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First recognition of predetermined core reduction sequences in the Southern Po Plain area before MIS 8 at the site of Cave dall'Olio (Bologna, Italy): an "ancient series" revisited.

This paper reports results of re-analysis of the assemblage of Cave dall'Olio (Bologna, Italy), which previous studies had allowed to include in the "Clactonian and Protolevallois *facies*" recognised in the Italian peninsula. On the base of correlations established with the climatic curves defined from oceanic cores this assemblage has been referred to a period preceding MIS 8. The technological study carried out has been focused on the recognition of *débitage* objectives and the identification of volumetric conceptions. Several reduction sequences have thus been recognised most of which are characterised by a considerable control of the flaking convexities and a hierarchical subordination between the flaking surface and the striking platform. Some of them perfectly fit the variability of the Levallois reduction concept while others are characterised by a volumetric *semi-tournant* exploitation of the core. Particularly the latter result in the production of thick laminar blanks. Analyses have also helped elements which were previously described as "typical clactonian and protolevallois products" to be replaced within the different phases of the reduction sequences identified, thus allowing a new interpretation of this assemblage. The results obtained highlight early appearance of predetermined core reduction sequences in the Italian peninsula, within the latest Acheulean complexes belonging to a middle-advanced phase of the Middle Pleistocene, in a good coherence with other regions of western Europe and the Levant.

KEY WORDS: *Po Plain, Middle Pleistocene, predetermination, core reduction sequences*

Introduction

The definition of Middle Pleistocene industries in Italy, after the development of Mode 1 complexes, is based on a twofold distinction between Acheulean and non-Acheulean cultural traditions. This distinction rests essentially on the identification of specific morpho-typological features, which for the so-called Acheulean assemblages consider the presence and rate of bifacial tools. By contrast either the absence or the low presence of hand-axes along with dominating *débitage* over *façonnage* sequences are the criteria which stand at the base of the exclusion of other assemblages from this cultural *facies*. Following up a long-term established tradition most authors recognize three main

groups across the peninsula spanning approximately between 600 and 300 kya (Palma di Cesnola, 2001; Grifoni, Tozzi, 2006):

a) an "Acheulean" group, which is distinguished into several sub-groups on the base of the number of bifaces and the typology of other tools (i.e. presence/absence of choppers); it is documented in the Lazio area, at Notarchirico (Basilicata) and in the Gargano where bifaces are associated to large flakes with "clactonian" features and to side-scrapers;
b) a "tayacian" group, characterised by the presence of a small dimension assemblage and tools with a dihedral ventral face, a high *carénage* index, *surélévé* and *Quina* retouch, choppers, denticulates and variable rates of side-scrapers, in which bifaces are either absent or rare. It has been recognised only at Loreto (Basilicata) and Visogliano (Trieste karst);
c) a "clactonian" group the most typical characteristic of which is represented by the presence of two different categories of items: "clactonian" blanks described as "large dimension flakes with marked butts" and "protolevallois" flakes and blades with "complex scars on the dorsal face". Side-scrapers are the dominant tools in these assemblages while the presence of choppers is variable and hand-axes are either absent or rare. It was identified along the eastern side of the Peninsula, from Emilia to Gargano. Some assemblages from the Tuscan area, recently attributed to the Acheulean, have been compared to those from Emilia (Giunti, 2004).

A fourth "denticulated" group is mentioned by Grifoni and Tozzi (2006) which is only present at Visogliano A (levels 39-37) and characterised by a micro-industry with denticulates and some choppers.

Although some Authors have expressed their perplexities to accept the existence of these separated traditions (Piperno, 1992) no definite key has been defined so far in order to contribute to shed light on the causes of the morphological variability identified and to get to a deeper understanding of the cultural processes taking place during this span of time. The low number of available dating and the uncertain stratigraphical provenance of most assemblages do not help clarifying the matter.

To start a discussion over these aspects a new programme of studies has recently been established, focusing on re-analysis of the rich evidence brought to light in the territory of the Bologna province, Southern Po Plain area (Fontana, Nenzioni & Peretto, in press). Within this project a technological approach has been applied to one of the most representative assemblages recovered in this area (Cave dall'Olio), which previous morpho-typological studies had allowed to include in the "Ancient Clactonian and Protolevallois *facies*" of the Italian peninsula (Nenzioni, Vanelli, 1982; Lenzi, Biagioli, 1996) (Fig. 1). This choice has also been motivated by the secure stratigraphical provenance of the industry and, therefore, of its chronological attribution which was carried out on a geological base by considering its position in the lithostratigraphic sequence reconstructed for north-eastern Apennines.

