A dynamic view of Aurignacian technology

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ABSTRACT The technological analysis of blank production in Balkan EUP sites (Bacho Kiro and Temnata caves) points to the stability of blade technology from the Pre-Aurignacian (>40 kyr BP) until the Typical Aurignacian (35-28 kyr BP). At the same time the analysis of blank production techniques in different regions of Europe (Poland, France) indicates similarities with the Balkan Aurignacian.

Introduction

The subject of the recent discussion on the origin of the Aurignacian has been the question whether the Early Upper Paleolithic assemblages that occur in the Balkans — described as the Bachokirian (Kozłowski, 1979, 1982) — can be regarded as an early stage of the Aurignacian proper in the same sense as the notion of the Pre-Aurignacian (Kozłowski and Otte, 2000). Such a hypothesis has been recently opposed by J.-Ph. Rigaud (2001, p. 66) and G. Lucas (2000) who argue that in comparison with the western European Aurignacian the Balkan Early Upper Paleolithic industries do not exhibit any features that "define the European Aurignacian". In a paper published in the book commemorating Dorothy Garrod I attempted (Kozłowski, 1999), on the basis of the typology of assemblages from layers 9, 8, 7/6b, 7, 6a/7 from Bacho Kiro cave and from trench I and V from the Temnata cave, to show that 1) these assemblages have an almost complete set of tool forms typical for the classical Western European Aurignacian, and 2) that there is a continuity between the assemblages from layer 11 at Bacho Kiro cave and layer 4 in the Temnata cave and further evolution of the assemblages that are already Aurignacian from the same sites.

In the Balkan sequences the continuity from the hypothetical Pre-Aurignacian to the Typical Aurignacian could be compared to similar sequences at the Middle Danube sites (Willendorf II, Geißenklösterle — Hahn, 1988). The objective of this paper is to show the technological evolution in the Balkan sequences, and to compare the Early Upper Paleolithic (Pre-Aurignacian) technologies in the Balkans with the technologies of the classical Aurignacian in Europe.

We can agree with J.-Ph. Rigaud's suggestion that the industry from layer 11 of Bacho Kiro cave, although it remains very distinctly Upper Paleolithic "is not without affinities with the Initial Upper Paleolithic of the Near East" (Rigaud, 2001, p. 66). In the sphere of technology the industries of the Initial Upper Paleolithic in the Near East such as the Ahmarian and/or the Emiran are characterized by the occurrence of the specific opposed platform Levallois point strategy which is basically unknown in western Europe (Marks and Ferring, 1988) but appears at the beginning of the Initial Upper Palaeolithic sequence in the Temnata cave, trench II, layer VI. Even if in the latest phase of the Ahmarian this strategy becomes replaced by the blade strategy of a single platform core, yet the Levallois tradition can still be seen in the blank forms and technical features. In respect to the typology the Ahmarian is dominated by the Levallois-like points (40-50%), while denticulated and notched tools are

	BACHO KIRO			TEMNATA		
	Layer	Date	Industry	Sector/Layer	Date	Industry
30	Base 6a	C-14 (bone) 29150±950 (Ly-1102)	Typical Aurignacian			A
	Base 7	AMS (charcoal) 32200±780 (OxA-3181)	Typical Aurignacian	TD-V – 3g	>31500 (Gd-4595)	U R
	Base 6b	AMS (bone) 32700±300	Typical Aurignacian	TD-V – 3h TD-V – 3i	>32200 (Gd-4693)	I G
	6b/8	AMS (charcoal) 33300±820 (OxA-3182)	?	TD-I 4 (top)	C-14 (charcoal) 31900±1600 (Gd-2354)	N
	8	-	Aurignacian with Mladeč point			A C
	6c	-	?	TD-V – 4	AMS (charcoal) 33000±900 (OxA-5174)	I A
35	9	-	Aurignacian with split- based point			N
				TD-V – 4	AMS (charcoal) 36900±1300 (OxA-5173)	
	11/I	AMS (bone) 34800±1150				
		AMS (charcoal) 37650±1450 (OxA-3183)	Final Bachokirian			
				TD-V – 4	AMS (charcoal) 38300±1800 (OxA-5172)	
				TD-1 4 (middle)	AMS (charcoal) 38200±1500 (OxA-5171) 38800±1700 (OxA-5170) 39100±1800 (OxA-5160)	EUP Unit B
	11/III	AMS (charcoal) 38500±1150 (OxA-3213)	Bachokirian			
40	11/IV	C-14 (charcoal) >43000 (GrN-7545)	Bachokirian			
45				TD-1 4 (base)	45000±7000 (GdTL-256) 46000±8000 (GdTL-255)	EUP Unit C

FIG. 1 – Correlation of stratigraphic sequences from Bacho Kiro and Temnata caves.

next, followed by endscrapers, burins and tools with lateral retouch. The presence of a large number of micro-retouched pointed bladelets at some Ahmarian sites causes that the Ahmarian is closer to the Mediterranean Proto-Aurignacian than to the Balkan Bachokirian (Pre-Aurignacian).

To present the development of blank production technology, we have selected several sites situated in different parts of Europe. For SE Europe the sequence of three levels in the Temnata cave (within lithostratigraphical unit 4, trench TD-I) was chosen (Drobniewicz et al., 2000). The sequence shows the formation of the basic morphology of Aurignacian lithic tools. Another example, from a more northern sphere of the diffusion of the Typical Aurignacian, is the site of Kraków-Zwierzyniec I, sector 3–4, layer 12 (Sachse-Kozłowska, 1982). Western Europe is exemplified by the site of Barbas in Dordogne (Teyssandier, 2000), and Mediterranean Europe by the Proto-Aurignacian site from the Fumane cave in northern Italy (Bartolomei et al., 1992).

