L'INSTITUT D'ARCHEOLOGIE
DE L'UNIVERSITE JAGELLONNE DE CRACOVIE

RECHERCHES ARCHEOLOGIQUES
NOUVELLE SERIE 1

KRAKÓW 2009

MISE EN PAGES
Wydawnictwo i Pracownia Archeologiczna “PROFIL” Magdalena Dzięgielewska

EN COUVERTURE
Trois figurines d’ivoire de site prédynastique de Tell el-Farkha

ADRESSE DE LA REDACTION
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www.archeo.edu.uj.pl/ra

ISSN 0137-3285

Cette publication est financée aux moyens destinés à l’activité statutaire
de la Faculté d’Histoire de l’Université Jagellonne

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RECHERCHES ARCHEOLOGIQUES A L'ETRANGER

THESES DE DISSERTATIONS

Recherches Archéologiques
SN 1, 2009, 641 – 654
ISSN 0137 – 3285

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The Middle Palaeolithic in Kraków region: Piekary IIa and Kraków ul. Księcia Józefa sites, in European context[1]

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Recent investigations at the open-air sites Piekary IIa and Księcia Józefa yielded abundant data dealing with stratigraphy, absolute chronology, typology, technological patterns and human behaviour during Middle-to-Upper Palaeolithic transition. Archaeological hiatus between 55–45 ky BP in Southern Poland starts to fill with new human occupations.

Discovered in 1997 open-air site of Księcia Józefa (excavated between 1998 and 2002), has a 7-meter sequence and three occupations (OIS 3; about 44 – 40 ky BP) (Sitlivy et al. 1999b; 2004; 2009). Artefacts were mostly made from local Jurassic flint of large and medium-sized, oblong, voluminous nodules of generally good and mediocre quality. Flint outcrops are local, within 1 km of the site but not directly at the site. This type of flint was used throughout all analysed industries as well as in Middle and Upper Palaeolithic assemblages in the Zwierzyniec region of Kraków. The artefacts have fresh state of preservation, altered items are very rare (patina, gloss), except numerous burnt lithic material; post-depositional damages are absent or very rare.

Księcia Józefa site shows a sequence of three in situ occupations:
level III – high density site with a huge variety of generally non-Levallois flake and some blade production systems (large camp with different activities);
level II – industry with fully Upper Palaeolithic core reduction (specialised workshop);
level I – periphery or ephemeral site with UP blade debitage and some Levallois elements.

The Palaeolithic complex at Piekary was excavated for the first time in 1879–1880 by G. Ossowski (Piekary I and IV) (Ossowski 1880; 1881) and after investigations was continued by: S. Krukowski in 1927 (Piekary II and III) and in 1936 (Piekary I and III) (Krukowski 1938/1948); L. Sawicki in 1954–1956 (Piekary I, II and IIa) (Sawicki 1956; 1957; 1959); W. Morawski in 1967

[1] Dissertation defence in 2005.

(Piekary I, III and V) and from 1968 to 1983 at Piekary II and IIa (Madeyska *et al.* 1994, Morawski 1975; 1992); K. Sobczyk, W. Morawski and V. Sitlivy from 1998 to 2000 at Piekary IIa (sectors XX, XXI and XXII) (Sitlivy *et al.* 1999a; 2004; 2008).

Last excavation on open-air site Piekary IIa yielded five Middle and three Upper Palaeolithic industries. For detailed study in this dissertation three Late Middle (7c, 7b, 7a) and one Early Upper Palaeolithic (6) layers were used. A short chronological scenario was proposed for both sites (OIS 3) based on TL dates on burnt flints, OSL of a loess-like deposits and AMS dating on charcoal. In Piekary IIa site the early blade production is accompanied by Middle Palaeolithic technologies (from bottom to top, layers 7c, 7b, 7a) and it is followed by local Early Upper Palaeolithic (layer 6) i.e. time interval 60 – 32/26 ky (Valladas *et al.* 2003; 2008). Piekary IIa site yielded assemblages of human occupations with debitage activities and an evidence of artistic production (two engraved pieces of hematite in layer 6).

The sites of Piekary IIa and of Księcia Józefa display various models of blade production development and significant technological variability during the Middle-to-Upper Palaeolithic transition.

Lithic assemblages are abundant (Table 1). Numerous individual reduction sequences (cores and tools) have been reconstructed often till initial nodule or blank with no or few missing pieces, especially in layers III and II in Księcia Józefa site, and show complex and unique tendencies in knapping activities and in human behaviour.

Księcia Józefa Site. Layer III (Lower Complex)

This layer represents high-density site, large camp with different activities: rest of 29 unstructured hearths and *in situ* highly variable lithic technologies appearing in strictly organised clusters. Many knapping methods were practised: generally non-Levallois flake (mostly polyhedral, accompanied by discoidal, unidirectional and various short reduction sequences of cores on flakes, including Kombewa and Pucheuil models) and some blade production of the Upper Palaeolithic type. The tool kit displays nearly the same proportions of simple scrapers, notches and retouched flakes which were accompanied by raclettes, natural and retouched backed knives, denticulates and rare end-scrapers. Retouch is non-invasive, light and often marginal or of "raclette" type.