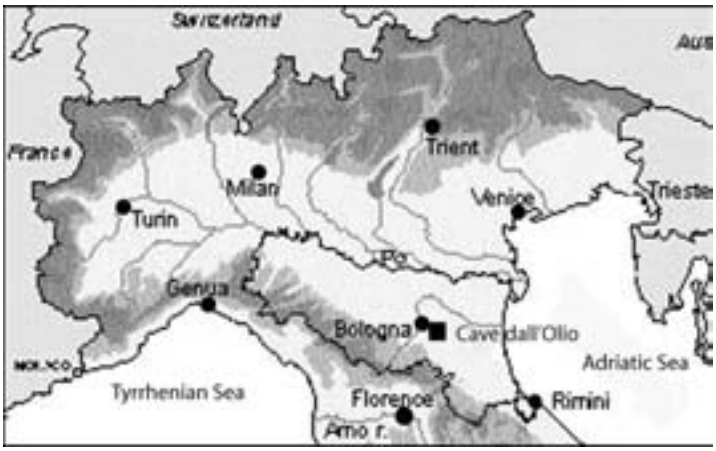

Fig. 1. Location of the site of Cave dall'Olio.

The lithic assemblage of Cave dall'Olio

The assemblage of Cave dall'Olio was recovered in the '70 along the stratigraphic profile brought to light by quarry activities, at a depth of about 20mt from the present soil, in the gravel deposits of the Idice river altered at the top by a pedogenetic event. On the base of correlations established with the climatic curves defined from the analysis of ocean cores this fersillitic palaeo-soil, known as Molino Unit, has been referred to MIS 9 (Farabegoli, Onorevoli, 1996; 1997).

A total amount of 494 lithic artefacts compose the assemblage, among which 71 cores, 403 retouched and unretouched blanks, 5 pebble tools and 15 bifaces. Most implements are obtained from a dark colour silicified siltstone, locally known as *ftanite*, which is very abundant and available as large-size nodules and pebbles in the river deposits of the area. The use of other local rocks, namely "radiolarite", red jasper, flint and chalcedony amounts to only a few implements. Due to river transport most artefacts are characterised by rounded surfaces and *concassage* with a variable degree of alteration.

Pebble tools are realised from river cobbles and they always present bifacial removals. They can thus be included in the morpho-typological category of chopping-tools. Bifaces are mostly obtained from large-size *ftanite* flakes and are characterised by wide and deep removals, apparently struck with a hard hammer-stone. They frequently keep cortical surfaces and present plano-convex and bi-convex sections, with one trihedral case. Different shapes are documented, especially amigdaloids and lanceolates.

The technological analysis carried out has focused so far on the recognition of *débitage* objectives and identification of volumetric conceptions and has been favoured by the presence in the assemblage of cores at different stages of exploitation along with

a collection of blanks issued from the diverse steps of reduction (first flakes, cortical and semi-cortical blades, semi-cortical flakes, blades and laminar flakes, plunging and *débordants* blades etc.)

Typometrical values of blanks and cores highlight that raw materials constraints were not relevant. Generally large size nodules were selected with different shapes according to the diverse volumetric conceptions adopted. Cores were mostly intentionally abandoned at a stage of exploitation which seems to correspond to a desired threshold. From a morphological viewpoint knapping was addressed at obtaining a various range of blanks of large and middle size (lengths included mostly between 50 and 120 mm and width between 20 and 90 mm) shifting from blades and laminar flakes, with both parallel and convergent margins, to flakes. Another recurrent feature is represented by the relative thickness of blanks (mostly included between 8 and 30 mm).

Due to preservation conditions of the assemblage, particularly the high presence of false retouch on the blanks margins, the recognition of intentionally modified implements remains uncertain. Nonetheless blanks selection apparently involves all categories of products. Retouch tends to be located along the lateral margins and side-scrapers result to be the best represented tool type (Lenzi, Biagioli, 1996).