The chronological position of these assemblages is determined by the following dates:

1. In Temnata cave, the lowest culture level C in layer 4 has been dated only by TL to 45 000±7000 BP (GdTl-256), level B has given AMS dates from 39 100±1800 BP (OxA--5169) to 38 200±1500 BP (OxA-5172), and level A is delimited by the dates of 36 900±1300 (OxA-5173) to 31 900±1600 (Gd-2354) (Fig. 1).
2. The dating of the site of Kraków-Zwierzyniec, layer 12 has been based on the similar chronostratigraphic position of layer 4 at Kraków-Spadzista A (unfortunately a very poor site, but Aurignacian too) which provided a ^{14}C date of 31 000±2000 BP (Kozłowski and Kozłowski, 1996).
3. The Aurignacian level at the site of Barbas is later than the date of 38 300±500 BP for the Mousterian level stratified below, and later than the site's Châtelperronian level, for which there is no absolute dating. We have chosen this site because its publication offers a thorough reconstruction of blade technology based on large quantities of cores and debitage products on the site.
4. The site of Fumane has been dated by a large number of AMS determinations ranging between 37 and 30 kyr BP. However, the most likely seems the interval between 33 and 31 kyr BP.

The evolution of chaînes opératoires in Temnata cave

Level C in layer 4 yielded only seven cores: these are residual cores, strongly exhausted, single-platform blade and blade-flake specimens, without traces of preparation (Fig. 2, nos. 1-2). One core is on a thick flake. The small number of cores does not allow us to reconstruct the *chaîne opératoire*, but taking into account the structure of these cores we can say that they are the outcome of a single *chaîne opératoire* whose objective, initially, had been blade production, and in the final phase of exploitation the production of blades and flakes. In the early phase of reduction the platform was shaped by a single-blow, subsequently blades were detached from the broad face of a flint nodule, gradually extending the flaking surface onto the narrower sides. When we take into account the occurrence of a variety of blade types (including large specimens with straight profiles, up to even 12 cm long) we can see that they may have come from other *chaînes opératoires* that had been realized off site (Fig. 2, nos. 3-6). Such blades could have been brought as finished products, a possibility that is confirmed by the comparison of the raw-material structure of blades and cores.

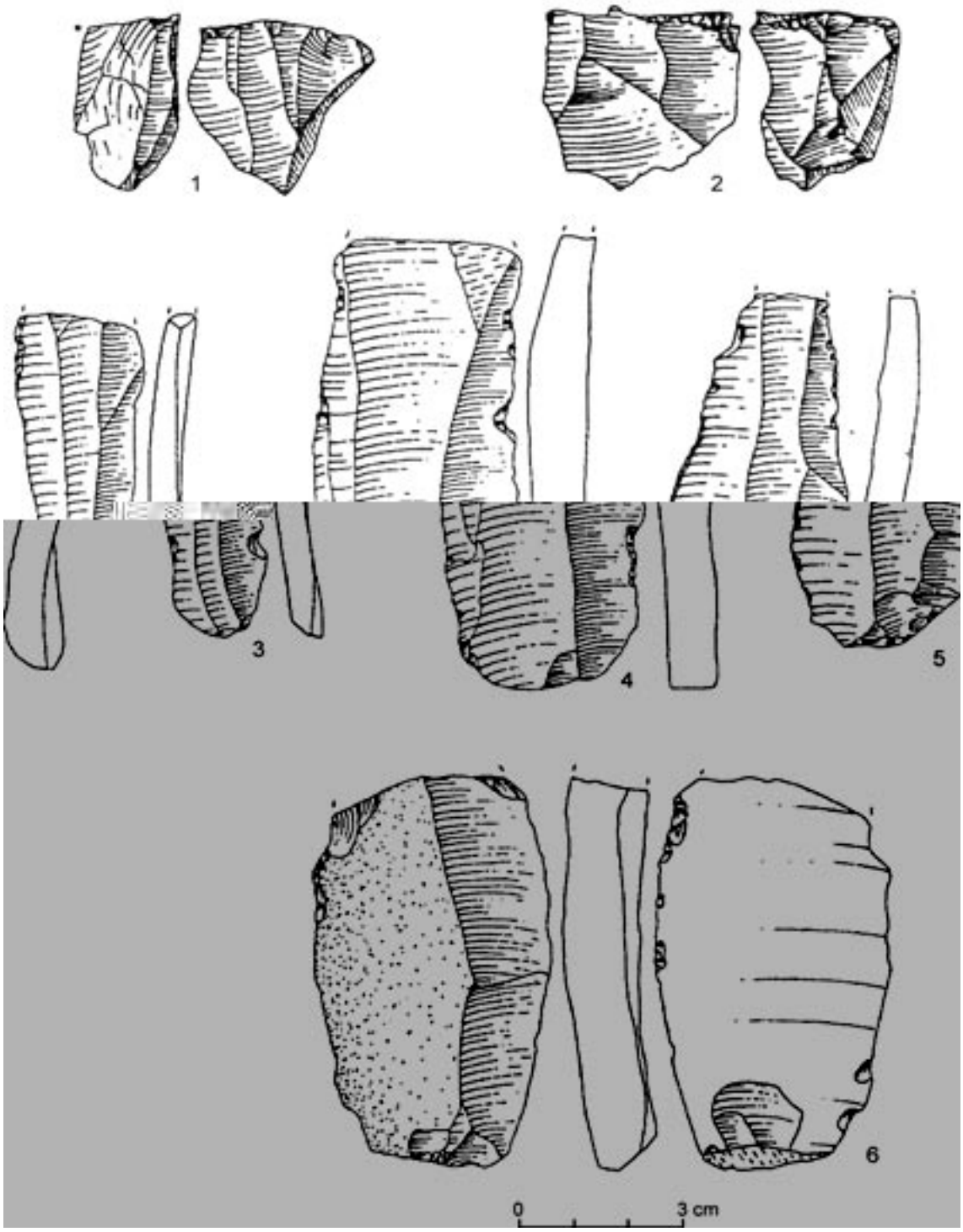

FIG. 2 – Temnata cave, layer 4, sector TD-I, unit C: 1-2. cores; 3-6. blades.

