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DENTICULATES OF THE EARLY MIDDLE PLEISTOCENE LITHIC ASSEMBLAGES FROM PAYRE (SOUTH-EASTERN FRANCE)

ABSTRACT: Denticulate represents a common tool in European Lower and Middle Palaeolithic assemblages. To identify its use, characteristics and origin, which can be anthropic or natural, various methods have been applied. Recent studies of Middle Palaeolithic assemblages rich in denticulates show that these tools are often among the thickest tools. In this paper we describe the importance of thickness of selected blanks for the configuration of denticulates at the site of Payre (MIS 8 to 5), situated in Southeast France, along the Rhône River valley. This site belongs to the early Middle Palaeolithic, and the method used for the manufacture of denticulates follows the same rules as in some collections of the recent Middle Palaeolithic.

KEY WORDS: Denticulates – Lithic assemblages – Payre – Southeast France – Early Middle Palaeolithic

INTRODUCTION

Denticulate is traditionally associated with the tool kit of the European Lower and Middle Palaeolithic. This tool appears very early in the Acheulean, and is found as frequently as scrapers in the assemblages. For some authors, this tool appears in Europe prior to the earliest Acheulean (Carbonell *et al*. 1999, 2001, Oms *et al.* 2000). During the Middle Palaeolithic, it becomes a secondary tool relative to the dominant side-scraper, except for certain cases known as the "Denticulate Mousterian" where it is the dominant tool. It is uncommon in the Upper Palaeolithic, but is found more frequently at Neolithic sites. Its appearance has sparked discussion of whether it is a tool or a core as suggested by Cremashi and Peretto (1988) or Farizy (1988a)? Furthermore, the "nature" of the retouch on a denticulate – a series of notches – often makes it difficult to identify it as a human-manufactured artefact. Taphonomic studies suggest that these notches could also have been caused by natural processes (Arnold 1991, Lemorini 2000, Caspar *et al*. 2003, 2005, Thiébaut 2003, 2005, 2007). According to previous studies, denticulate is associated with a specific activity, or with a particular cultural phase (Bordes 1950, 1981, Binford et Binford 1966, Binford 1973, 1983). These presumed associations, which have also anticipated a relationship between the denticulate and woodworking activities (Deffarges, de Sonneville-Bordes 1972), have since been contested at Abric Romaní in Spain (Martínez *et al*. 2001, 2005) as well as for other time periods (Jensen 1988).

Recently, a detailed analysis of denticulates was done on several Middle Palaeolithic assemblages (Marine Isotopic Stage, MIS 3) (Theodoropoulou 2008): level D of Brouillaud (Peyrony, Bourrinet 1928, Geneste 1985), level B of Breuil (de Lumley 1969), and levels Ja and E of Romaní rock shelters (de Lumley, Ripoll Perelló 1962, Carbonell *et al.* 1994, 1997, Vaquero 1999, Vaquero *et al.* 1998, 2001, Martínez *et al*. 2005), and level 2 of the Tournal Cave (Tavoso 1987a, b, Yokoyama *et al.* 1987, Bischoff 1988, Patou-Mathis 1994, 1999). These results demonstrate that denticulates are made on blanks thicker than 9 mm on average, regardless of the blanks' length and width, while the scrapers are made on any type of blank. The thickness of

the blank as a criterion for the manufacture of these tools is observed in other assemblages of the Middle Palaeolithic (level C of the Brouillaud shelter, Hauteroche, Esquicho-Grapaou, La Quina, Marillac, Cova Negra sites, and level C of the Chadourne shelter) (Peyrony, Bourrinet 1928, Bordes *et al.* 1954, Girard 1978, Bourguignon 1997). The same is true of denticulates found in some Lower Palaeolithic and Early Middle Palaeolithic series. Even if the reduction sequence used resulted in a majority of thick blanks, for example at Isernia la Pineta (Italy), Baume Bonne and Orgnac 3 (France), it appears that the thickness is yet an important criterion characterising the denticulates (Piperno 1999, Moncel 1999, Notter 2007).

This particular study focuses especially on denticulates found in different levels of the Early Middle Palaeolithic site of Payre (MIS 8 to 5) located in Southeast France, along the Rhône River valley. We concentrate on the three levels which are richest in tools, namely levels Ga, F and D of the sequence. Scrapers and convergent tools are dominant within each of these levels, whereas denticulates are found less frequently. The aim of this analysis is to describe the characteristics and the variability of these tools through a morphological and technological study of the pieces in relation to the reduction sequences. Subsequently we discuss the status of denticulates in lithic assemblages of the early Middle Palaeolithic, and compare them to collections belonging particularly to some recent Middle Palaeolithic series classified by F. Bordes as "Denticulate Mousterian."

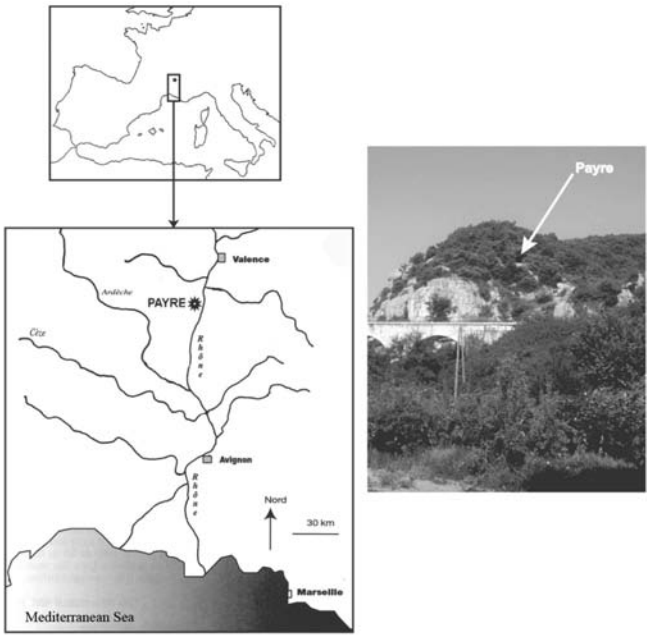

FIGURE 1. Geographic location of the site of Payre (Moncel *et al.* 2007).

