.3	5.3	3.75	3.75
Bourgeois-Delaunay	10	Ferrassie Mousterian	5.4	5.4	4.11	4.11
Siouville		Denticulate Mousterian	5.4	5.4	4.11	4.11
Subalyuk	11	Quina Mousterian	5.4	5.4	4.11	4.11
Colonia Montani	Surface	Mousterian racloirs	5.4	5.4	4.11	4.11
Ponte de Crispiero	26	Mousterian racloirs	5.4	5.4	4.11	4.11
Sclayn	5	Mousterian	5.5	5.3	3.09	3.75
Gouberville	Unique	Denticulate Mousterian	5.5	5.3	3.09	3.75

Average Age (ky BP)	Calculated Flint Tool Total	Stated Flint Tool Total	Residual Flint Tools	Number of Scrapers	Number of Upper Paleolithic Tools	Number of Encoches	Number of Denticulates	Number of Acheulean Bifaces	Number of Micoquian MTA Bifaces	Number of Foliates	Number of Choppers and Chopping Tools	Diversity Index
82	70	68	1	45	8	5	9	0	2	0	0	3.15
82	150	146	5	92	13	23	13	0	4	0	0	3.39
82	92	87	43	0	16	20	8	0	4	0	1	4.01
82	370	370	0	239	13	63	98	0	0	0	0	2.87
82	1199	1196	265	173	82	194	482	0	3	0	0	4.36
82	146	83	14	46	7	8	8	0	63	0	0	4.12
82	152	152	16	102	7	12	15	0	0	0	0	2.93
82	339	338	113	192	8	15	10	0	1	0	0	2.82
87	133	131	18	63	13	15	22	0	2	0	0	4.30
87	120	111	17	47	16	12	19	0	9	0	3	5.50
87	121	121	42	43	7	12	17	0	0	0	0	4.07
92	92	92	19	44	11	5	13	0	0	0	0	3.92
92	231	231	0	159	12	20	46	0	0	0	0	2.57
92	585	582	130	262	60	0	130	0	0	0	0	3.54
92	477	449	14	156	88	71	120	0	28	0	2	4.95
92	424	418	0	229	40	64	131	0	6	0	0	3.47
92	305	305	0	60	44	62	158	0	0	0	0	3.49
92	116	114	14	72	4	9	15	0	2	0	0	3.32
92	223	213	26	44	6	51	86	0	0	0	10	4.54
92	66	66	6	13	3	4	40	0	0	0	0	3.16
92	953	953	132	648	34	65	74	0	0	0	0	2.82
92	220	220	11	137	4	25	43	0	0	0	0	2.96
92	339	339	39	179	33	35	53	0	0	0	0	3.81
92	68	68	26	34	4	3	1	0	14	0	0	3.87
101	115	91	47	31	7	3	3	0	24	0	0	4.08
101	23	20	20	0	0	0	0	0	3	0	0	1.47
101	115	114	75	21	6	6	6	0	1	0	0	2.98
101	38	38	9	25	1	1	2	0	0	0	0	2.62
101	501	501	0	263	55	64	136	0	0	0	0	3.29
101	82	81	25	12	2	19	23	0	1	0	0	4.41
101	109	72	20	32	11	3	6	0	37	0	0	4.61
101	436	436	7	274	45	36	74	0	0	0	1	3.04
101	356	356	92	145	0	70	49	0	0	0	0	3.70
101	123	123	26	46	24	10	17	0	0	0	0	4.45
101	35	31	0	2	12	3	18	0	0	0	4	3.68
101	170	170	42	50	34	32	12	0	0	0	0	4.61
101	27	27	16	8	2	0	1	0	0	0	0	2.68
101	178	151	61	33	19	12	26	0	27	0	0	5.30
101	79	79	2	40	3	3	31	0	0	0	0	2.87
101	226	226	47	129	9	25	16	0	0	0	0	3.34
101	530	525	67	233	57	103	65	0	0	5	0	4.40
109	122	122	5	60	15	13	29	0	0	0	0	3.74
109	11	11	2	5	0	0	4	0	0	0	0	2.82
109	203	203	20	154	14	12	3	0	0	0	0	2.34