In level B, where the Aurignacian tool typology is restricted to only nosed endscrapers and retouched blades with multiseriate retouch, cores are more numerous (20 specimens). These cores document divergent reduction sequences, especially in the advanced phase (Fig. 3). In the preliminary stage most cores exhibit platform shaping and postero-lateral crests. At first, the preparation was limited to broad surfaces from which flaking faces were extended onto a side (one or two sides), and, consequently, one or two lateral crests were

detached (Fig. 4, nos. 2-3). As reduction was continued neo-crests were sometimes formed. Another reduction method was the shaping of postero-mesial and antero-mesial crests in the preliminary stage. The result of this procedure was that already in the early phase of reduction narrow and convex flaking surfaces were formed which gave narrower blades (Fig. 4, nos. 4-5). The flaking surfaces were corrected by shaping opposed platforms from which blades were successively detached. In the case of double platform cores the flaking surface, formed by blades detached from the opposed platform, twisted onto the core side. The cores side could have been first prepared by a postero-lateral crest (Fig. 4, no. 8).

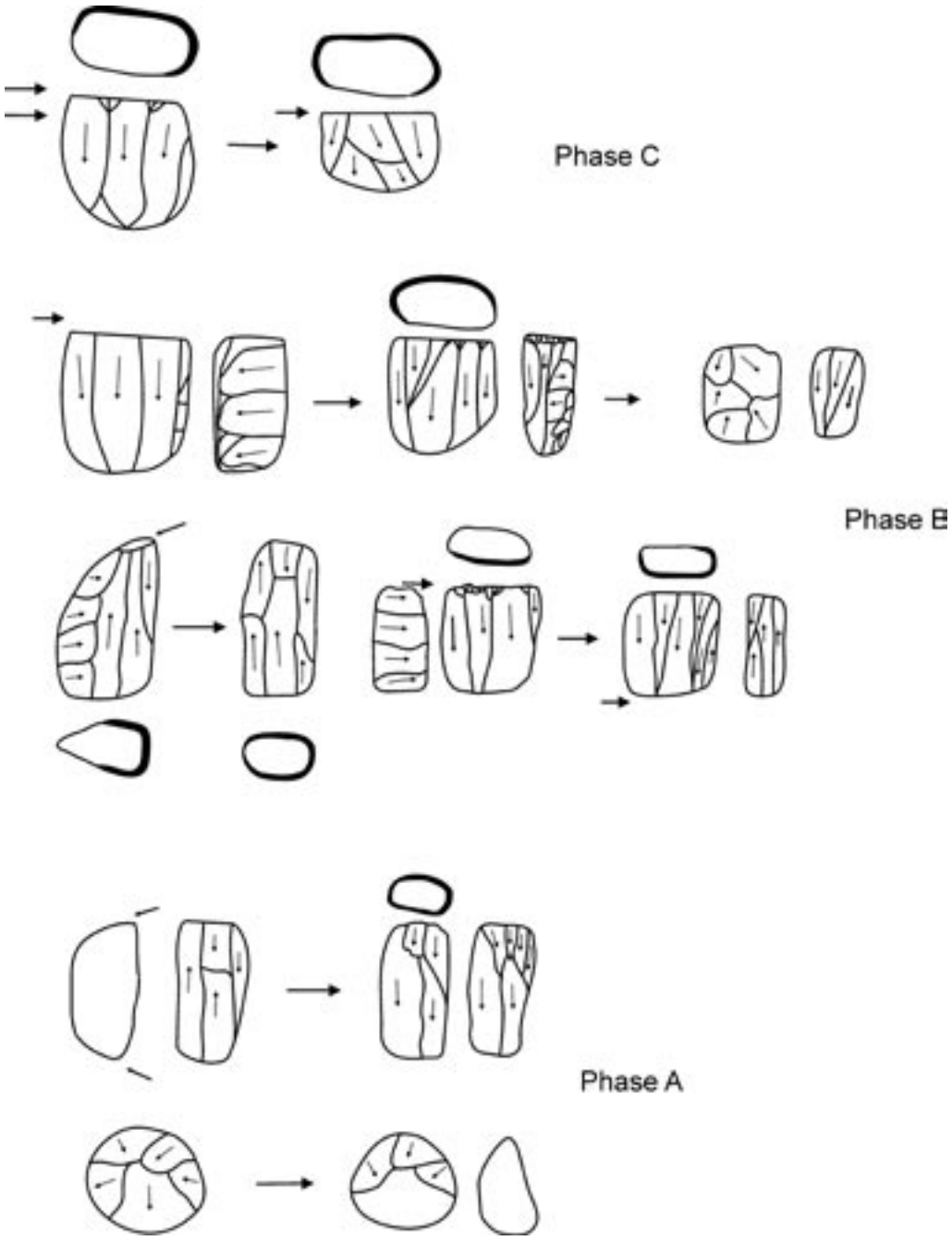

FIG. 3 – Temnata cave, layer 4, sector TD-I. Core reduction sequences in particular units.