The core reduction sequences

Several core reduction sequences have been identified, including some laminar schemes, also reported as "Direct non-Levallois reduction sequences" (Révillon, 1995), a wide variety of Levallois schemes (Boëda, 1994), a *débitage* scheme on flake and, probably, a discoid one. According to the original morphology of the block and the method employed - implying different core volumetric shapes - preparation and maintenance of core surfaces and platforms proceeded differently.

1. The laminar reduction schemes

Two laminar reduction schemes are documented: a recurrent unidirectional and a bidirectional parallel method. End-products consist of elongated thick blanks, often characterized either by a flat back or plunging extremities (Fig. 2, nn. 2-4, 6). Profiting of the natural convexities of selected blocks both methods do not seem to apply, at least in most cases, any complex shaping process of the core. After creation of the striking platform/s at the shortest edge/s of the nodule, opening of the flaking surface occurred with removal of a totally cortical blade which was followed by semi-cortical elongated blanks (Fig. 2, n. 1). One only exception documents a large thick crested-blade the presence of which could testify the existence of a "Non-Levallois reduction sequence of upper Palaeolithic style" (Révillon, 1995) (Fig. 2, n. 5).

Most cores issued from the laminar reduction scheme with a single striking platform show to have been abandoned after removal of a few, mostly cortical blades (Fig. 3, n.1).

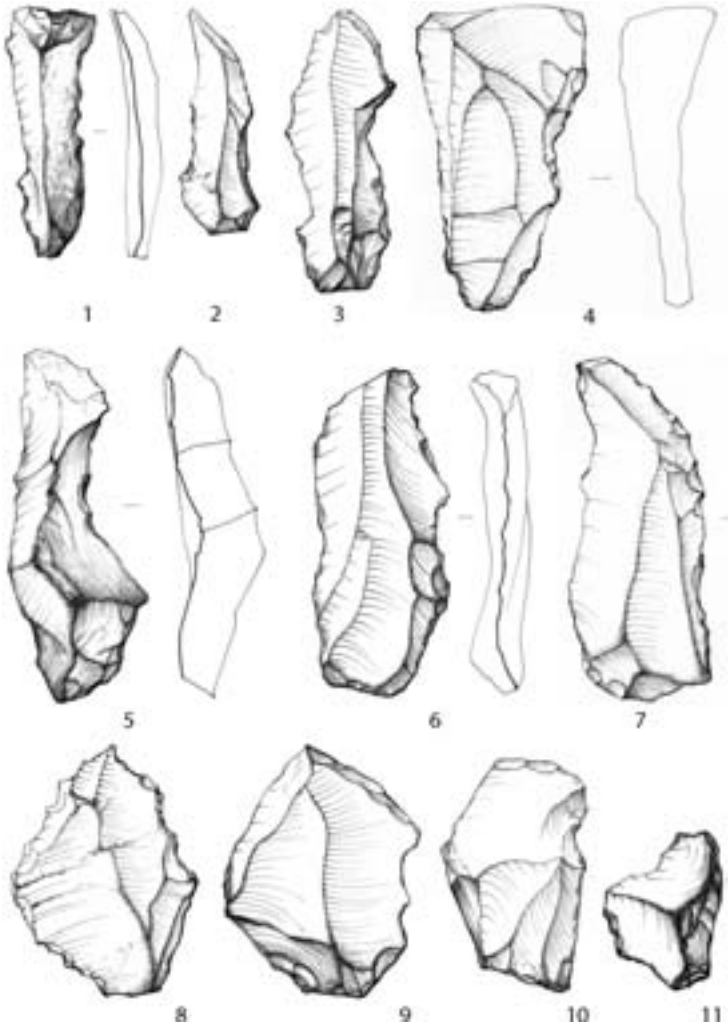

Fig. 2. Cave dall'Olio, lithic industry: 1. semi-cortical plunging blade, 2. lateral blade (lame de cintrage), 3., 7. blades, 4., 6. plunging blades, 5. crested-blade, 8-9. Levallois flakes, 10 débordant Levallois flake; 11. debordant flake (scale 1:3, drawings G. Nenzioni)