Artefacts (22362 items) were found at the top of Member III-2: medium – and coarse – grained sands (Sitlivy *et al.* 1999b). This is thin (5–10 cm) occupation covering about 80 m^2. The artefact composition (Table 1) evidences the debitage aspect of this complex, however dominated chips (<2 cm) were also result of tool retouching and re-sharpening confirmed by many refitted scrapers, notch and denticulate tools. Flint fragments, tested and un-worked nodules, chunks (as raw material reserve), pre-forms as well as pebble hammerstones (25 pieces) and retouchers are present (0.03–0.1%). Un-identifiable burnt items are extremely abundant (559 pieces or 25% of all assemblage). General lithic artefact composition and large number of refitted production sequences, modifications and breaks suggest on-site core reduction, tool production and using.

Spatial distribution

Material was dispersed throughout whole excavated living-floor, forming separated dense scatters. Higher artefact density was recorded in southern part. Numerous flint-knapping areas have been recorded, varying in size, density, composition and activity (debitage, tool production posts, raw material reserve, burnt artefact clusters,

Table 1. Księcia Józefa and Piekary IIa. General artefact composition

	KJ III		KJ II		KJ I		P IIA 7C		P IIA 7B		P IIA 7A		P IIA 6	
	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%	Nº	%
Chunks	9	0.04	-	-	-	-	-	-	-	-	1	0.1	-	-
Fragments	174	0.80	-	-	-	-	-	-	-	-	-	-	-	-
Pebbles	131	0.60	-	-	-	-	-	-	-	-	-	-	-	-
Thermal frg.	18	0.08	-	-	2	2.9	18	11.2	3	0.5	38	2.5	17	1.1
Debris	85	0.40	14	0.65	1	1.5	47	29.2	12	2.1	81	5.4	13	0.9
Burnt frg.	559	2.50	-	-	-	-	-	-	-	-	1	0.1	6	0.4
Tested blocks	14	0.06	-	-	-	-	-	-	1	0.2	-	-	1	0.1
Pre-forms	8	0.03	-	-	-	-	1	0.6	-	-	-	-	-	-
Cores	257	1.10	13	0.60	2	2.9	7	4.3	9	1.6	20	1.3	14	1
Chips (<2 cm)	12544	56.10	1571	71.80	10	14.7	8	5	107	18.9	471	31.5	561	38.9
Flakes	7521	33.60	241	11	34	50	60	37.3	314	55.4	725	48.5	392	27.2
Blades	421	1.90	275	12.60	15	22	15	9.3	82	14.5	113	7.6	322	22.3
Bladelets	45	0.20	49	2.20	-	-	2	1.2	9	1.6	5	0.3	63	4.4
Blanks frg.	-	-	14	0.65	1	1.5	-	-	11	1.9	11	0.7	18	1.2
Burin spalls	4	0.02	-	-	-	-	-	-	-	-	-	-	6	0.4
Hammerstones	25	0.10	-	-	-	-	-	-	2	0.3	-	-	-	-
Pebble retouchers	9	0.04	5	0.20	-	-	-	-	-	-	-	-	-	-
Retouched tools	538	2.40	7	0.30	3	4.4	3	1.9	17	0.3	28	1.9	29	2
Total	**22362**	**99.97**	**2189**	**100.00**	**68**	**99.9**	**161**	**100.0**	**567**	**99.9**	**1494**	**99.9**	**1442**	**99.9**

combinations of these accumulations). Intact production areas with dense accumulation of chips and various refitted reduction sequences is common. Large concentrations of burnt stones were associated with hearths or were localised around them. Isolated burnt artefacts display also long distance connections with fireplaces. Traces of ash and charcoal are common across excavated area. The hearth shape (round, oval) and dimensions (with a diameter of about 50–70 cm) are more or less constant with clear-cut boundaries. No dominant orientation can be recognised what could document their *in situ* position. However other type of structure is represented by larger charcoal zone without clear-cut boundaries (with a diameter of more than 100 cm). These ashy zones could comprise several small hearths. Thickness of discovered hearths vary from 1–2 to 5–7 cm. Three types of hearths have been distinguished according to their filling:

1) containing exclusively burnt lithic remnants;
2) filled mostly by fresh flint material; heated, burnt and fresh artefacts occurred also around hearth's periphery;
3) "sterile" or with few non-burnt remnants inside small round hearths surrounded by flint material.

In sum, 29 hearths were localised which were organised in five main concentrations:

1) northern cluster (squares L2, L1, K3, K2, K1, I1), small compact hearths without artefacts;

2) central cluster (squares K-1, K-2, I-1, H0, H-1, G0), mostly big composite eroded (washed away) hearths with exclusively burnt flints;
3) western cluster (squares E0, D1, C1, B1), several small oval hearths lacking burnt material; mostly fresh and few burnt artefacts occurred in hearth's periphery;
4) eastern cluster (squares N-5, M-5, M-4, L-4, L-3, K-3), divers types of fire places bigger ones with mixed (burnt and fresh) filling as well as small sterile hearths;
5) southern cluster (squares G-4, F-4, G-5, F-5, E-5, G-6, F-6, E-6, F-7, E-7), sterile small hearths with surrounded un-burnt lint; except only one large fire-place comprising both burnt and fresh material.

It seams that, several models of hearth's function were practiced:
a) after extinguishing of fire on the same place knapping activity took place (hearths contain fresh artefacts); b) hearth functioned simultaneously with flaking activities (hearths of different types); c) hearth was installed in the knapping area after finalisation of certain activities (abundant burnt material).