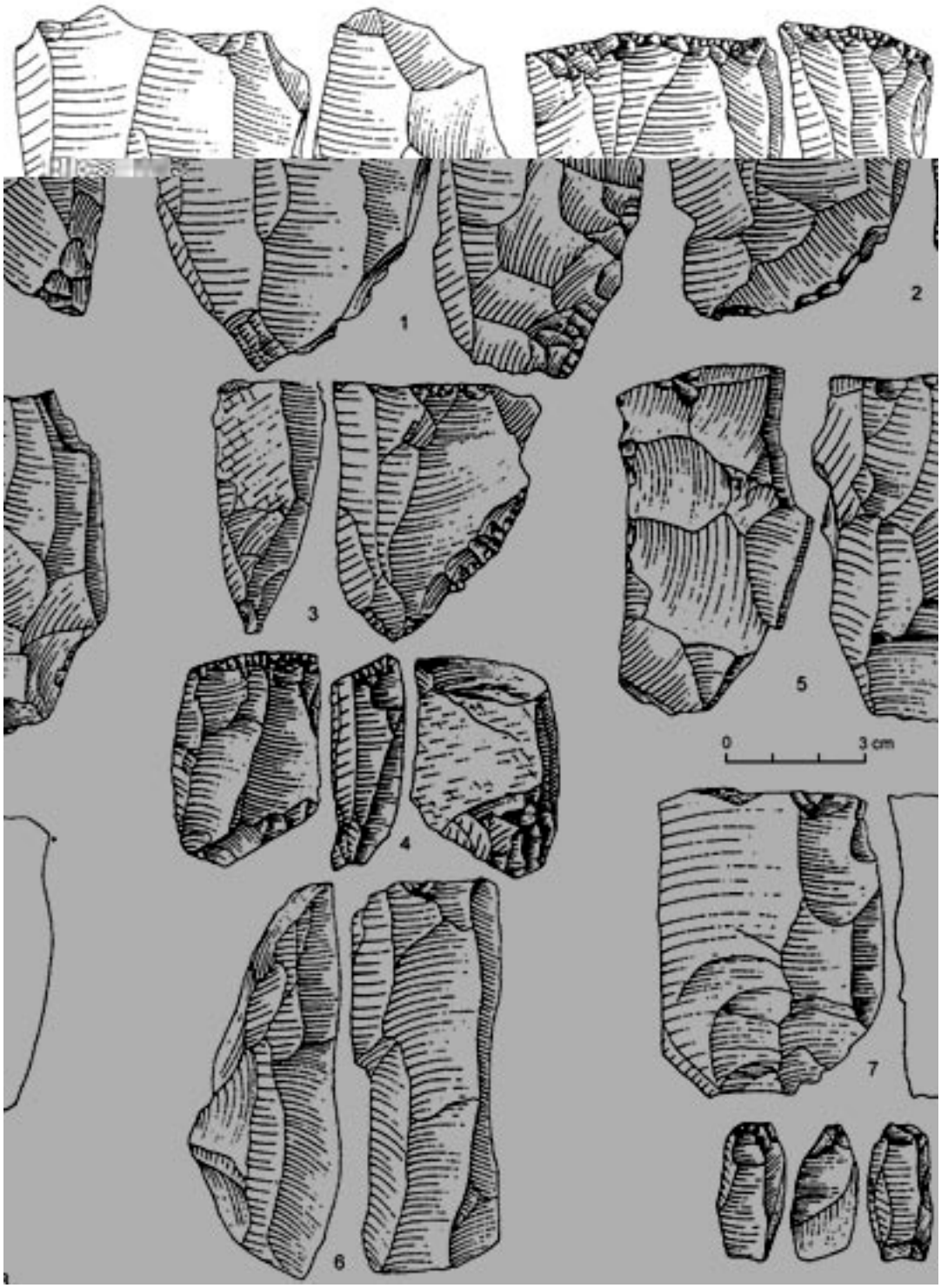

FIG. 4 – Temnata cave, layer 4, sector TD-I, unit B: 1-8. cores.

Level A yielded a complete tool-kit characterized by Aurignacian morphology, comprising carenoidal and nosed scrapers, retouched blades of *appointé* type with stepped retouch. Aurignacian scrapers account for 20% of all endscrapers, which are more numerous than burins (the IG:IB ratio varies between 28.4 and 54.8) and nearly equal in number to tools with lateral retouch. In level A, two *chaînes opératoires*, similar to those in Phase B, can be seen, with a tendency towards a much strongly rounded flaking face on the side until, in the advanced phase of reduction, subconical and subcylindrical cores were shaped (Fig. 5,

nos. 1-2). However, we did not record the shaping of neo-crests. Double-platform cores are known in the two sequences as an advanced phase in which, sequentially, first one and then the other platform were used (Fig. 5, nos. 3-4). Alternate detachment of blades from both platforms does not occur. In level A, a third *chaîne opératoire* appears which produced flakes from discoidal cores, possibly multiplatform flake cores (Fig. 5, nos. 5-6). The latter cores could be the final stage of double-platform cores reduction.