THE SITE OF PAYRE

The site of Payre is situated at the edge of the Rhône valley. It opens to the southeast on a cliff, 60 m above the Payre River, a small tributary of the Rhône River (*Figure 1*). Since 1990, systematic excavations have been carried out there on a surface area covering 30 to 70 m^2 of the 80 m^2 extent of the site (Combier 1967, Moncel *et al.* 2002, 2008). The Payre site belongs to a karstic complex of the Jurassic and Cretaceous formations which cover a large part of the right edge of the Middle Rhône valley (Debard 1988).

This site yielded human remains, which have been attributed to the Neanderthal evolutionary lineage, as well as artefacts and faunal assemblages throughout the entire sequence (Moncel, Condemi 1996, 1997, Moncel *et al.* 2002). This 5 m thick sequence is composed of five main levels (G, F, E, D-C and B-A from bottom to top), divided into sub-layers. Bones and large mammal teeth were dated by U/Th and ESR, and burned flint sampled on the basal stalagmitic floor and throughout the sequence, by TL (Masaoudi *et al*. 1997, Moncel *et al.* 2002, 2008). TIMS dates (Valladas et al. 2008) suggest that the stalagmitic floor was formed in the cave during the end of MIS 8 and MIS 7. This is overlaid by level G, which is characterised by orange clay containing numerous stones and slabs, and has yielded most of the scattered human remains of two occupations. Eight teeth and a fragment of a left parietal bone represent 3 or 4 individuals of diverse age, and have been attributed to the Neanderthal lineage (Moncel, Condemi 1996, 1997). The second deposit, level F, is composed of seven stages of grey sediment and beds of rubble and clay. It corresponds to alternating human and carnivore (mainly bear) occupations. These two cave deposits are dated to the end of MIS 8 and the beginning of MIS 7. The TL dates give an average age of 232±15 ka for level G and 231±27 ka for level F; the U/Th and ESR dates for levels G and F lay between 235±18 ka and 169±13 ka. The cave ceiling collapsed and the cavity opened at the end of MIS 6 or the beginning of MIS 5, as suggested by new ESR and U/Th dates obtained from bones and teeth of large mammals. After this, Payre Cave was progressively reduced to become a shelter for human occupations in open air during the last period of sedimentation, levels D and C. The deposits of unit D (average age of 144±11 ka by U/Th and ESR) are also attributed to the end of MIS 6 or the beginning of MIS 5 (Masaoudi *et al.* 1997, Valladas *et al.* 2008, Moncel *et al.* 2008).

Paleoenvironmental reconstructions suggest that the three main occupation levels (G, F, and D units) correspond to interstadial phases when the climate was temperate and humid, and there is little variation in the composition of the faunal assemblage between these levels (Moncel *et al.* 2002, 2008). The environment was composed of highly developed forested areas as well as open spaces, which allowed for a great diversity of taxa. The species represented in the faunal assemblage occupied several ecological niches, characterised by the abundance of herbivores, especially *Equus sp*. which represents more than 10% of the remains (MNIc) in levels G and F. *Cervus elaphus* is most frequent in level D with a MNIc of 7%, associated with *Bos primegenius.* Among the carnivores, *Ursus spelaeus* is the most abundant taxon, especially in level F.

The association of four species of rodents in unit D (*Pliomys lenki, Microtus brecciensis /Iberomys/*, *Arvicola terrestris* and *Arvicola sapidus*) suggests an open humid environment which corresponds to the end of the Middle Pleistocene and the beginning of the Upper Pleistocene. The avian remains (*Pyrrhocorax graculus, Corvus monedula, Corvus corone, Lyrurus tetrix*) suggest a temperate climate with a rather open and rocky landscape (El Hazzazi 1998, Moncel *et al*. 2002, 2008).

Rare pollen grains indicate a semi-forested environment with Mediterranean trends (Kalaï *et al*. 2001, Moncel *et al.* 2008). For unit D, pollens indicate a temperate environment, which leads us to assign it to a sub-stage of the MIS 5, probably MIS 5d. All biostratigraphical data suggest that level D corresponds to the end of MIS 6 and beginning of MIS 5 deposited during a milder climatic phase, and the base of the sequence (levels G and F) to a temperate period, drier in level G than in level F.

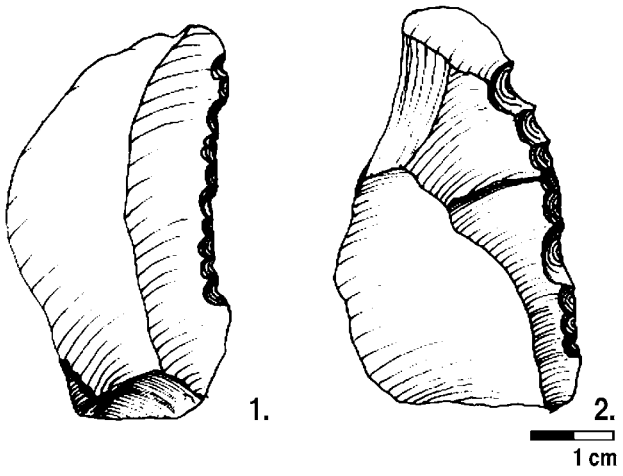

FIGURE 2. Examples of scrapers-denticulates.

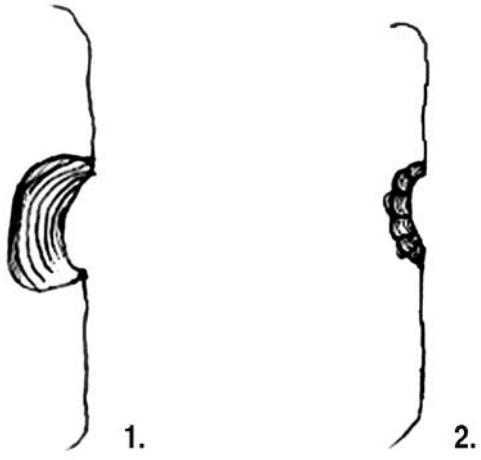

FIGURE 3. Types of notches: 1 – Clactonian notch, 2 – retouched notch.