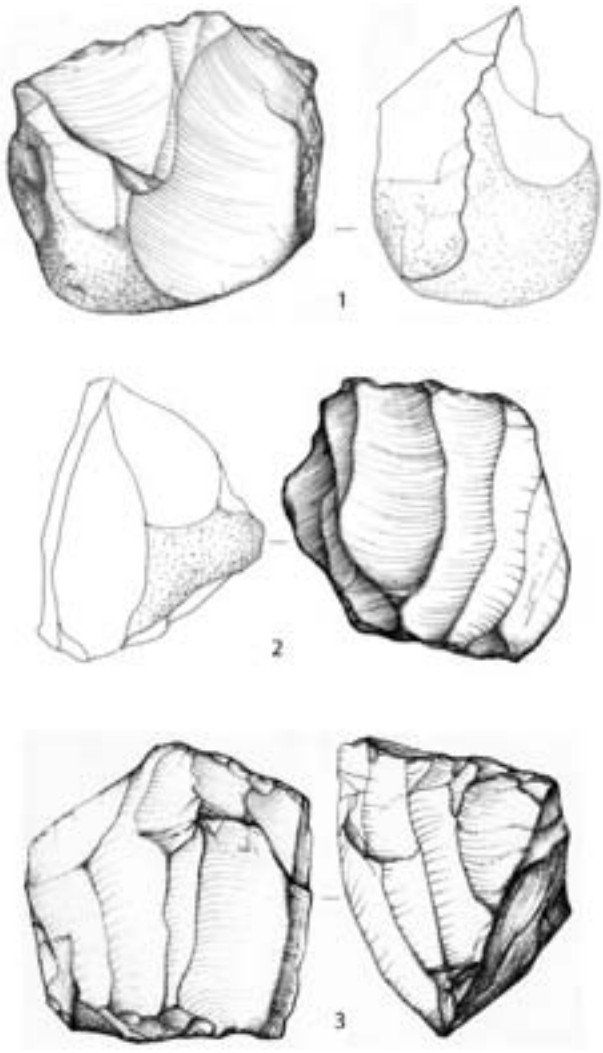

Fig. 3. Cave dall'Olio, lithic industry: 1. single platform core; 2. blade core with two opposed platforms; 3. mixed Levallois/blade core (scale 1:2, drawings G. Nenzioni)

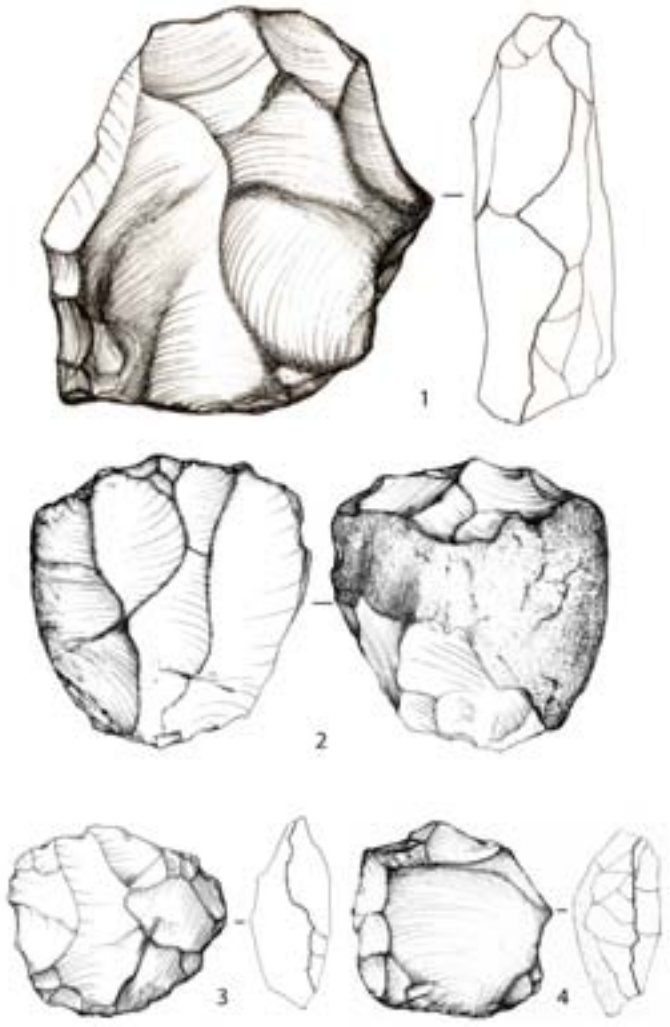

Fig. 4. Cave dall'Olio, lithic industry: 1-3. Levallois recurrent cores; 4. Levallois lineal core (1. scale 1:2, 2-4 scale 1:3, drawings G. Nenzioni)

For this reason we cannot exclude that these cores may represent only the first exploitation phase of this laminar reduction sequence which, in the following steps, would have proceeded by opening of an opposite platform. In most documented cases the second striking platform is slightly twisted from the first one and blades are essentially struck from two different lateral independent sides of the core (Fig. 3, n. 2). Nonetheless, in some cases, opposite platforms also serve to maintain distal convexities over the same surface.