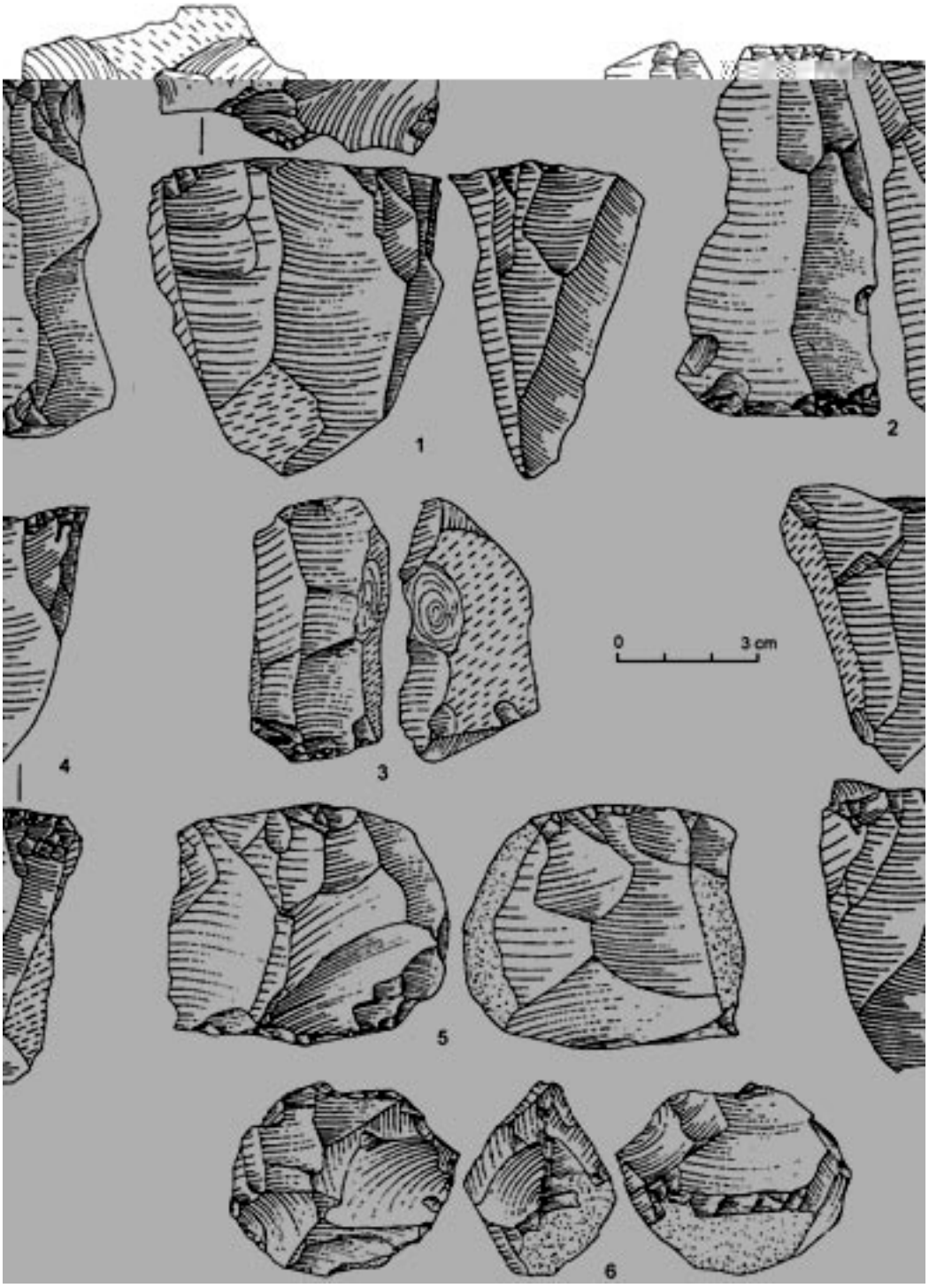

FIG. 5 – Temnata cave, layer 4, sector TD-I, unit A: 1-6. cores.

The whole sequence of C-B-A levels in layer 4 of Temnata cave is characterized by the stability of technological attributes of both flakes and blades. Blades in all the levels exhibit a similar proportion of butt types (there is a small increase in single-blow butts and a minimal drop in the facetted butts) (Fig. 6). Blade profiles (Fig. 7), just like the shape of blades, are similar in the three levels (a small increase is seen in the blades with convergent sides and a minimal drop in the irregular blades — Fig. 8). It is interesting that the ratio of blades from single platform cores to those from double-platform cores is similar in all levels (i.e. blades with the parallel dorsal pattern are five times as many as blades with opposed direction pattern of dorsal scars).

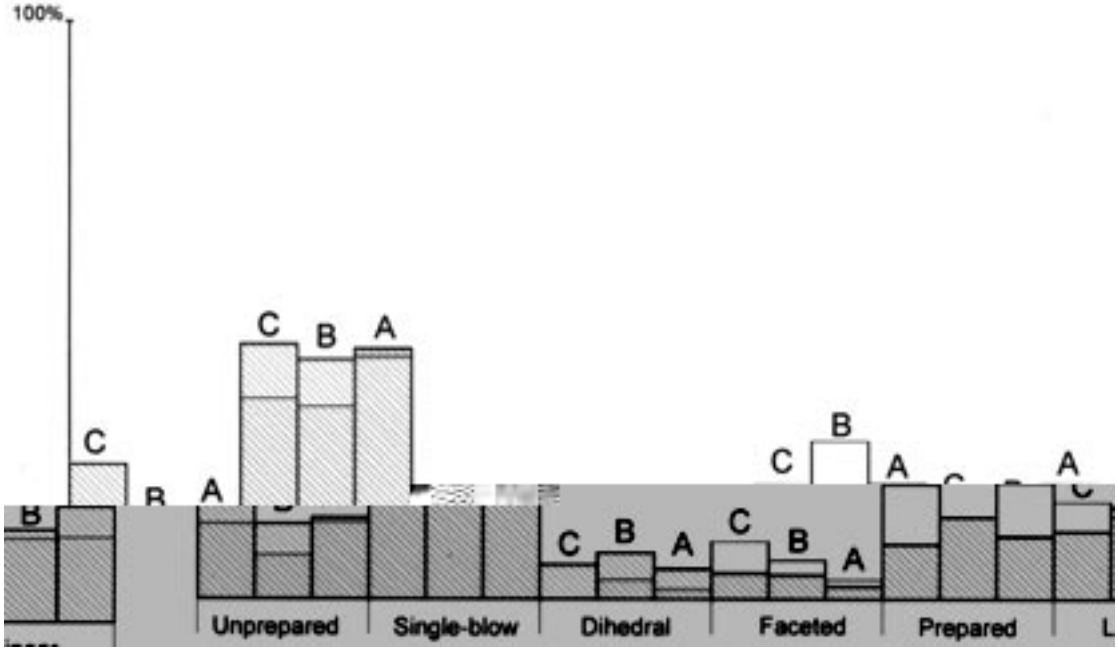

FIG. 6 – Temnata cave, layer 4, sector TD-I. Butt types in particular units C-A.

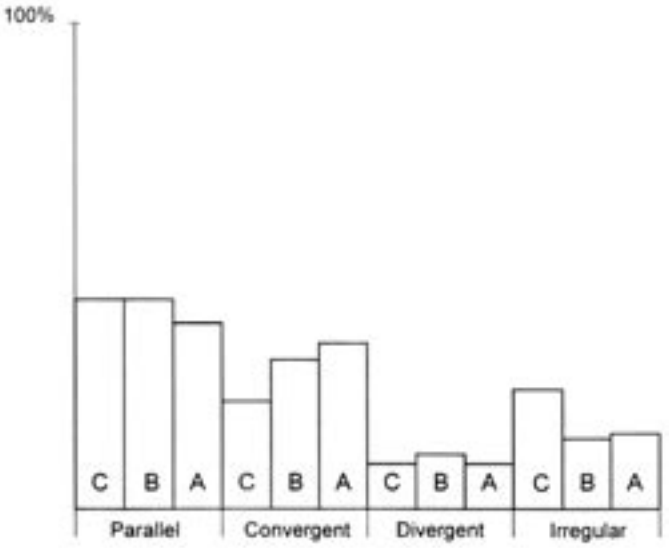

FIG. 7 – Temnata cave, layer 4, sector TD-I. Blade profiles in particular units C-A.