109	215	215	65	115	9	12	14	0	0	0	0	3.22
109	312	312	84	162	19	32	15	0	0	0	0	3.47
128	163	163	10	65	34	0	54	0	0	0	0	3.42
128	176	176	32	23	9	34	78	0	0	0	0	4.08

Appendix. (*continued*)

Site	*Level*	*Culture*	*Maximum Isotopic Stage*	*Minimum Isotopic Stage*	*$\delta^{18}O$ Max.*	*$\delta^{18}O$ Min.*
Querqueville	Unique	Micoquian	5.5	5.1	3.09	3.82
Saint-Germain-des-Vaux	D2A	Denticulate Mousterian	5.5	5.5	3.09	3.09
Tréissény		Mousterian, Acheulean	5.5	5.5	3.09	3.09
Subalyuk	3	Mousterian racloirs	5.5	5.5	3.09	3.09
Tata		Quina Mousterian	5.5	5.5	3.09	3.09
Abri Suard (La Chaise)	51	Ferrassie Mousterian	6	6	4.98	4.98
Bapaume. les Osiers	Series B	Upper Acheulean	6	6	4.98	4.98
Barbas I	C′3 base	Acheulean	6	6	4.98	4.98
Beaumetz-les-Loges	Glossy series	Mousterian	6	6	4.98	4.98
Combe-Grenal	59	Middle Acheuleam	6	6	4.98	4.98
Mont-de-l'Evangile	LBN	Upper Acheulean	6	6	4.98	4.98
Le Lazaret	UA25	Upper Acheulean	6	6	4.98	4.98
Longavesnes	Unique	Acheulean	6	6	4.98	4.98
Piégu	G	Ferrassie Mousterian	6	6	4.98	4.98
Port Pignot	III	Upper Acheulean	6	6	4.98	4.98
Vaufrey	VIII	Mousterian racloirs	6	6	4.98	4.98
El Colombo	11.10.8.6.5	Mousterian	6	6	4.98	4.98
Pietraszyn 49		Eastern Micoquian	6	6	4.98	4.98
Ripiceni Izvor	I	Mousterian	6	6	4.98	4.98
	II	Mousterian	6	6	4.98	4.98
Cotte-de-St-Brelade	A	Upper Acheulean	6	6	4.98	4.98
Külna	14	Epi-Acheulean	6	6	4.98	4.98
Cotte-de-St-Brelade	E	Mousterian racloirs	7.1	7.1	3.54	3.54
Rissori	Ivb	Ferrassie Mousterian	7	7	3.70	3.70
Bapaume. les Osiers	Series A	Upper Acheulean	7	7	3.70	3.70
Biache-Saint-Vaast	IIA	Ferrassie Mousterian	7	7	3.70	3.70
	II base	Ferrassie Mousterian	7	7	3.70	3.70
Champvoisy		Ferrassie Mousterian	7	7	3.70	3.70
Port Pignot	II	Acheulean	7	7	3.70	3.70
Salouel	All	Denticulate Mousterian	7	7	3.70	3.70
Vimy	17	Upper Acheulean	7	7	3.70	3.70
Cave of Poggio	9-3	Mousterian	7	7	3.70	3.70
	2		7	7	3.70	3.70
Cotte-de-St-Brelade	C	Upper Acheulean	7	7	3.70	3.70
Yarimburgaz Cave	lower layers W–X	Tayac	7	7	3.70	3.70
Cotte-de-St-Brelade	H	Denticulate Mousterian	7.3	7.3	3.54	3.54
Mesvin IV	Channels I and II	Mousterian, Acheulean	8	8	4.41	4.41
Atapuerca	TD, unit IV	Mousterian	8	8	4.41	4.41
Mont-de-l'Evangile	CLG	Acheulean	8	8	4.41	4.41
Vallée du Muid	G	Upper Acheulean	8	8	4.41	4.41
	H	Upper Acheulean	8	8	4.41	4.41
Les Bosses	Unique	Acheulean	8	8	4.41	4.41
Orgnac 3	4b	Acheulean	8	8	4.41	4.41
	4a	Acheulean	8	8	4.41	4.41
	3, base	Acheulean	8	8	4.41	4.41
	2	Acheulean	8	8	4.41	4.41