METHODS

To assess the role of denticulates, and further refine analysis of their complexity and variability in lithic assemblages and at Payre, we investigated the reduction sequences leading to the production of blanks and tools, especially that of denticulates. The first typological classification of retouched products was based on Bordes' methodology (1961, 1970) and further elaborated by various subsequent analyses (Laplace 1962, 1974, Tixier 1963, Kantman 1970a, b, Bocquet 1980, Farizy 1988b, Arnold 1991, Verjux 1988, Jaubert et al. 1990, 2005, Jaubert 1993, 1999, Inizan *et al.* 1995, Jaubert, Mourre 1996) and our own methodology (Theodoropoulou, 2008). According to Bordes (1961) and Tixier (1963), the term 'denticulate' refers to any blank of knapped stone which is modified by a series of contiguous notches (two or more), made intentionally. Several types of denticulates are distinguished by the number and location of their notches: single, multiple, convergent, lateral, transversal or pointed (known as Tayac points). We have identified scrapers-denticulates, tools on which the cutting edges are formed by both retouches and notches, forming a sinuous or irregular delineation (*Figure 2*). We distinguish different types of denticulates, depending on the position and number of retouches: single, multiple, converging or non-converging.

For our study, several criteria such as type, size, degree of modification, amplitude, direction, and location of notches, were used to describe the variability of this type of tool. Below we clarify several characteristics that require further attention, either in order to refine existing definitions, or because they are new criteria developed for the purpose of this study. Blanks which did not possess clear features, for example those with only isolated retouches, or blanks with retouches of questionable origin, were excluded from the present study sample.

Two *types of notches* were distinguished: the Clactonian notch, created by one removal; and the retouched notch, characterised by a concavity obtained by several short removals (*Figure 3*).

The *delineation of edges* of denticulates was initially identified by the size of notches, and then by the degree of modification of the edges. Depending on the dimensions of the notches, we distinguished the types as follows (*Figure 4*):

- macrodenticulates: the length of notches is larger than 5 mm
- microdenticulates: the length of notches is smaller than 5 mm
- festooned denticulates: the length of notches varies (more or less than 5 mm).

The *degree of modification* of the edges of notches is characterised by their depth on the edge, which may be small, average or invasive (*Figure 5*).

The *amplitude of notches* has been defined by the extent of removal (or removals in the case of a retouched notch) on the surface of the blank. This amplitude may be marginal, little-invasive or invasive (*Figure 6*).

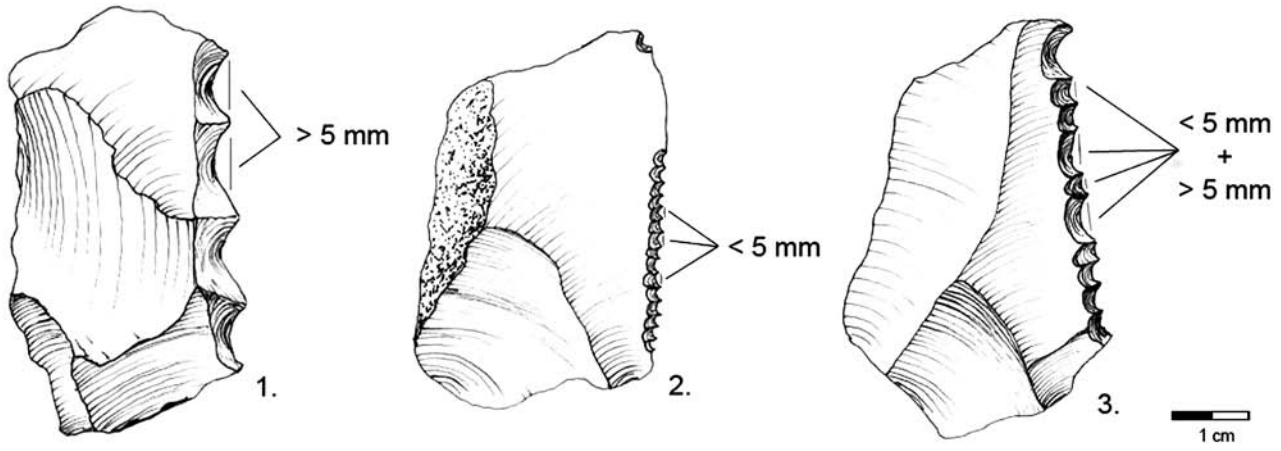

FIGURE 4. Types of denticulates with regard to delineation of the edges: 1 – macrodenticulate, 2 – microdenticulate, 3 – festooned denticulate.

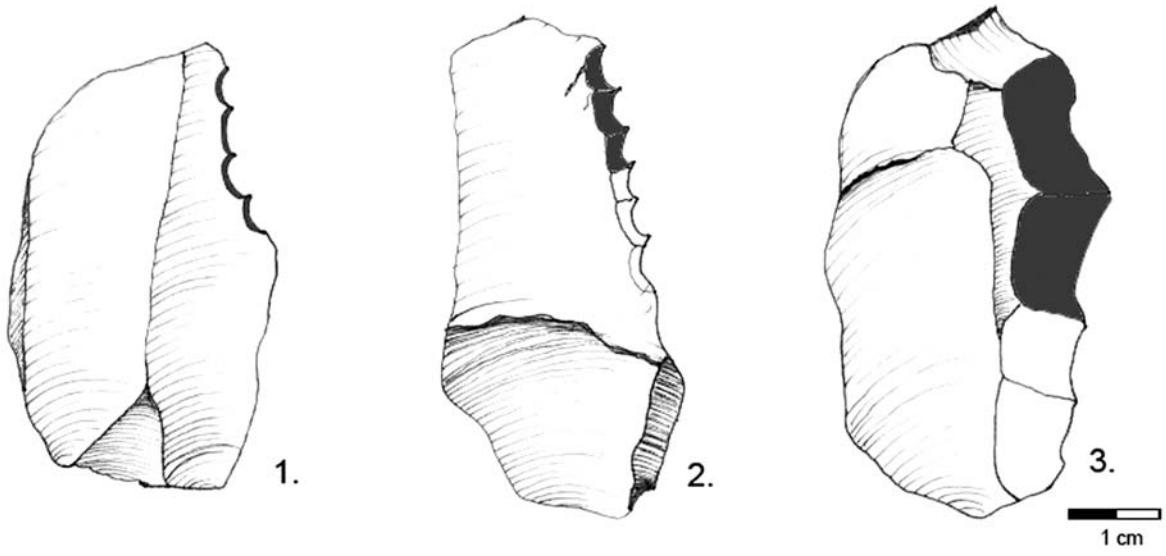

FIGURE 5. Degree of modification of the edge in denticulates: 1 – denticulate with small modification of the edge, 2 – denticulate with average modification of the edge, 3 – denticulate with invasive modification.