Different degrees of burning of flint artefacts were also recorded:
1) heated artefacts, complete, without fractures, visible negatives and ridges; slight alteration concerns only colour (reddish spots);
2) artefact disintegration in large fragments and dispersal of them due to sudden heat (e.g. throwing of flint into the fire); numerous reconstructed burnt pieces (often retouched tools) have rather long refitting lines (about 1 m); clear changing of colour (whitish, greyish);
3) considerable changing of colour, contrast network of internal cracks; complete or partial heating (often unifacial) resulted in abundant "fire chips" (e.g. several concentrations yielded 2557 chips from which nearly a half were heated and burnt; moreover most of them belong to the category of "fire chips" – 79%). Cracked fire debris stays on the place and disintegrates during excavation. Burnt artefact surface is morphologically illegible. This kind of alteration is due to long gradual heat of a flint (hearth installation on flint remnants).

In the central hearths cluster the lithic filling and next to the hearths accompanied (surrounded) material exhibits contacts with high temperature. Burnt artefacts display all these levels of heat what could confirm long function of these hearths.

As for horizontal distribution of cores, three main concentrations is visible: in G(-1)/F(-1); F(-6)/G(-6), and M(-4)/(-5). Most of them as well as tools, except several areas [I(-4), I(-5), H(-4) and H(-5)], has even spatial patterning. Refitted cores and tools formed clusters, which density depends of reduced flint mass. Normally short and medium connection lines of more than 300 reconstructed blocks were recorded. Very long scattering and flints with long biography occurred rarely and it concerns mostly isolated artefacts rather than whole refitted unit (e.g. point with long biography was found in 10 m away from completely reconstructed nodule). *In situ* technological order of refitted cores is common as well as a number of tools which were surprisingly left on the place with chips and moreover be fitted with original core.

Settlement structure

Spatial, technological, typological, attribute analyses and refitting make possible to propose a general model of site structure. Raw material was transported to the site and occurred in large nodules and chunks (between 1–5 kg) as well as some large primary flakes (about 500 g), which are much bigger than cores and refitted blocks found on the

settlement. Local flint was reduced, except one used blade made from exotic white mat Jurassic flint from Sikornik area. It appears that imported local flint was tested on the site: tested blocks, pre-cores on nodules, pre-forms on flakes (flaked flakes). Different stages of core reduction were distinguished: cortex removal or initial direct reduction or preliminary shaping, exploitation, rejuvenation and finally exhaustion as well as discard of cores on the different technological phases. Numerous pre-cores contrasted with also abundant heavy exhausted cores (from nodules of several kg till micro-cores e.g. 13 g). Cores on nodules and on flakes were reduced by means of very different flaking strategies. Cores on nodules, fragments represent all reduction stages. Often reconstructed nodules comprise several independent cores with their own technological "life". Some exhausted and full debitage cores were used like tools. Some cores on flakes have similar reduction pattern (even with less mass than nodules): from initialisation (often Kombewa cores) till exhaustion and transformation into tools, showing long reduction chain. Other ones exhibit short reduction pattern.

Core exploitation resulted in flakes and some blades as well as in waste. Blanks, often without strict selection, were used directly (partly retouched flakes and blades) or were modified by careful retouch into tools. However large primary cortical flakes were usually transformed into cores and side-scrapers as well as naturally backed or débordant (by debitage) blanks into backed knives and some other implements. On the other hand, abundant raclettes were produced on small ordinary flakes and surprisingly on large flakes and blades (including cortical) what contradict traditional definition of this tool type. Significant part of produced *in situ* blanks, mostly flakes, was again reduced like cores (second generation). Retouched tools were also used and re-sharpened on the site or/and broken during rejuvenation and finally again reduced like a cores (Kombewa pattern). Considerable amount of refitting show complete on-site raw material exploitation: production phases and using (e.g. blocks without missing pieces, including good quality blanks and retouched tools).

Refitting and artefact composition displays using of two production strategies: economical and wasteful. Wasteful pattern is characterised by numerous debris occurring during core reduction and careless using of raw material sources. Cores were abandoned after technological mistakes, appearing of natural inclusions and fractures but very often without any reason on the full debitage stage. Immediate *ad hoc* short using of blanks and quick abandon was confirmed also for some tool categories. Economical behaviour of raw material treatment differs a lot. Nodules were often divided into several parts, each of them were reduced in their own manner (independent methods) and even with appearance of natural defects flaking sequence was long, often complicated and resulted in heavily reduced cores. Many debitage products in these reconstructed blocks were retouched or used as next generation of cores: core-on-flakes. It happened also that at the final stage core was accidentally broken, however both fragments were continuously reduced till the maximum. Small fragments and flakes were also used as micro-cores.

All these data shows complicated, untrivial character of raw material exploitation, technological behaviour and site function in comparison with known MP occupation of this region. The similar notion as for Maastricht-Belvedere site J, "it is easier, in fact, to determine what the flint technology does not look like" (Roebroeks *et al.* 1997) can be used in this case for Księcia Józefa, layer III patterns.

Księcia Józefa Site. Layer II (Middle Complex)

A small debitage area of a bigger settlement (?) or more probably limited short term workshop with remnants of hearths and with dense flint concentration was discovered in member III – I (silty sands). This assemblage consists of 2189 artefacts. Flint industry exhibits blade production (Ilam=57.3) by means of several methods of UP style: crest installation, often striking platform rejuvenation, mostly bidirectional exploitation of narrow cores on nodules and on flake, and volumetric prismatic cores (Sitlivy *et al.* 1999b; 2004). The tool kit is modest (only 7 items) and represented by retouched flakes and blade, notch tool, *pièce esquillée*, borer and scraper fragment. There is neither characteristic Middle Palaeolithic tool nor Aurignacian implements what contrasted with exclusive blade production. Unspecific isolated types are present (lack of end-scrapers and burins).