Saint-Acheul	Bultel-Tellier quarry	Upper Acheulean	8	8	4.41	4.41
Torre Pagliaccetto	Unit m, layer 8	Acheulean	8	8	4.41	4.41

Average Age (ky BP)	Calculated Flint Tool Total	Stated Flint Tool Total	Residual Flint Tools	Number of Scrapers	Number of Upper Paleolithic Tools	Number of Encoches	Number of Denticulates	Number of Acheulean Bifaces	Number of Micoquian MTA Bifaces	Number of Foliates	Number of Choppers and Chopping Tools	Diversity Index
128	159	155	8	28	19	18	82	0	4	0	0	4.02
128	160	160	4	32	18	7	99	0	0	0	0	2.99
128	90	64	0	51	8	0	5	0	24	0	2	3.11
128	105	105	10	88	2	3	2	0	2	0	0	2.02
128	2318	2318	644	1196	231	102	145	0	5	0	10	3.57
149.5	321	321	3	214	25	15	64	0	0	0	0	2.66
149.5	201	193	6	105	27	18	37	8	0	0	0	3.93
149.5	1463	1296	293	197	71	558	177	167	0	0	0	5.00
149.5	105	105	18	45	17	10	15	0	0	0	0	4.32
149.5	692	676	87	354	43	78	114	16	0	0	0	4.08
149.5	11	4	0	3	1	0	0	7	0	0	0	2.36
149.5	99	74	9	44	8	9	4	25	0	0	0	4.38
149.5	303	112	16	42	3	21	30	191	0	0	0	3.25
149.5	36	36	2	18	7	3	6	0	1	0	0	4.14
149.5	80	72	0	14	16	2	40	5	0	0	3	3.90
149.5	105	105	0	59	3	3	40	0	0	0	0	2.45
149.5	121	121	17	78	3	8	15	0	0	0	0	2.97
149.5	42	22	0	12	10	0	0	0	3	0	0	2.65
149.5	271	271	79	129	9	23	31	0	0	0	0	3.61
149.5	164	164	60	57	6	11	30	0	0	0	0	3.85
149.5	0	2516	280	1453	285	220	278	70	0	0	0	3.88
149.5	35	34	10	15	4	3	2	1	0	0	0	4.24
193	0	398	28	222	25	45	78	0	0	0	0	3.50
208	37	37	14	10	6	3	4	0	0	0	0	4.31
208	76	75	5	34	9	13	14	1	0	0	0	4.32
208	290	290	63	146	29	15	37	0	0	0	0	3.76
208	62	62	11	37	2	7	5	0	0	0	0	3.24
208	318	318	27	234	11	20	26	0	0	0	0	2.53
208	42	36	2	5	6	5	18	2	0	0	4	5.27
208	73	73	7	2	9	14	41	0	0	0	0	3.39
208	400	229	4	109	26	18	72	171	0	0	0	4.01
208	4300	4300	954	1419	194	830	903	0	0	0	0	4.41
208	550	550	99	275	45	34	97	0	0	0	0	3.81
208	0	646	54	426	44	42	80	7	0	0	0	3.15
208	0	538	128	121	45	50	194	0	0	0	64	5.24
218	0	160	36	22	15	47	40	0	0	0	0	4.65
264.5	154	136	38	46	30	0	22	0	18	0	0	4.73
264.5	49	49	4	5	10	11	19	0	0	0	0	4.33
264.5	369	258	45	59	41	35	78	97	0	0	14	6.18
264.5	768	725	35	136	84	314	156	43	0	0	0	4.67
264.5	1261	972	21	100	15	709	127	282	0	0	7	3.46
264.5	215	165	39	28	7	41	50	14	0	0	36	6.17
264.5	262	254	27	160	22	10	35	8	0	0	0	3.47
264.5	295	285	27	185	29	12	32	10	0	0	0	3.41
264.5	388	371	38	230	33	22	48	17	0	0	0	3.69
264.5	465	460	181	212	14	24	29	5	0	0	0	3.34
264.5	66	55	8	17	13	6	11	15	0	0	0	5.67
264.5	101	98	23	37	9	11	18	51	0	0	24	6.03