The presence of some blades with a triangular section (*lames de cintrage*) struck from the edge of laminar cores shows that during the reduction process while edges served to restart the production of a new series of blades exploitation progressively assumed a *semi-tournant* rhythm (Fig. 2, n. 2). Furthermore processes of auto-maintenance of the core convexities are clearly testified by some backed blades and plunging laminar blanks (Fig. 2, nn. 3, 4, 6).

2. The Levallois reduction schemes

Some Levallois both lineal and recurrent reduction schemes are documented in the assemblage. The recurrent schemes include a unidirectional parallel method, a unidirectional convergent method, a bidirectional method, an orthogonal method and, probably, a centripetal one (Fig. 4, nn. 1-3). Striking platforms are variably organised according to the modality of preparation of the flaking surface and position of extraction of end-products.

The unidirectional parallel method aims at the production of laminar blanks (Fig. 2, n. 7). The core convexities are essentially maintained by the removal of backed blades *(lames débordantes)* and, to a lesser extent, of distal and orthogonal flakes (Fig. 4, n. 1). Therefore striking platforms appear usually prepared only in the portion from which the laminar end-products are struck. In some cases the volumetric shape of these cores is close to that of laminar cores but the surface does not tend to invade the lateral edges as in the latter.

Conversely, in the recurrent unidirectional convergent method, both *débordants* and orthogonal removals contribute consistently to the preparation and maintenance of the core convexities. The objective of this scheme is the production of variably elongated products with convergent lateral margins (Fig. 2 , n. 9). End-products issued from this scheme and the unidirectional parallel one are frequently *déjétés*, i.e. their morphological axis do not corresponds to the *débitage* axis. This feature seems to be a consequence of the convex profile of the portion of the striking platform from which end-products are detached.

In the recurrent orthogonal method the surface convexities are apparently auto-maintained by the removal of crossed blanks from two orthogonal platforms. The remaining margin of the core is prepared as shown by the presence of scars which are either longitudinal to the two orthogonal directions of blanks' extraction or centripetal.

In association to these dominating methods, others are less represented, such as a recurrent bidirectional scheme, which is maintained by both centripetal and *débordants* removals and aims at producing flakes and laminar blanks (Fig. 4, n. 2, Fig. 2, n. 8) and

a centripetal recurrent which, in some cases, cannot be easily distinguished from the discoid scheme (Fig. 4, n. 3).

The lineal method is represented by a few exhausted cores of small dimensions (Fig. 4, n. 4). It has not been possible to ascertain whether these cores were exploited all over the reduction process with the same method or just represent the final stage of blocks which were previously knapped according to a different scheme. Convexities are obtained either by centripetal or by an association of centripetal and longitudinal removals. End-products are represented by roughly oval-shaped small-middle sized flakes.

Generally most Levallois cores appear intensively exploited. Therefore they tend to assume a typical plano-convex volumetric shape and a rather flat profile.

3. The mixed laminar/levallois scheme

In some cases trimmed limits seem to separate the laminar from the levallois unidirectional/bidirectional recurrent scheme. In fact some cores show, on one side, a volumetry which is organised "along the thickness of the block" (Meignen, 1998) with removals which tend to develop around its edge (*semi-tournant*) while, on the other side, the maintenance of the cores lateral convexity is carried out with flat removals either longitudinal or orthogonal to the direction of the flaking surface. These cores seem thus to keep, within the same implement, two different volumetric conceptions, one laminar and one levallois (Fig. 3, n. 3).