Spatial distribution

Most of archaeological remains were localised in the small zone of about 6 m^2, the rest of excavated area (80 m^2) yielded only isolated flint artefacts. Spatial analysis demonstrates that tools occupy western part, whereas cores were found in the centre and eastern area of this cluster. Intact production area with high dense accumulation of chips and small waste evidenced about blade debitage activity, which took place next to the hearth.

The artefact composition (Table 1) confirms the debitage aspect of this complex. Chips are the most numerous category (>72%) among all studied assemblages in this region; blades and bladelets are on the second position. The lithic artefact composition and refitting suggests on-site core reduction. Unlike the layer III and many workshops and site-workshops of this region, un-worked and tested nodules, fragments of raw material, pre-forms are absent as well as and other remnants like re-sharpening flakes, burin spalls. Interestedly among numerous debitage products with developed bulbs and 13 reduced cores (6 were refitted) only 5 small abraded pebbles and no one hammerstone were recorded. However, hard stone percussion was often used. Together with faceting of core platforms (IFl=30, IFs=24.2) they are the only Middle Palaeolithic technological traits in this industry. Flakes without cortex are dominant (>55%); small number of cortical and semi-cortical flakes and blades (47 and 5 pieces respectively) and their low ratio to cores (4 to 1) do not confirm on-site décorticage stage of many cores. Refitting shows only two cases of *in situ* cortex removal stage and on-site reduction of rather small nodules. Primary and ordinary flakes (241 items) together with refitted sequences exhibit mostly "flake character" of the preparation stage. Rather numerous naturally backed blades were used to maintain the debitage surface. Blade debitage in majority is represented by un-complete blanks (about 90% in contrast to 63% in layer III) or by irregular blades. On the other hand, cores keep blade and bladelet negatives with regular shape. In one case a core from good quality rare flint was not conjoint with any recovered pieces from large area of about 80 m^2. Debitage products (including deliberately produced blanks) from this type of flint are scarce in this assemblage. This core was at minimum prepared outside excavated area; target blades are absent. These facts as well as partially reconstructed cores with missing peaces and high chip/shatter component could evidence about specialised production of blades and bladelets, modification of some final blanks into tools and their exportation.

Settlement structure
Application of various analyses document specialised workshop character of this occupation (several? short visits with intensive blade core reduction in limited knapping post). General structure of this assemblage demonstrates mostly of-site testing of raw material, cortex removal stage and shaping of some cores. Large flake were imported to the site in order to use them like a narrow-faced blade/bladelet core.

Core reduction was devoted to production of good quality medium size and small narrow blades (rarely >100 mm), including bladelets and some tool manufacturing. They are clearly more elongated and less massive than blades from underlying complex III. Cores (only several were exhausted and one burnt), technical pieces (crests, tablets), debitage waste, rarely complete blades/bladelets (10.5% and mostly irregular) as well as rare un-expressive tools were left.

Final blanks were exported together with some retouched tools; pebble tools for hard percussion were also not forgotten.

Księcia Józefa Site. Layer I (Upper Complex)
Artefacts came from low and middle parts of Series II (silty muds). Layer I is not rich, however many artefacts were localised in the northern part of a trench. Cores were also found in this concentration, as well as one notch tool refitted to volumetric mixed blade/point core. The rest of tools were found out of this concentration. Blade production of UP type is documented by the presence of blade blanks, crested blades with two slopes and the use of soft hammer percussion. Tools are rare and "neutral". One Levallois preferential flake is heavy altered and contrasted strongly with the rest "fresh" assemblage. This complex with UP blade production, some Bohunician influence in core reduction strategy, un-characteristic tools display a periphery/destroyed part of a bigger occupation or more probably ephemeral site.

Piekary IIa site
New investigations at Piekary area document several pre-leptolithic blade episodes in the sequence of the site IIa in the period between 61 and 35/33 ky BP (Sitlivy *et al.* 1999a; 2004; Valladas *et al.* 2003; Mercier *et al.*, 2003; Kalicki and Budek 2004). The lower part of Piekary IIa sequence yielded 4 human occupations attributed to Blade Levallois-Mousterian (layer 7c), Levallois-Mousterian (layer 7b), Blade Mousterian (layer 7a) and local non-Aurignacian EUP (layer 6) industries lacking bifacial tools.

Artefacts composition is similar throughout these layers and is characterised by domination of debitage products, low quantity of tools and cores (Table 1). Low rate of chips in all Piekary's assemblages can be partially explained by post-depositional processes, however progressive increasing of them from layer 7c till 6 could be induced by human activity. Inter-assemblage comparison confirms that tool to core ratio is low in all sites from Kraków region: 2 to 1 and less (the lowest were recorded in low density occupations in PIIa, 7c and KJ, I: periphery or ephemeral sites). On the other hand, blank to core ratio (except these two cases) is high: up to 55.5 to 1 the highest rate in PIIa, 6. Blade debitage was intensive in both EUP complexes (PIIa, 6 and KJ, II): 27.5 to 1 and 26 to 1 respectively and contrasts with Blade Mousterian in PIIa, 7a where blade productivity was very low 7 to 1. Thus, core flaking (flake/blade or only blade production) was common for all analysed inventories. All Piekary assemblages document absence of raw material

reserve on the site and few tested nodules were found, what differs a lot from Księcia Józefa, III. Generally Piekary complexes fit to the category of site-workshop with less complete processes as for raw material exploitation in comparison with KJ, III. Also, workshop character is less pronounced in PIIa, 6 (presence of engraved pieces of hematite, more numerous and definite UP tool types) than in specialised blade/bladelet workshop with occasional ad hoc tools in KJ, II.