RESULTS

Study material

The series deriving from levels Ga, F and D at the Payre site contains the largest number of lithic products in the stratigraphical sequence (*Table 1*). Most used on nodules or flakes is the discoid method. It is associated with secondary reduction sequences such as Levallois cores, orthogonal cores, and Kombewa cores (Moncel *et al.* 2008).

Two groups of flake tools were distinguished: simple tools (which include blanks with a single tool) and composite tools (blanks with at least two different types of tools). The different types of retouched products of flaking were divided into groups (*Tables 2, 3*).

Tools are made mainly on flint, which is the most widely available material sourced from the local or semi-local outcrops (5 to 8 km, Fernandes *et al*. 2008). The dominant side-scrapers and convergent tools are nearly always made on flint, with fewer tools made on quartz and quartzite. Denticulates comprise about 15% of the total of tools for each level, the majority of which are flint tools. Most of the Payre tools were single and double scrapers (*Tables 2, 3, Figure 7*). In the lower level Ga, some Quina-type scrapers were found. These scrapers have ordinary and short retouches on one edge. The scaled retouch is rare (about 10%). The retouches had slightly transformed the cutting edges of the blanks (Ga 3.5%; Fa 7%; D 2%).

Types of blanks for denticulates

The blanks used for denticulates at Payre were compared to the entire series of blanks, according to quantitative, technological (type, state of flaking, morphology of blanks) (*Tables 4, 5, 6, 7, 8, 9*) and dimensional criteria (*Tables 10, 11*). Denticulates were analysed according to the morphology, location and direction of notches (*Tables 12, 13*).

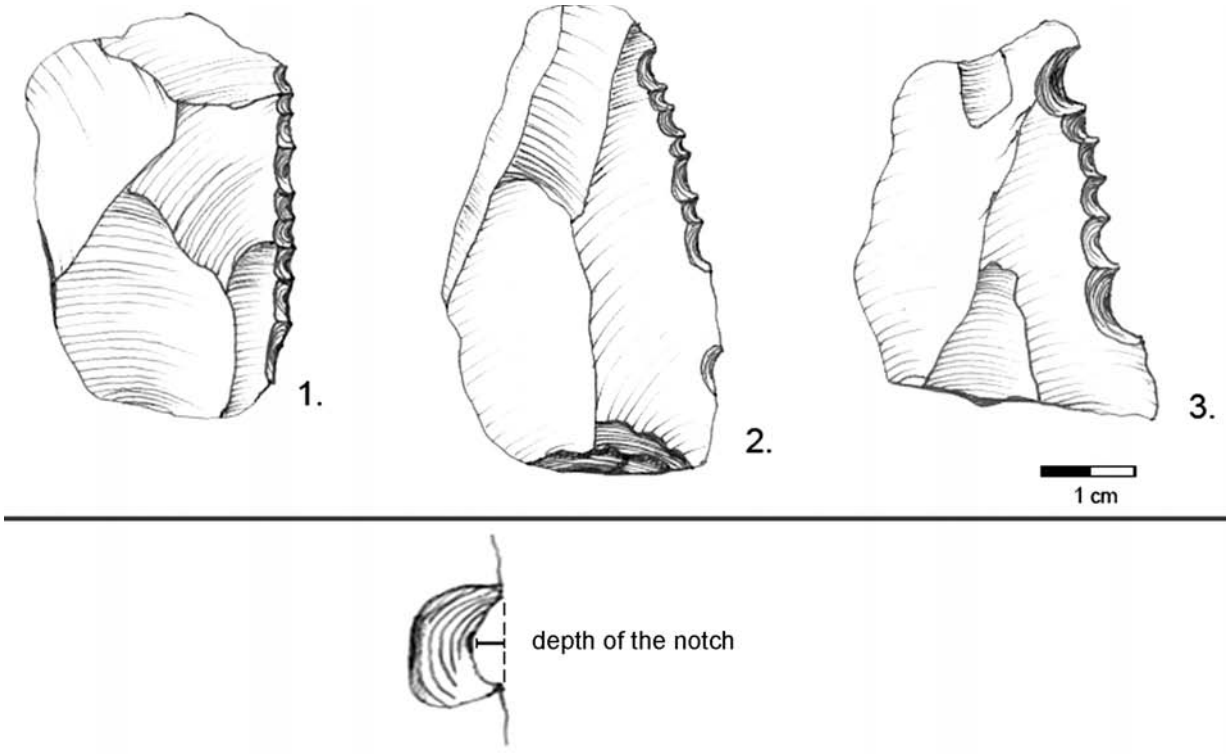

FIGURE 6. Amplitude of notches in denticulates: 1 – denticulate with marginal amplitude of notches, 2 – denticulate with little-invasive amplitude of notches, 3 – denticulate with invasive amplitude of notches.

TABLE 1. Knapping products and flake tools in levels Ga, Fa, and D at Payre.

	level Ga		**level Fa**		**level D**	
Material	*Knapping products*	*Flake tools*	*Knapping products*	*Flake tools*	*Knapping products*	*Flake tools*
Flint	2739	274	1991	152	1426	398
Quartz	176	4	212	4	242	20
Quartzite	44	15	26	1	38	0
TOTAL	2959	293	2229	157	1706	418

TABLE 2. Types of single tools on flint, quartz and quartzite in levels Ga, Fa, and D at Payre.

Single tools	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
	Ga						***Fa***						***D***					
	flint		*quartz*		*quartzite*		*flint*		*quartz*		*quartzite*		*flint*		*quartz*		*quartzite*	
Side-scrapers	**123**	*34.6*			**9**	*60*	**62**	*43.5*					**198**	*53.2*	**11**	*55*		
Denticulates	**45**	*12.7*	**2**	*50*			**27**	*19*	**2**	*50*			**56**	*15*	**2**	*10*		
Notches	**23**	*6.5*	**1**	*25*	**1**	*6,5*	**10**	*5*	**1**	*25*			**11**	*3*	**1**	*5*		
Scrapers-denticulates	**53**	*15*	**1**	*25*	**2**	*13.5*	**38**	*26.5*	**1**	*25*	**1**	*100*	**100**	*27*	**6**	*30*		
Quina scrapers	**13**	*3.6*																
Bifacial tools	**2**	*0.5*											**3**	*0.8*				
Burins	**3**	*0.8*					**1**	*0.6*										
Becs	**3**	*0.8*			**2**	*13.5*	**4**	*2.7*					**2**	*0.5*				
End-scrapers	**1**	*0.2*			**1**	*6.5*	**4**	*2.7*					**2**	*0.5*				
Points	**35**	*9.8*																
Retouched points	**55**	*15.5*																
TOTAL	**356**	*100*	**4**	*100*	**15**	*100*	**146**	*100*	**4**	*100*	**1**	*100*	**372**	*100*	**20**	*100*	**0**	*0*

TABLE 3. Types of composite tools on flint, quartz and quartzite in levels Ga, Fa, and D at Payre.