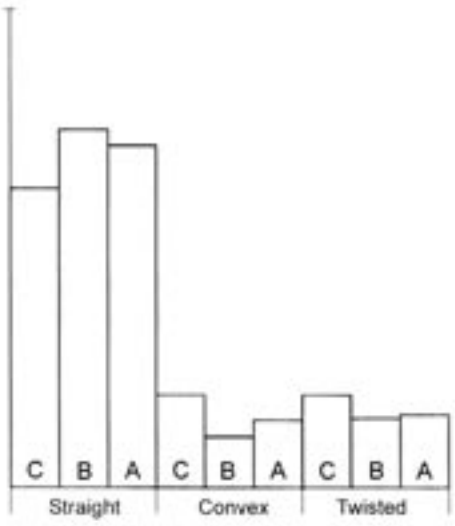

FIG. 8 – Temnata cave, layer 4, sector TD-I. Blade shapes in particular units C-A.

Measurable blade attributes show multimodal length curves (Fig. 9a) with modes at about 3,5 cm (only in phase A), 4-5 cm, 6-7 cm and 9-10 cm (except phase C). These modes are the expression of core reduction stages and the passing from single- to double-platform exploitation rather than the result of two distinct *chaînes opératoires* in levels A and B. The width (Fig. 9b) and thickness (Fig. 9c) curves are unimodal with the same modes for the three levels: for thickness, between 0,3 and 0,8 cm, and for width, between 1,4 and 2,6 cm.

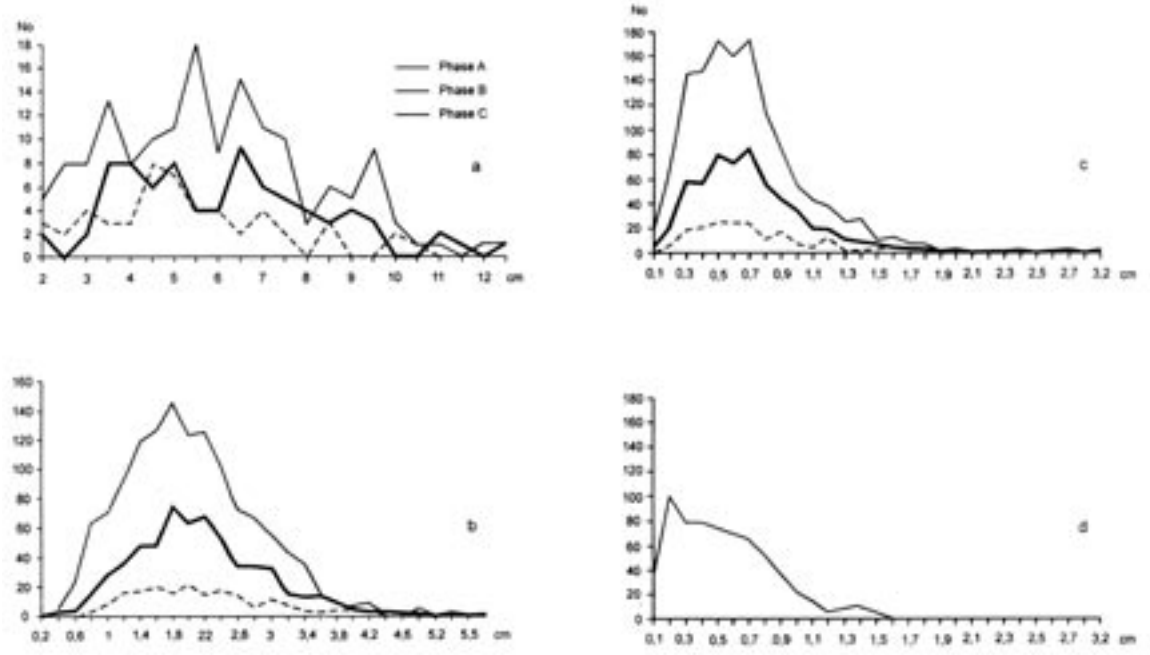

FIG. 9 – Temnata cave, layer 4, sector TD-I: a. blade lengths; b. blade widths; c. blade thickness. Kraków-Zwierzyniec: d. Aurignacian blade thickness.

The blade technique in the Temnata cave sequence and the blade technique at Kraków Zwierzyniec

The assemblage in layer 12 of Kraków-Zwierzyniec is an industry where tool morphology has distinctly Aurignacian features. The index of carenoidal and nosed endscrapers is 45.2. However, the assemblage is not dominated by endscrapers but by burins (38,8 and 54,8%, respectively). Among burins, carenoidal and busked specimens are dominant. The proportion of tools with lateral retouch is smaller (12,5%).

Blade production was carried out by means of two *chaînes opératoires* (Figs. 10-11):
a) Without preparation, on flat flint nodules or thermal fragments. The edge at the intersection of the broader face and the narrow lateral side was used as a guiding ridge (*nervure-guide*) for the first blades detached from a core. Reduction was continued either on the broader or on the narrow face. The platforms of cores were prepared by one or, at most, two or three flake scars. Exploitation was usually carried out from one platform, less often from two opposed platforms. The blades were detached in succession: first from one and next from the other platform. The instances of alternate detachment of blades from one and the other platform are very rare.

b) Starting from a pre-core, on which postero-lateral crests were shaped, the platform was carefully prepared, usually by detaching a number of small flakes. Exploitation began on the broad side of a nodule and was continued onto the sides (naturally, after crested blades had been detached). The formation of neo-crests at the site has also been recorded.