Spatial patterning

Piekary sites exhibit low/medium density occupations however remnants tend to be denser from the bottom to the top of sequence (contrary to Księcia Józefa pattern). No peculiar differentiated horizontal distribution was visible; few clear-cut accumulations were recorded. Vertical scattering of the artefacts is rather important (palimpsest is very probable as well as post-deposition effects) and differs considerably from state of preservation of living-floors in Księcia Józefa, layers III and II.

Layer 7c represents low density occupation. Artefacts in trench XXII were localised mostly near western profile i.e. near old Morawski's trench XIII, which yielded the richest sample of this industry in whole Piekary area. One big concentration comprise among different finds blades and tools, while cores were found in different places of two newly excavated trenches.

Assemblage from layer 7b is more numerous. Spatial organisation shows generally even horizontal distribution of artefacts and one big concentration in the southern part of the trench XXII. Levallois products were localised across all area, tools were found inside concentrations.

Industry from layer 7a is most dense with even repartition of artefacts; two concentrations on opposite parts of excavated trenches were recorded. Different blank production activities was practice in two zones: trench XX yielded only flakes, especially small débordant without corresponding cores, when in trench XXII all blade cores were found as well as majority of blade debitage.

Repartition of artefacts in layer 6 shows direction of solifluction along the slope. Several concentration of material, including cores and tools can be recognised; however their origin (natural or human) is not clear.

Groups of industries

Inter-assemblage attributes, refitting and technological comparisons of these sites make it possible to distinguish several groups of industries.

1. Blade/flake group with Levallois features (Piekary IIa, layer 7c and 7b; Księcia Józefa, layer I?; about 61–48 till 38 ky BP)

The technology for flint reduction is represented by several production systems of Middle and Upper Palaeolithic types:

a) direct (i.e. with no preparation of flaking surface), non-Levallois unidirectional and rare bi-directional blade reduction;

b) mostly prepared (crest installation or bifacial pre-form) non-Levallois uni- and often bidirectional blade reduction (Valladas *et al.*, 2003); predominance of well-developed bulbs and open flaking angles attest a direct use of hard hammerstones;

c) Levallois methods: lineal Levallois for preferential circular flakes, for points (mostly unidirectional convergent method) (Valladas *et al.* 2003) and recurrent centripetal method for flakes;

d) non-Levallois flake production of massive asymmetrical convergent and centripetal débordant flakes with crudely prepared butts based on reduction of discoidal cores.

Assemblages are characterised by a medium level of Levallois (IL=14.9–16) and blades (Ilam=22), rather high faceting rate (IFl=56–45). The tool kit dominated by simple scrapers accompanied by retouched blades and flakes and some truncated facetted pieces. Upper Palaeolithic types of tools occur in layer 7c (backed blades, burin), which are absent in 7b. Layer 7b yielded only Middle Palaeolithic tools with more numerous notch and denticulate pieces.

2. Flake group with blade and rare Levallois components (Księcia Józefa, layer III; about 44 ky BP)

The debitage technique used direct percussion by means of a hard stone (pronounced bulbs, double bulbs after very strong blows, large platforms and obtuse platform angles). All proposed methods and technological interpretations are based on numerous refitted sequences. More than 300 refitted blocks have been reconstructed (refitting rate is 20.7%; without chips); about 1/3 of them are complete and semi-complete. This industry is characterized by dominant flake production resulted from various *"chaînes opératoires"*, mostly polyhedral (42.4% to all refitted debitage blocs). Flaking surfaces and platforms are inter-exchangeable during long reduction sequences and represented by several modes:

a) exploitation of ridges by means of crested removals: blade or flake with high triangular section and two-sloped crests of UP type;

b) exploitation of surfaces by means of large removals: flakes, some blades, débordant pieces including peculiar débordant flake bearing 4 sides corresponding to 4 surfaces/platforms of a core;

c) mixing of these modes in order to continue reduction as long as possible (numerous cores and refitted blocs on different stages, including exhaustion).

Simple changing of orientation was used very rare. Continuation of debitage was realised also by mixing of polyhedral and discoidal methods along one reduction sequence (7.5% of refitted blocs). Discoidal method is common (12.1% of refits) and occurred in unifacial, bifacial successive and alternate versions. Various short reduction sequences based on core-on-flake was also common (16.6%): Kombewa, Pucheuil methods (Delagnes 1996), exploitation of dorsal or narrow parts (slice) of a flake in longitudinal and transversal manner, including flaked flakes (core/tool pre-forms). Unprepared unidirectional, orthogonal debitage occurred as well as trifacial, "chopping-like" flaking. Refitted centripetal technological episodes are rare; these cores are also scarce. Often nodules and cores have been divided in several parts and reduced by using of different independent methods or represent during long reduction a fusion of several technologies.