Composite tools		**Ga**		**Fa**		**D**	
flint		N	%	N	%	N	%
Side-scrapers +	Notches	**2**	*25*	**1**	*11*	**9**	*36*
	Scrapers-denticulates	**3**	*37.5*	**4**	*45*	**8**	*30*
	Denticulates	**2**	*25*	**1**	*11*	**4**	*15*
Denticulates +	Notches					**1**	*4*
	Becs			**1**	*11*		
	End-scrapers			**1**	*11*		
	Scrapers-denticulates					**2**	*7*
Scrapers-denticulates +	Becs					**1**	*4*
	End-scrapers			**1**	*11*		
Quina scrapers +	Scrapers-denticulates	**1**	*12.5*				
Notches +	End-scrapers					**1**	*4*
TOTAL		**8**	*100*	**9**	*100*	**26**	*100*

The selection of blanks does not show any significant differences from a technological point of view. The blanks for the tools are generally non-cortical flakes or often flakes with cortical back (*Tables 4, 6*). The removals are unipolar or orthogonal (*Table 5*). Some cores show ordinary or denticulate retouches. This selection of materials is similar with flint, quartz and quartzite (*Tables 7, 8*), although in quartz and quartzite the blanks are often less cortical in nature.

Dimensions of denticulates

The discoid flaking method produces variable sizes and morphologies of flakes at Payre. In this case, the blanks used for denticulates were always sought out among the largest flakes and mainly among the thickest blanks (*Table 10*). Tools of level Ga have the largest dimensions (*Table 10*). In this level there are as well several Quina-type scrapers also manufactured on long, wide and very thick flakes, thicker than those of notched pieces. The size of scrapers varies regardless of the level, between short (min. 18 mm) and thin flakes (min. 5 mm) to long (max. 76 mm) and thick flakes (max. 27 mm), while the dimensions of denticulates remain relatively constant. Tools made of quartz and quartzite are longer than flint tools (*Table 11*). Notched tools (denticulates and notches) are nearly always made on thicker blanks.

Manufacture of denticulates

Among the three types of denticulates distinguished (*Figure 8*), macrodenticulates dominate in levels Ga and Fa while at the upper level D, festooned denticulates are the most dominant form. Most of the denticulates are located on the upper (dorsal) side of the flake and on one lateral edge, often the longest. The notches have slightly modified the edges and the shape of the flake (*Table 12*). Converged denticulates are rare (approximately 5% on each level), and one atypical Tayac-point was found in the upper level D. Macrodenticulates, with invasive notches and always made on very thick blanks, comprise about 6% of the denticulates for each level (*Table 13*). Comparison of thicknesses of these macrodenticulates indicates that the only exception is the Quina-type scraper which is on the thickest blanks in level Ga. Macrodenticulates could be considered as cores producing small flakes or as tools. In each level, numerous small flakes of less than 15 mm have been classified as flaked products or as flakes from retouch. Some of them could be related to macrodenticulates. Unfortunately the rare refitting of pieces made at Payre does not concern these artefacts.

DISCUSSION

The technological and morphological analyses of denticulates at Payre show that the selected blanks of these tools are among the thickest, regardless of the raw material used or the level in which the tools were found. Flint, which is the primary raw material, was sourced from the local environment. The few artefacts coming from remote outcrops are no denticulates (Moncel *et al.* 2008). In the upper level D, the blanks of flake tools are generally shorter but the thickness of denticulates remains almost constant.

Although Payre belongs to the early Middle Palaeolithic, the manufacture of denticulates follows the same rules as were identified in some assemblages of the recent Middle Palaeolithic (Geneste *et al.* 1997, Geneste, Turq 1997, Thiébaut 2005). For example, in the "Mousterian of Acheulean Tradition" (MAT) of the Brouillaud shelter (level C), the denticulate blanks were sought out among the largest flakes (9.7 mm in average) while the blanks for scrapers were chosen from among the longest, widest and thinnest ones (47.9 × 38.2 × 8 mm in average) (Theodoropoulou 2008). Similarly, in the lower MAT levels at the site of Rouquette (Duran, Tavoso 2005), denticulates are on thick blanks produced by discoid flaking.

For the "Quina-type Mousterian" described by Bordes (1961), the main knapping method is the Quina-type flaking which produces thick flakes (Bierwith 1996, Bourguignon 1997, Bourguignon, Turq 2005). At Hauteroche, Esquicho-Grapaou, La Quina, Marillac and Cova Negra sites for example, the Quina-type scrapers are also on thick flakes, thicker than denticulates, while the denticulates themselves are generally manufactured on thick blanks.

In the other facies, the size difference between denticulates and the other tools is still more obvious.

TABLE 4. Types of tool blanks at Payre.

Type of blank	level Ga					level Fa				level D			
	n=45	n=23	n=53	n=123	n=13	n=27	n=10	n=38	n=62	n=56	n=11	n=100	n=198
	%	%	%	%	%	%	%	%	%	%	%	%	%
	D	N	S-D	S	Q	**D**	N	S-D	S	**D**	N	S-D	S
Flakes	**78**	**74**	**79**	**86**	**100**	**77**	**70**	**79**	**74**	**84**	**91**	**96**	**91**
Levallois flakes	2		6	2					5	1.5		3	2
Cores	11	4	7	4		13		11	10	1.5			0,5
Retouched flakes or flakes related to a notch	7	4		0,5		3				1.5			
Kombewa flakes	2		6	5		7		5	10	1.5	9	1	2,5
Débris		18	2	2,5			30	5	1				4

D = Denticulates, N = Notches, S-D = Side-scrapers-denticulates, S = Side-scrapers, Q = Quina side-scrapers

TABLE 5. Organisation of scars on the flint tools at Payre.