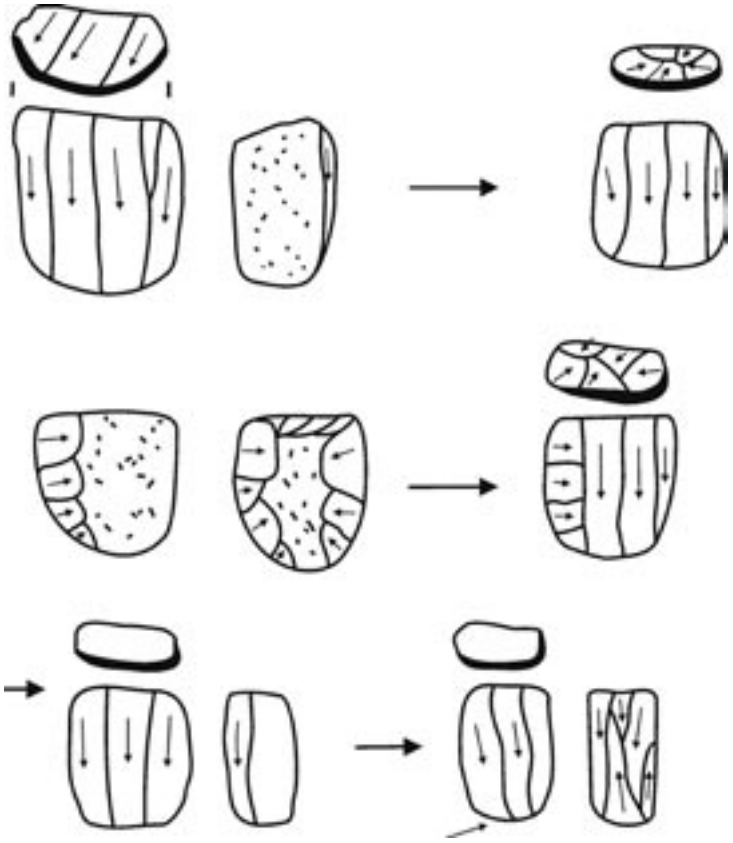

FIG. 10 – Kraków-Zwierzyniec. Core reduction sequences.

The products of the two *chaînes opératoires* were blades whose measurable and technological parameters are close to the blades from levels B and A of Temnata cave. This similarity is seen in the structure of butts and of shapes and profiles of blades. As regards morphometric parameters the length curves are, just like in Temnata cave, multimodal, with three modes of less than 10 cm and a mode of about 12 cm (higher than in Temnata, but within the maximum length interval of its phases B and A). The difference between Kraków-Zwierzyniec and Temnata cave is first of all in width, namely: at Kraków-Zwierzyniec, width is a multimodal curve with the modes of 0,7-0,8, 1,3-1,7 and 1,92,0 cm, whereas in Temnata cave there is only one mode of 1,4 to 2,6 cm; blade thickness at Kraków-Zwierzyniec gave a unimodal curve with one mode between 0,2-0,7 cm which, basically, corresponds to the Temnata cave, although at this site very thin blades, of less than 0,3 cm, do not occur, whereas they are present at Kraków-Zwierzyniec (Fig. 9d).