According to typological and statistical data, this industry could be typed as "non-blade" and "non-Levallois". However, after refitting, several clear blade non-Levallois and Levallois point strategies have been reconstructed: Levallois convergent method for points displays uni- and bidirectional modes of working-surface preparation. Final products (points) have an "atypical" appearance because of knapping mistakes, which occurred during the preparation of working convexity or during the last point removal (e.g. hinged fracture). Levallois character of core preliminary shaping contrasts with failed results. Point production was based on cores with convergent preparation. The same result (triangular points) could be obtained during mixed (with blade) core reduction on initial or final stages of technological chains (similar to Bohunician and Boker Tachtit trend).

Blade production is represented by different methods:
a) direct exploitation (without core preparation) based on one-platform unidirectional partially turned cores (debitage extended from a narrow to a large working surface) and platform rejuvenation by means of tablets;
b) direct exploitation based on cores with two opposed platforms and bidirectional successive series of blades (from one platform and then from the other one); partially turning debitage (from the narrow side via a large working surface or vice-versa);
c) direct and prepared (crest installation) unidirectional exploitation of narrow part of a flake;
d) prepared bidirectional exploitation on a narrow working surface and two large sides; during a phase of large surface reduction an elongated point was produced.

Core platforms were restored by elimination of overhang (retouching or/and abrasion). Such maintenance was observed on all debitage products of above-mentioned blade methods. Refitting and conjoining of numerous burnt items, including cores and tools was documented, as well as manufacturing of scraper, denticulate/notched tools (13.1%), re-sharpening and transformation of tools into cores.

The tool kit is represented in nearly the same proportions by simple lateral scrapers, notches and retouched flakes which were accompanied by raclettes, natural and retouched backed knives, denticulates and rare end-scrapers. Retouch is non-invasive, light and often marginal or marginal abrupt of raclette type.

3. Blade group with rare Levallois elements (Piekary IIa, layer 7a; about 42–36 ky BP)

The blade component is attested through the predominance of blade cores, even if Ilam is not very high (=14). Butt faceting also decreases in comparison with the first group (from 1.5 to 2 times less). IL is low (<5). The use of soft stone together with hard hammerstone is evident. Several methods of blade and flake production were identified:
a) direct and prepared uni- and bidirectional exploitation of nodules of Upper Palaeolithic types with central crest installation or bifacial pre-form reduction; bidirectional core exploitation with no crest installation is common; the exploitation went on taking advantage of the natural convexities; maintenance was insured by the retrieval of lateral crests and débordant flakes/blades; like in layer 7c, debitage started on the narrow working surface and it extended on large sides; other variation is also present: exploitation from the large working surface via the narrow sides; platforms were prepared mainly by one or several small removals; platforms were rejuvenated during debitage thanks to retrieving partial tablets, by facetting and by grinding of overhang; dominating blade production was accompanied by flake core reduction;
b) discoidal core reduction is common and resulted in short massive and small asymmetrical débordant flakes;
c) rare Levallois centripetal recurrent debitage (small débordant flakes with facetted butts).

The tool kit is scarce and trivial for Middle Palaeolithic: domination of simple side-scrapers, less numerous notches, retouched flakes and knives with a natural or prepared back. Blades are still nearly unmodified. Upper Palaeolithic tools are absent. Non-invasive retouch prevails.

4. Blade group (Księcia Józefa, layer II; Piekary IIa, layer 6; about 40 till 32/25 ky BP)

The characteristic features of this group are on the one hand the high level of blades and

bladelets (Ilam is up to 58) and the complete absence of Levallois debitage and technology in general. Moreover, there is no Middle Palaeolithic core reduction in these industries. Exclusive blade and some bladelet productions based on volumetric core reduction (with crest installation or rarely direct) were practised. All cores were also devoted to blade production. In both assemblages, cores and blade proximal parts evidence intensive grinding (from 2 to 3 times more than in Piekary IIa, layer 7a). A large number of various crested blades (14–15%) and tablets (13–15%) were recovered in contrast to rare débordant blades and flakes. However, platform preparation is different in both industries: single-blow platforms are more numerous in Piekary IIa, layer 6, while facetted butts occurs more often in Księcia Józefa, layer II (IFl= 30, IFs=24.2). The use of soft stone percussion is well documented. However there are some differences in technique of blank obtainment. Soft stones were used for blade detachment in Piekary IIa, layer 6, while hard hammerstones occurred more often in Księcia Józefa, layer II. Hard stone percussion and faceting of core platforms are the only Middle Palaeolithic technological traits in Księcia Józefa, layer II industry.

As for technology, prepared blade production based on the reduction of cores with two opposed platforms is dominant. Intentional bladelet obtainment occurred. Layer II in Księcia Józefa yielded bidirectional blade/bladelet core made on flake with a crest on one narrow part and bidirectional reduction started from "burin spall" blade removal. This method was attested in Chatelperronian industry of Roc-de-Combe, layer 8 (Pelegrin 1990) and absent in Piekary IIa, layer 6. Cores are mostly partially turned in both polish industries. The working surface is located on the narrow part of initial nodule or flake and it extended to large sides. The exploitation of large debitage surface and extension from the large side to the narrow part occur too. In layer 6, both directions and extensions of debitage are present; however in layer II exploitation of narrow cores dominates. A few completely turned cores were found in layer 6.