Organisation of scars	level Ga					level Fa				level D			
	n=45	n=23	n=53	n=123	n=13	n=27	n=10	n=38	n=62	n=56	n=11	n=100	n=198
	%	%	%	%	%	%	%	%	%	%	%	%	%
	D	N	S-D	S	Q	**D**	N	S-D	S	**D**	N	S-D	S
unipolar	**50**	**55.5**	**52**	**60**	**50**	42	**60**	**73**	**62**	**79**	**80**	**57.5**	**63**
bipolar	9		5	5	8	4		4	4,5			1	4
orthogonal	36	39	25	30	34	**54**	40	16,5	20	16	20	27.5	23
crossed	5	5.5	18	5	8			6,5	13.5	5		14	10

D = Denticulates, N = Notches, S-D = Side-scrapers-denticulates, S = Side-scrapers, Q = Quina side-scrapers

TABLE 6. Cortical patches on the flint tools at Payre.

Tools	level Ga					level Fa				level D			
	n=45	n=23	n=53	n=123	n=13	n=27	n=10	n=38	n=62	n=56	n=11	n=100	n=198
	%	%	%	%	%	%	%	%	%	%	%	%	%
	D	N	S-D	S	Q	**D**	N	S-D	R	**D**	N	S-D	S
cortical	13	30.5	8	9	15	7		5	5		27	8	11
little-cortical	23.5	26	19	36.5	31	36	30	16	26	32	27	24	27
non-cortical	**63.5**	**43.5**	**73**	**55.5**	**54**	**57**	**70**	**79**	**69**	**68**	**46**	**68**	**62**

D = Denticulates, N = Notches, S-D = Side-scrapers-denticulates, S = Side-scrapers, Q = Quina side-scrapers

TABLE 7. Types of blanks of the quartz and quartzite tools at Payre.

Type of blank	level Ga				level Fa				level D			
	n=2	n=2	n=3	n=9	n=2	n=1	n=2	n=0	n=2	n=1	n=6	n=11
	D	N	S-D	S	**D**	N	S-D	S	**D**	N	S-D	S
Flakes	**2**	**2**	**3**	**9**	**2**	**1**	**2**		**2**	**1**	**6**	**10**
Broken pebbles												1

D = Denticulates, N = Notches, S-D = Side-scrapers-denticulates, S = Side-scrapers, Q = Quina side-scrapers

Denticulates are rarely found on Levallois products, which are thin. In these Middle Palaeolithic assemblages, the blanks of any type of tools were not always sought out among the longest, widest and thickest specimens. Usually, denticulates are on the thickest blanks which are not of Levallois style. At the Vauffrey Cave (upper levels), denticulates are found on thick blanks produced by discoid flaking, while scrapers are mostly produced on thinner blanks made by the Levallois flaking (Rigaud 1988).

Even when the Payre assemblages are compared with lithic assemblages of the lower and early Middle Palaeolithic, these observations remain unchanged. In sector II of Isernia la Pineta in Italy (dated 750 ka BP), these denticulates are significantly thicker than the other flint pieces. According to the authors, denticulates are either cores knapped by a bipolar method on flint slabs, or tools (Cremaschi *et al.* 1988, Peretto 1999). In this case, the thickness of these artefacts could be explained (Cremaschi e*t al.* 1988, Minelli, Peretto 2005). At Notarchirico in Italy (dated 850 ka – 450 ka BP, Piperno 1999), denticulates were made on thick blanks (13 mm in average), and scrapers on the longest and widest blanks. In the lower levels of Baume Bonne (MIS 10-8), the numerous denticulates are always on

TABLE 8. Organisation of scars on the quartz and quartzite tools at Payre.

Organisation of scars	**level Ga**				**level Fa**				**level D**			
	n=2	n=2	n=3	n=9	n=2	n=1	n=2	n=0	n=2	n=1	n=6	n=11
	D	N	S-D	S	**D**	N	S-D	S	**D**	N	S-D	S
unipolar	**2**	**2**	**2**	**4**		**1**	1			**1**	**4**	**7**
orthogonal			1	1	**2**		1		**2**		2	2
no scars				5								2

D = Denticulates, N = Notches, S-D = Side-scrapers-denticulates, S = Side-scrapers, Q = Quina side-scrapers

TABLE 9. Cortical patches on the quartz and quartzite tools at Payre.

Tools	**level Ga**				**level Fa**				**level D**			
	n=2	n=2	n=3	n=9	n=2	n=1	n=2	n=0	n=2	n=1	n=6	n=11
	D	N	S-D	S	**D**	N	S-D	S	**D**	N	S-D	S
cortical		1		3						1	1	3
little-cortical	**2**		**2**	2		1					**4**	**4**
non-cortical		**1**	1	**4**	**2**		**2**		**2**		1	**4**

D = Denticulates, N = Notches, S-D = Side-scrapers-denticulates, S = Side-scrapers, Q = Quina side-scrapers

TABLE 10. Average sizes of the flint tools at Payre.

	Denticulates	**Notches**	**Scrapers**	**Scrapers-denticulates**	**Quina scrapers**
	level Ga (mm)				
Length	41	40	43.6	45.5	59.7
Width	36.6	34	35.8	36.1	47.6
Thickness	13.4	12.5	12.2	12.3	18.8
	level Fa (mm)				
Length	37.2	37.8	40	37.7	
Width	35.1	31.8	35.5	35.1	
Thickness	13.3	14.8	12	11.2	
	level D (mm)				
Length	36.9	41.6	40.3	36.5	
Width	33.3	36.5	34.2	34	
Thickness	10.5	11.6	11.2	11.3	

TABLE 11. Average sizes of the quartz and quartzite tools at Payre.

	Denticulates	**Notches**	**Scrapers**	**Scrapers-denticulates**
	level Ga (mm)			
Length	52.5	42.5	50	50
Width	49.5	37.5	43	43
Thickness	25.5	14	19	20
	level Fa (mm)			
Length	50	37	43.6	47
Width	35.5	35	40.2	23.5
Thickness	19	20	11.3	16
	level D (mm)			
Length	39.5	74	39	43.7
Width	31.5	43	38	36.2
Thickness	15	22	15	15.7

very thick blanks (14.7 mm in average) slightly thicker than the rest of the tools (Gagnepain, Gaillard 1996, 1997, Notter 2007). In levels 8 to 4 at Orgnac 3 in Southeast France (MIS 9), denticulates and notches are always on thick blanks, and usually on products coming from knapping (cortical flakes from the manufacture of pebble tools) or flaking (first removals or cortical products from the first stages of the reduction sequence). On the contrary, in levels 3 to 1 at Orgnac 3 (MIS 8), where most products were related to a Levallois reduction sequence, denticulates are associated with thick flakes coming mainly from flaking while the Levallois flakes were frequently used for scrapers (Moncel 1999).