4. Other reduction schemes

The variability of the methods recognised is completed by some examples of discoid core exploitation and *débitage* on flake. The latter uses as support large thick flakes, issued from the preparation and maintenance of other cores. Only a few blanks are struck from these cores, mostly from their ventral faces, so that the original shape of the blank is still easily recognizable. Discoid cores are rare and probably this method of reduction is not part of the most genuine tradition of local groups. As previously mentioned in some cases the distinction between discoid and recurrent centripetal cores is not an easy task.

The technical systems adopted by the knappers at Cave Dall'Olio: a synthesis

The general technical features recognised in the lithic assemblage of Cave dall'Olio can be summarised as follows:

a) Most reduction sequences identified are characterised by a hierarchical subordination between the striking platform and the flaking surface, a considerable control of the flaking convexities and a high predetermination level. Some of these follow a laminar volumetric conception, while others fit the variability of the Levallois concept. These reduction sequences are accompanied by some flake and discoid reduction schemes.

b) The shaping of flaking convexities and platforms is mostly reduced to simple actions which are strictly dependant on the blocks original morphology and the different objectives planned. A careful selection of blocks according to the volumetric conception applied is documented. In the laminar scheme opening of the flaking surface occurs in

correspondence of natural convexities and/or edges while striking platforms are positioned at the shortest sides of cores. The Levallois reduction schemes are dominated by unidirectional, bidirectional and orthogonal recurrent methods, while centripetal recurrent and lineal sequences seem to play a secondary role. In most cases core preparation and maintenance are reduced with rare centripetal preparation; usually orthogonal negatives of removals are associated to predeterminant *débordant* longitudinal scars.

c) End-products consist of a wide range of blanks, including blades and laminar flakes, usually characterised by a considerable thickness, which are essentially issued from unidirectional and bidirectional controlled recurrent methods, both levallois and laminar. Among blades, issued from the laminar method, plunged and backed items are frequent (Fig. 2).

d) The technique adopted by the knappers is direct percussion with a hard hammer-stone. Although no detailed study could be undertaken on the specific traces of percussion on blanks and cores overhangs, due to the low preservation conditions of the assemblage, blanks removals do not seem to have been preceded by any accurate preparation of the platform. The shot was thus essentially favoured by keeping platforms with low angles to knapping surfaces (< 90°) and detaching blanks from a backward position with a hard hammer-stone, which resulted in rather wide and flat butts on the blanks, frequently leaning towards the ventral face.

e) Bifaces and pebble tools, which have not been so far the object of a detail technological analysis, play a secondary role in this assemblage.

Discussion: Cave dall'Olio reconsidered within the "Clactonian and Protolevallois *facies*" of the Italian peninsula

As already mentioned the assemblage of Cave dall'Olio has long been considered, on the base of morpho-typological analyses, as belonging to the tradition of "Ancient Clactonian and Protolevallois" industries developing along the Adriatic side of the Italian peninsula during a period which was considered to span, according to Alpine chronology, between the Mindel and the Mindel-Riss interglacial (Cremaschi, Peretto, 1977; Bisi, Cremaschi, Peretto, 1982; Palma di Cesnola, 2001).

The recognition of the Ancient Clactonian "complex" in the peninsula dates back to the fifties and was first applied to the assemblages of Gargano and Abruzzo (Palma di Cesnola, Zorzi, 1961; Radmilli, 1965). About ten years later Palma di Cesnola (1967) introduced the term "Protolevalloisiano" to indicate the "most evolved part of these industries". In a recent work the same author summarizes the most significant traits of "Ancient Clactonian and Protolevallois industries" as follows: "The ancient Clactonian is different from ancient Tayacian for several aspects: the larger dimensions of blanks, the less defined typology of tools, the *débitage* and blanks morphology (…) the ancient Clactonian shows an indefinite predetermination both in the shape of the blades, which are thick and more or less elongated, and flakes which are characterised by medium di-

mensions. Core analysis reveals the presence of rather regular pyramidal and prismatic cores…. The negatives of removals along the core sides show evidence of precise shots, unidirectional or bidirectional (prismatic cores), frequently elongated. In harmony with these types of cores, blades have sometimes parallel longitudinal or sub-parallel arrises on the dorsal face. Among flakes, some rare examples of triangular elements with a reversed Y arris have been observed. Butts are dominated by the classical clactonian features – i.e. they are wide, plain and inclined – although some small, orthogonal cases, with a losangic outline, sometime even facetted are present. Although discoid types with a final unique negative and other cores, so typical of the levallois (method), for the extraction of blades and points are absent it seems that we are very close to this technique (…)" (Palma di Cesnola, 2001 p. 79-80; translated by the Authors).