The tool kit is modest. There is neither characteristic Middle Palaeolithic tool nor Aurignacian tool. Unspecific isolated types are present in layer II – specialised blade workshop (lack of end-scrapers and burins). On the other hand, layer 6 is characterized by clearly Upper Palaeolithic tools with dominance of retouched flakes and blades over end-scrapers, burins and backed pieces. Up to 50% of tools were made on blades.

Conclusions

Analysed newly recovered industries vary chronologically, functionally and stylistically. However they display a "compact" chronological sequence of assemblages in the frame of OIS 3 covering Late Middle Transition period – Early Upper Palaeolithic. Rich debitage composition, workshop character of sites and tool kit without bifacial pieces is typical. Middle Palaeolithic industries belong to "non-Micoquian" entity, generally to Levallois-Mousterian or Mousterian. Assemblages with Upper Palaeolithic features are clearly non-Aurignacian and attest local blade Early Upper Palaeolithic. Layer II of Księcia Józefa documents a fully UP blade/bladelet reduction and exportation of good blanks, and with unspecific tools could represent:

1) Blade Mousterian;
2) Early Upper Palaeolithic unit (more probable).

The oldest Middle Palaeolithic record in Kraków region (i.e. > OIS3), based only on geological interpretations, attested mostly by Levallois-Mousterian which has following features:

– Levallois debitage originated from different methods (linear for single preferential flake or rarely point and recurrent centripetal and especially uni-/bidirectional of Biache type for elongated flakes/blades);
– non-Levallois flake debitage: mostly recurrent with flat (centripetal) and secant (discoidal) exploitation of cores resulted in thick asymmetrical short flakes;
– absence of UP blade production systems (except probably layer 2 in Kraków-Zwierzyniec I);
– monotonous tool kit without clear domination: simple side-scrapers, retouched flakes, raclettes, naturally backed knifes, denticulates, notches, rarity or absence of UP tools; few convergent pieces, including Mousterian points;
– light non-invasive retouch is common.

Typologically the oldest Levallois-Mousterian is similar to Late Middle Palaeolithic industries, especially, taking into consideration the tool composition and their morphology. However technologically they differ from recent MP by absence of fully UP prismatic core reduction and some peculiarities in flake production (presence of Levallois blade strategy of Biache type) demonstrating other technological group presence.

The Late Middle Palaeolithic documents Blade Levallois-Mousterian, Levallois-Mousterian, Mousterian and Blade Mousterian industries lacking bifacial tools, displaying some new features and generally they differ considerably from technological point of view from their predecessors:
– co-existence of several independent parallel core reduction systems i.e. blade strategy of Upper Palaeolithic type and Middle Palaeolithic flake technologies (Levallois and non-Levallois);
– absence of Levallois flake/blade uni-/bidirectional recurrent method of Biache type; practised Levallois methods resulted in obviously non-elongated debitage products (short flakes or points);
– bigger variety of flake non-Levallois methods (polyhedral, discoidal, centripetal, uni-/bidirectional, convergent, short reduction sequences of cores-on-flakes including Kombewa manner, as well as various exploitation of dorsal face or thick narrow slice etc.;
– systematic UP volumetric blade reduction strategies based on various modes (direct or prepared with different crest position, orbifacial pre-core shaping) from often opposed platforms (faceted or prepared by single or several large blows); maintenance by neo-crests, platform rejuvenation often by tablets and platform zone trimming, grinding;
– appearance of soft hammer percussion technique;
– tool kit does not show significant changes; convergent pieces are rare or absent; however, increasing of abrupt light retouch and consequently of raclettes and backed knives in Księcia Józefa, layer III, is striking.

Thus, TL and OSR dated UP volumetric concept of blade production which was widely applied in Levallois-Mousterian industry of Piekary IIa, layer 7c, coexisted with several MP flake methods during Later MP (Piekary IIa, 7b, 7a and Księcia Józefa, III) and developed into a unique standardised blade production during Transition period and EUP (Księcia Józefa II, I and Piekary IIa, 6).

Early Upper Palaeolithic industries of Kraków region are characterised by:
– absence of flake methods of core reduction, including Levallois; the Levallois heritage evidently was not strong and Bohunician influence attests only by failed attempts of point removals as well as by several refits in LMP and EUP industries of Księcia Józefa site (layer III and layer I respectively);

– fully UP prismatic blade reduction, as well as intentional bladelet debitage based on reduction of a narrow part of core-on-flake;
– using both hard and soft hammers.

Tool kit is non-Aurignacian, unspecific or modest without persistence of MP types. Invasive retouch and bifacial pieces are absent.

Finally, Early Upper Palaeolithic in this region and Southern Poland documents the emergence of different traditions:

1) Zwierzyniecian (Sachse-Kozłowska, Kozłowski 1975);
2) local EUP with bidirectional prismatic reduction, simple end-scrapers, some burins, retouched blades, flakes and artistic production (Piekary IIa, layer 6);
3) Bohunician: Dzierżysław, lower layer (Foltyn, Kozłowski 2003); Bohunician influence (Księcia Józefa, layer I).

References

Foltyn E., Kozłowski J. K., 2003 *The Lower Level of the site of Dzierżysław I, Opole Voivodship (Silesia, Poland) and the problem of Bohunician,* Eurasian Prehistory, 1 (2), pp. 79–116.

Kalicki T., Budek A., 2004 *Paleolithic site at Piekary in the Vistula river valley near Cracow: New stratigraphical and micromorphological data,* (in:) H. Dobrzańska, E. Jerem, T. Kalicki (eds.), The geoarchaeology of river valleys, Archeolingua, Series Minor, 18, Budapest, 87–104.