TABLE 12. Morphological and typological patterns of the flint denticulates at Payre.

	level Ga n=45 %	**level Fa** n=27 %	**level D** n=56 %
Width of notches			
Microdenticulates	31	16	31
Macrodenticulates	38	45	32
Small notches	31	39	37
Degree of modification of the cutting edge			
low	23,5	16	27
medium	55	61	53
high	21,5	23	20
Size of not ches			
small	22	19	18
average	58	42	63
invasive	20	39	19
Way of location of notches			
direct	78	71	80
inverse	19	26	12
direct-inverse	3	3	8
Location of notches			
lateral left	38	23	34
lateral right	42	55	41
transversal distal	14	19	20
transversal proximal	6	4	5

TABLE 13. Average sizes (mm) of the flint denticulates at Payre.

	Length	**Width**	**Thickness**
	level Ga n=45		
Macrodenticulates	44.1	41.4	15.4
Microdenticulates	43.2	35.5	12.1
Small notches	38	32.2	12.8
	level Fa n=27		
Macrodenticulates	39.5	37.7	17
Microdenticulates	36	31	8.2
Small notches	36.4	33.4	13
	level D n=56		
Macrodenticulates	37	35	12
Microdenticulates	33.6	30.4	8.8
Small notches	42	34	11

CONCLUSIONS

After analysing the reduction sequences applied on denticulates at the Payre site levels Ga, F and D, we can conclude that the manufacture of denticulates during the early Middle Palaeolithic follows the same rules as were observed in several recent Middle Palaeolithic assemblages. Even if denticulates are not numerous at Payre, the criteria for the selection of blanks – and especially that of macrodenticulates (thickness of more than 12 mm) – are based mainly on thickness for technical reasons (Verjux 1988, Caspar *et al*. 2005). At Payre, the selected blanks were produced by discoid flaking, and the thickest flakes have been used by humans to manufacture denticulates. The rare Quina-type scrapers are the only tools thicker than denticulates (*Figure 9*). In contrast, the side-scrapers were made on various kinds of blanks. This technical choice was already observed in the Lower Palaeolithic. Consequently, it can be related neither to a specific activity nor to the duration of occupation (Daujeard 2008, Rivals *et al.* 2008). The subsistence strategies observed at Payre indicate seasonal occupations: a shorter duration for level Fa, and a longer duration for levels Ga and D.

Whatever their use, the denticulates found at Payre are part of the tool kit employed during each phase of human occupation, and this tool could be thus considered as one of the basic artefacts of the Middle Palaeolithic. Recent microwear analysis shows that this tool is not related to a specific activity, and is rather multifunctional such as the scrapers (Anderson-Gerfaud 1981, Beyries 1987, Martínez, Rando 2001, Martínez 2005). For manufacturing these tools, humans required thick blanks and made various kinds of notches. We group these tools by the presence of notches but they are certainly related to diverse functional purposes. At

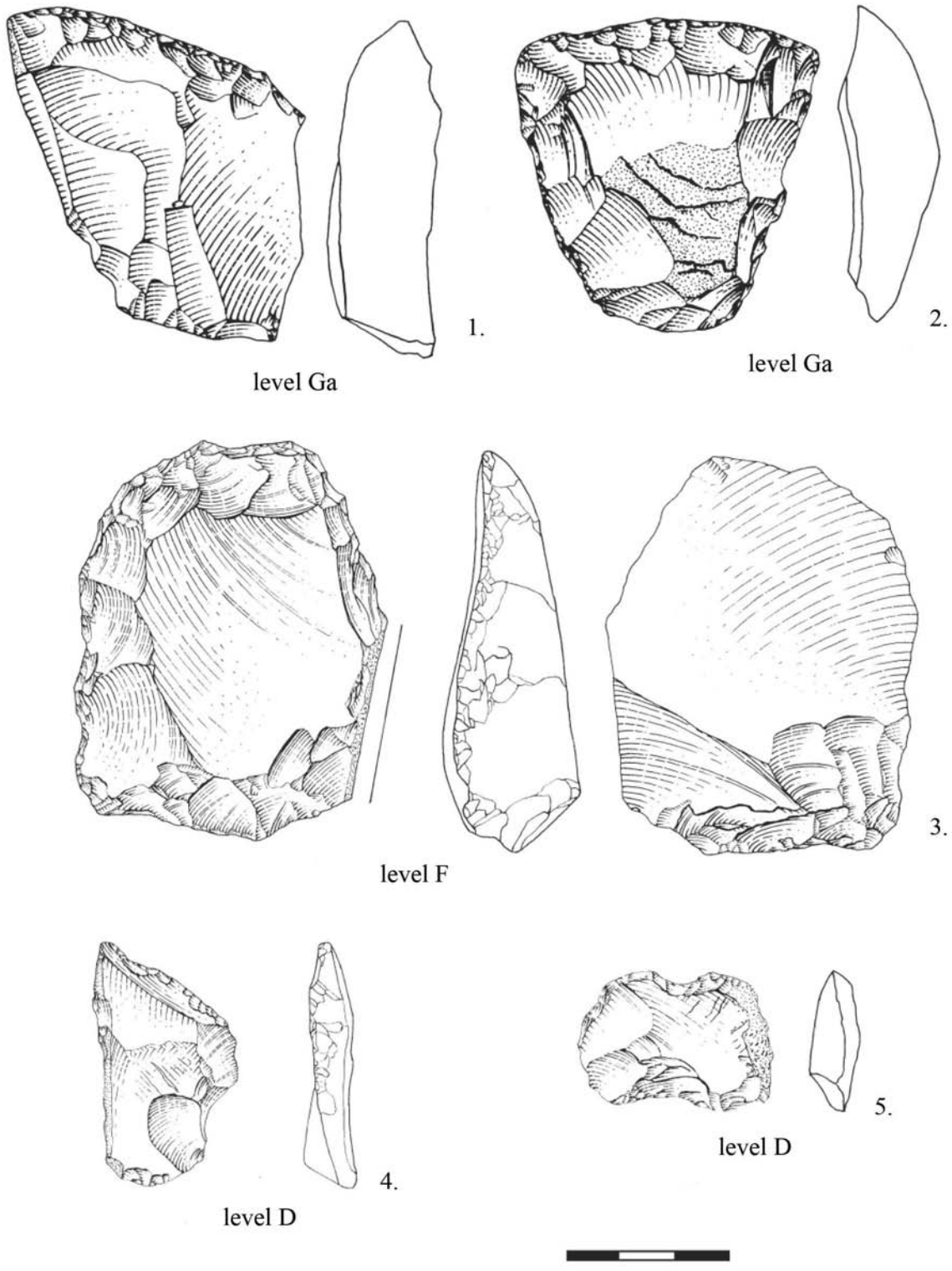

FIGURE 7. Flint side-scrapers in levels Ga (1, 2), Fa (3) and D (4, 5) at Payre (drawings by P. Giunti).