We may say that, although technologists know that end-products with the same shape may be obtained by applying different reduction schemes, the detailed description reported above contains several elements suggesting that these assemblages may effectively result from the application of predetermined reduction systems. This idea, which Palma di Cesnola actually never completely expressed, has been demonstrated for the assemblage of Cave dall'Olio by the present study. By comparing the detailed description reported above to the results of the technological approach developed in this work we may now try to replace some features described as typical of the "Clactonian and Protolevallois complex" within the different steps of the reduction sequences identified in the analysis of our assemblage. Some points may thus be underlined:

a. the idea that these industries contain a "an indefinite predetermination" is absolutely confirmed. As demonstrated by several studies carried out in the last decades both laminar and levallois reduction strategies are characterised by a higher variability than it was previously believed and the analyses reported in this work have demonstrated that most reduction sequences documented in the assemblage of Cave dall'Olio fit this variability. The presence of "elements with complex scars on the dorsal face" traditionally defined as "protolevallois flakes" represents therefore a clear consequence of the adoption of controlled and predetermined reduction sequences, which according to actual definitions perfectly fall within the Levallois conception of core reduction (Boëda, 1994). The scarce investment in shaping and maintenance activities and the adoption of dominating unidirectional and bidirectional schemes result in the production of blanks which are probably marked by a simpler scars organisation of the dorsal face than those which will be typical of later Middle Palaeolithic assemblages.

b. The presence of prismatic cores and blades with parallel longitudinal or subparallel arrises derives from the application of laminar reduction sequences *sensu lato* which mostly profit of natural convexities and the typical products of which are represented by thick frequently plunging and backed blades.

c. Skipping the debate on the identity of Clactonian as a separate non-handax technical tradition and of its relationship with Acheulean (White, 2000) we can affirm that the presence of large dimension flakes with wide, plain butts leaning on the ventral

face, which have earned our assemblage an attribution to the Italian Ancient Clactonian *facies*, has nothing to do with the recent technical redefinition of the "clactonian method" (Forestier, 1993). By contrast their presence in this assemblage appears almost exclusively connected to the technique used which, implying scarce preparation of cores overhangs, tended to keep platforms with acute angles - especially in the core shaping phase - and to strike blanks with a hard hammer-stone at a considerable distance from the core overhang.

c. Last but not least the large dimension of blanks and, generally speaking, of the whole assemblage is strictly connected to the local abundance of raw materials which are available in large-size blocks.

In sum, results obtained from this analysis have led to a new interpretation of this assemblage and demonstrated the importance of re-studying "old series" by the adoption of integrated methodologies, also suggesting the need to reconsider other contemporary assemblages of the peninsula.

Concluding remarks: Cave dall'Olio in th e context of Middle Pleistocene complexes

The technological analyses carried out enable us to include the assemblage of Cave dall'Olio within the latest Acheulean complexes which are referred to a middle-advanced phase of the Middle Pleistocene. The technological features described indicate the presence in this assemblage, in which *façonnage* processes seem to assume a secondary role, of predetermined core sequences. The results obtained are coherent with those available for other regions around the Mediterranean and Northern Europe, especially southern and northern France and the Levant, showing early development, in a chronological range between MIS 9 and 5, of Levallois and laminar schemes and a significant trend towards the production of elongated blanks which appear to be characterised, at most sites where this production is documented, by similar morphological features, i.e. relative thickness, slightly irregular edges and ridges etc. (see for instance: Gopher *et al.,* 2005 ; Kozlowski, 2001 ; Meignen, 1994 ; 1998, Moncel, 1998 ; Moncel, *et al.,* 2005 ; Révillon, 1995 ; Tuffreau A. & Révillon S. 1996). As a matter of fact quite unexpected - in the assemblage of Cave dall'Olio - is the high variability of the reduction schemes adopted, the recognition of which thus enlarges the geographical diffusion of early predetermined core reduction strategies in the ancient world.

To conclude an aspect which should be further investigated is the technological relationship between this assemblage and the industries dated to the following period, between MIS 8 and 6, which are abundantly documented over the same territory (Fontana, *et al*.; Fontana in preparation).

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