Krukowski S., 1938–1948 *Paleolit,* (in:) S. Krukowski (ed.), Prehistoria ziem polskich, Encyklopedia Polska PAU, 4, Kraków, pp. 16–29.

Madeyska T., 1981 *Środowisko człowieka w środkowym i górnym paleolicie na ziemiach polskich w świetle badań geologicznych,* Studia Geologica Polonica, 69, pp. 7–125.

Mercier N., Valladas H., Froget L., Joron J-L., Reyss J-L., Balescu S., Escyutenaire C., Kozłowski J., Sitlivy V., Sobczyk K., Zięba A., 2003 *Luminescens dates for the palaeolithic site of Piekary IIa (Poland): comparison between TL of burnt flints and OSL of a loess-like deposit,* Quaternary Science Reviews, 22, pp. 1245–1249.

Morawski W., 1975 *Middle Palaeolithic Flint Assemblages from the Piekary IIa Site,* Światowit, 39, pp. 139–146.

1992 *Kompleks stanowisk paleolitycznych w Piekarach, Prądnik,* Prace i materiały Muzeum im. prof. Władysława Szafera, 6, pp. 163–172.

Ossowski G., 1880 *Sprawozdanie z badań geologiczno-antropologicznych dokonanych w r. 1879 w jaskiniach okolic Kraków,* Zbiór Wiadomości do Antropologii Krajowej, 4, pp. 51–52.

1881 *Drugie sprawozdanie z badań geologiczno-antropologicznych w jaskiniach okolic Krakowa,* Zbiór Wiadomości do Antropologii Krajowej, 5, pp. 21–25.

Roebroeks W., Kolen J., Van Poecke M., Van Gijn A., 1997 *„Site J": an early Weichselian (Middle Palaeolithic) flint scatter at Maastricht-Belvedere, The Netherlands,* Paléo, 9, pp. 143–172.

Sachse-Kozłowska E., Kozłowski S.K., 1975 *Nowa kultura górnopaleolityczna w Europie Środkowej. Ze studiów nad materiałami ze stanowiska Zwierzyniec I,* Archeologia Polski, 20 (2), pp. 275–313.

Sawicki L., 1956 *Sprawozdanie tymczasowe z prac wykopaliskowo-badawczych przeprowadzonych przez Zakład Paleolitu IHKM PAN w latach 1953–54,* Sprawozdania Archeologiczne, 2, p. 20.

1957 *Sprawozdanie z badań stanowisk paleolitycznych Zwierzyniec I i Piekary II przeprowadzonych w 1955 r.,* Sprawozdania Archeologiczne 4, pp. 18–20.

1959 *Sprawozdanie z terenowych prac badawczych Zakładu Paleolitu IHKM PAN przeprowadzonych w r. 1956,* Sprawozdania Archeologiczne 5, p. 9.

Sitlivy V., Sobczyk K., Morawski W., Zięba A., Escutenaire C., 1999a *Piekary IIa Palaeolithic industries: preliminary results of a new multidisciplinary investigations,* Préhistoire Européenne, 15, pp. 45–64.

Sitlivy V., Sobczyk K., Kalicki T., Escutenaire C., Zięba A., Kaczor K., 1999b *The new Palaeolithic site of Księcia Józefa (Cracow, Poland) with blade and flake reduction,* Préhistoire Européenne, 15, 87–111.

Sitlivy V., Sobczyk K., Escutenaire C., Kalicki T., Kolesnyk A., Kozłowski J., Mercier N., Tisnerat-Laborde N., Valladas H., Zieba A., 2004 *Late Middle and Early Upper Palaeolithic complexes of Cracow region, Poland,* (in:) Actes du XIVème Congrès UISPP, Universite de Liège, Belgique, 2–8 septembre 2001. Section 6. Le Paléolithique supérieur. Sessions générales et posters. Présidents: M. Dewez, P. Noiret, E. Teheux BAR International Series, 1048, pp. 305–317.

Sitlivy V., Zięba A., Sobczyk K., (eds.), 2008 *Middle and Upper Palaeolithic of Kraków region. Piekary IIa,* Musées Royaux d'Art et d'Histoire, Bruxelles, Monographie de Préhistoire générale, 6.

2009 *Middle and Early Upper Palaeolithic of Kraków region. Księcia Józefa,* Musées Royaux d'Art et d'Histoire, Bruxelles, Monographie de Préhistoire générale, 7.

Valladas, H., Mercier, N., Froget L., Joron J-L., Reyss J-L., Kaltnecker E., Tisnerat N., Fifield L.K., 2008 *Radiometric dates for the Middle Paleolithic sequence of Piekary,* (in:) V. Sitlivy, A. Zięba, K. Sobczyk (eds.), Late Middle and Early Upper Palaeolithic of Kraków region. Piekary IIa, Musées Royaux d'Art et d'Histoire, Bruxelles, Monographie de Préhistoire générale, 6, pp. 53–61.

Valladas H., Mercier N., Escutenaire C., Kalicki T., Kozłowski J., Sitlivy V., Sobczyk K., Zięba A., 2003 *Dating the Late Middle Palaeolithic technologies and transition to the Upper Palaeolithic in southern Poland,* Eurasian Prehistory, 1 (1), pp. 57–82.