Payre, the type of raw material did not influence the manufacture of denticulates whereas the quartz products are thicker than those made of flint. The tools are found always on local stones, as observed by Geneste (1985) in Vaufrey shelter. Denticulates exist all over the Palaeolithic and the study of the series of Payre shows that their technical rules did not change through time, whatever the knapping method was.

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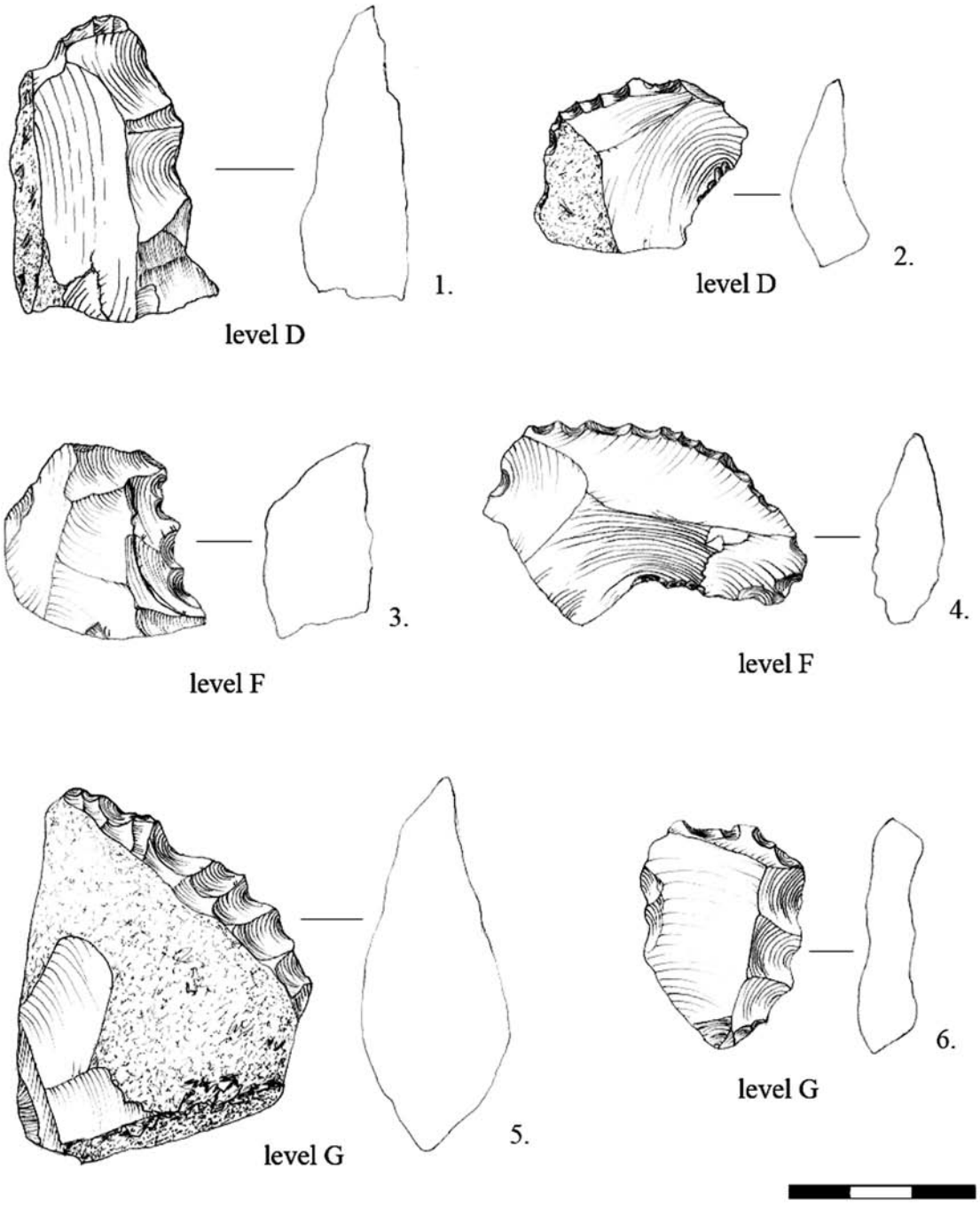

FIGURE 8. Flint denticulates from Payre: 1, 5, 6 – macrodenticulates, 2, 4 – microdenticulates, 3 – festooned denticulate (drawings by A. Theodoropoulou).

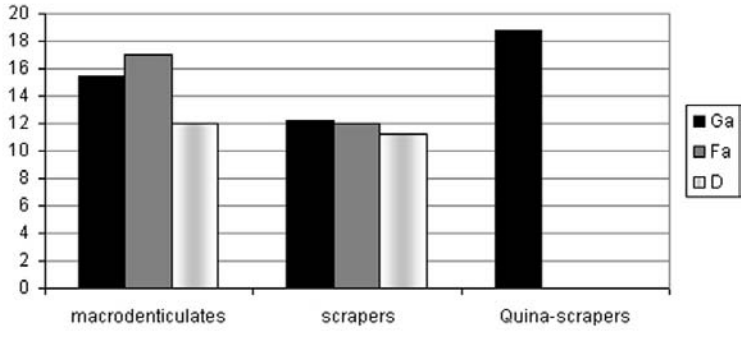

FIGURE 9. Comparison between the thicknesses (mm) of macrodenticulates, scrapers and Quina-type scrapers in levels Ga, Fa, and D at Payre.

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