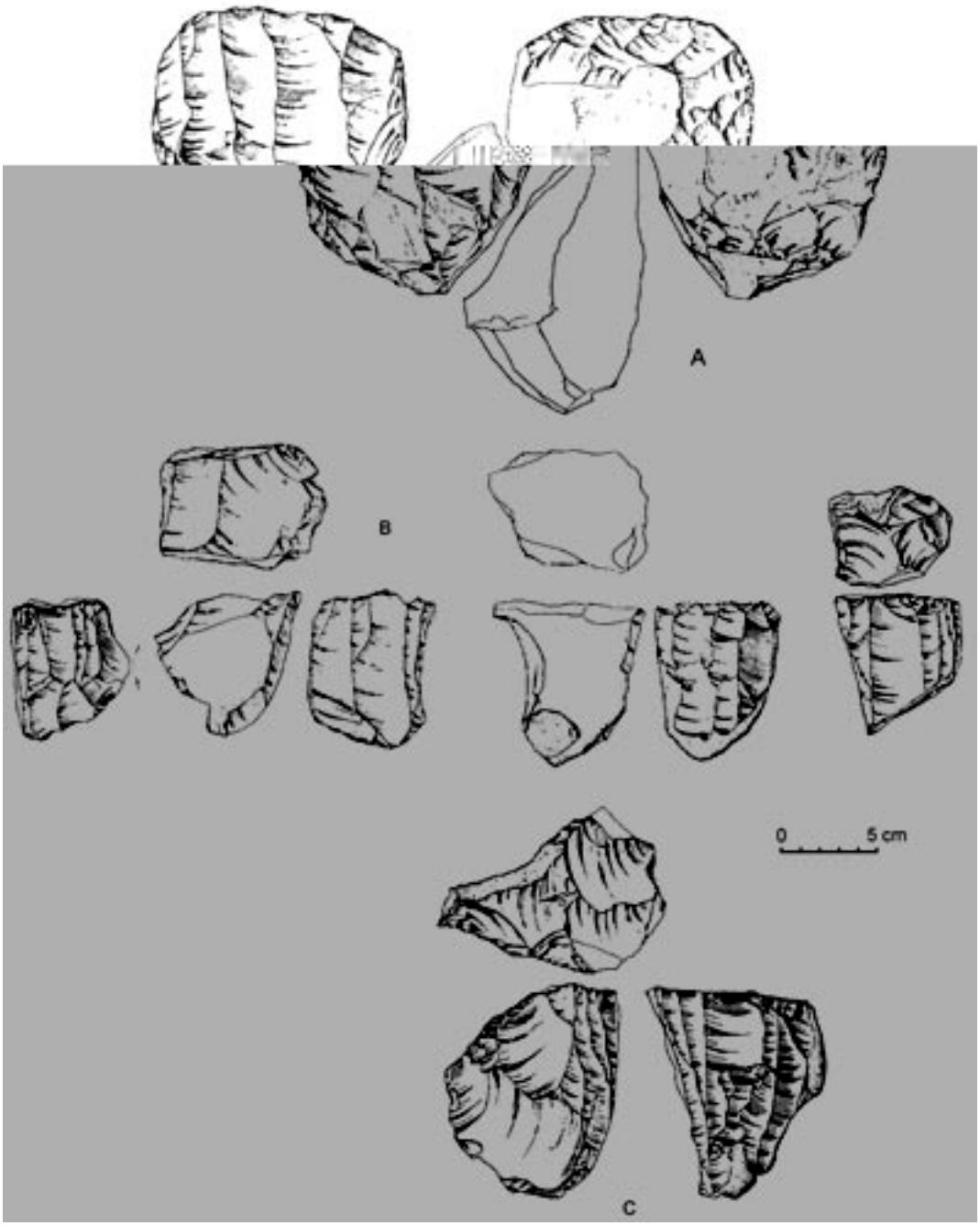

FIG. 11 – Kraków-Zwierzyniec. Examples of single platform cores (after Sachse-Kozłowska, 1982).

Comparison with the blade technology in western Europe

As an example of an Aurignacian assemblage from western Europe we have chosen the site of Barbas II not only because the technology on this site has been described in an excellent work by N. Teyssandier (2000), but also because of the features of raw-material on this site. The dimensions of flint nodules from Bergerac and its technological properties are close to both flint C from the vicinity of Karlukovo in Bulgaria as well as to type C Jurassic flint from the region of Kraków in the hill range of Góra Bronislawy and Sowiniec.

At Barbas the technological features are distinctive for the whole Aurignacian of south-western France. According to Teyssandier these are:

a) Detachment of blades from one platform, on the broader face of a nodule and, consequently, the receding of the front face of a nodule as its volume diminishes.
b) Frequent preparation of *en éperon* type which correlates with the rejuvenation of the platform by tablet detaching.
c) Location of the flaking face on the broader face of a flint nodule or block.
d) Rejuvenation of flaking faces by the formation of neo-crests or detachment of *lames débordantes* at the ridge between the flaking face and the core sides.
e) The use of a hard hammer stone in the preliminary phase and a punch during the reduction itself.

All these features are conspicuous both in the Temnata cave sequence and at the site of Kraków-Zwierzyniec. We should draw attention to the fact that at Barbas there are also cores for large blades with preparation from antero- or postero-lateral crests (one or two). In such cases reduction began from detaching cortical blades and blade-flakes. The contiguous scars formed guiding ridges (*nervures-guides*). Rejuvenation is relatively weakly exhibited on these cores. This means that they were discarded in a stage that still made reduction possible as the volume of cores was considerable. A similar situation can be observed for some cores at Kraków-Zwierzyniec, whereas it has not been recorded in any of the levels at the Temnata cave where the core volumes were much more exhausted.

At Barbas the length curve of blades is, too, multimodal within the interval of 7-15 cm. Thus, only the first two modes from Barbas correspond to the last two modes from the Temnata cave. When we compare Kraków-Zwierzyniec and Barbas we can see that all the upper modes overlap. It is important to add that at Barbas there occur exceptionally long blades (more than 18 cm), but they are represented mainly by mesial fragments which, according to N. Teyssandier, come from reduction phases that were carried out away from the site. Just as at Kraków--Zwierzyniec and in the Temnata sequence also at Barbas separate *chaînes opératoires* have been identified whose end-product were flakes produced from discoidal cores.

The difference between Temnata cave, Kraków-Zwierzyniec and Barbas rests, in all likelihood, in the occurrence at Barbas of cores for the production of bladelets. At the other two sites bladelet production is, in my opinion, an epiphenomenon of *chaînes opératoires* for blade production. Bladelets come either from final stages of exploitation of blade cores, or from the retouching of high scrapers and carenoidal burins.

The specificity of bladelet production in the Mediterranean zone

The feature that distinguishes the sites of the Mediterranean Aurignacian (also referred to as Proto-Aurignacian) from central and western European sites is the presence of well--defined *chaînes opératoires* whose purpose was the production of bladelets with straight and not twisted profiles. Twisted profiles are frequent at some Aurignacian sites, but they come from the "retouching" of high-scrapers.

When we analyze cores from the site in the Fumane cave we can attempt to reconstruct two different *chaînes opératoires* aiming at bladelet production. Both chains resemble the core reduction leading to the production of macroblades, typical for the whole Aurignacian:

a) In the first reduction sequence, during the preliminary phase platforms were prepared on flat, oval nodules and postero-lateral crests were made, then blades and blade--flakes were detached from a broad, slightly convex flaking surface. The flaking surface was extended onto core sides and, sometimes, neo-crests were shaped.

b) In the second reduction sequence, more cuboid, blocky nodules were used which restricted preparation to the platform (shaped by centripetal flake scars), then blades were detached on the broader face of a nodule with the purpose of making a rounded flaking face. This was sometimes combined with scars from the core tip in order to make the core narrower by side reduction. As a result, conical or subconical cores for bladelets were made which enabled the exploitation of nearly the whole volume of a nodule.

The bladelets obtained from both core types were narrow (the width was limited to one mode only from 0,5 to 1,0 cm), but they were occasionally fairly long, between 3,5 to 4,0 cm.

Conclusions

The technological analysis of assemblages from the Temnata cave sequence points to the stability of blade technology from the Initial Upper Palaeolithic until the Aurignacian in the Balkans, in the period from >40 to 32 kyr BP.

At the same time, the analysis of production techniques in regions remote from one another (Poland, France) indicates similarity of technology within the Typical Aurignacian. This technology derived from the Initial Upper Palaeolithic, known as the Bachokirian in southeastern Europe.

Also, in the Mediterranean zone, specialized bladelet production shows principles of manufacture similar to the macroblade techniques known in other areas of the European Aurignacian.

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