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DAMIAN STEFAŃSKI, JAROSŁAW WILCZYŃSKI

EXTRALOCAL RAW MATERIALS IN THE SWIDERIAN CULTURE. CASE STUDY OF KRAKÓW-BIEŻANÓW SITES

ABSTRACT: The Swiderian is part of Tanged Point Technocomplex, the Late Glacial cultural unit of North European Plains. It is dated between middle part of the Younger Dryas and early Preboreal (12.7–11.4 kyr BP). Raw material economy of the Swiderian communities is one of the most discussed issues. Researchers present a dynamic system based on local or semi local resources (provinces), on one hand, on the other – supplemented with extralocal materials. Chocolate flint, spread up to 700 km from its outcrops, was the most desired raw material. Long-distance circulation of raw materials supports the idea of great mobility in that period, as well as an existence of interregional exchange systems. This paper deals with new data brought to light by extensive rescue excavations carried out in the Kraków region in southern Poland. The most popular resource in the western part of Little Poland was a local Jurassic flint of high quality. A small number of extralocal raw materials were also recognized. The research objective was to analyze their role in lithic production and utilization amongst the local Swiderian communities. Special attention was paid to chocolate flint and radiolarite, for which comprehensive studies were undertaken. Analyzed artefacts were classified into groups following guidelines of "dynamic classification", which allowed us to investigate process of their use in lithic production. Our analysis showed that either finished products were manufactured elsewhere and subsequently were brought to the site or cores were exploited on site, while their initial preparation was carried out outside the site. This research was also carried out in respect to functional differentiation of the researched area which revealed some interrelation between spatial organization and use of extralocal raw materials. Relevant models were presented as an explanation of the results. Presented data displayed additional vectors of Swiderian migrations in the region.

KEY WORDS: Swiderian culture – Late Palaeolithic – Raw material economy – Chocolate flint – Radiolarite – Jurassic flint

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INTRODUCTION

Tanged Point Groups defined by Taute (1968) – TP Culture acc. Kozłowski (1999) or TP Technocomplex acc. Burdukiewicz (2011) – is the youngest cultural unit involved in process of resettling of North European Plains after ice sheet retreated in the Late Glacial. TPC was simultaneously to Arched-Backed Point (ABP) in western and central part of Europe (Weber *et al.* 2011) and other backed industries (i.e., Molodovian, Epigravettian) in Eastern Europe (Zaliznyak 1999), but it occupied more northern position reaching a northern periphery of Plains. In the early phase, dated to the end of Allerød and beginning of Younger Dryas, TPC is represented by Brommian in north Germany, Denmark, south Sweden, and Poland; but also similar units like Vilnius group in Lithuania and Valdai culture in Belorussia. After climatic change at the beginning of the Younger Dryas the ecumene shifted southwards. It resulted in significant cultural change and wide spread of TPC. Beside a vast area of North Plains and western part of East European Plains it reached Central European Highlands but also Carpathians and eastern part of Pontic Steppe. In the late phase, on a background of the older phase, new cultural units appeared. In western part of TPC range, between North See and Oder – Ahrensburgian, in central part, between Oder and upper Dniepr – Swiderian, and Desnenian – in eastern range of TPC. The late phase could have lasted to early Preboreal when it adapted to early Mesolithic economy or shifted northwards giving impulse for settling circumpolar area (Burdukiewicz 2011, Kozłowski 1999, Weber *et al.* 2011).

Significant cooling of the Younger Dryas brought harshness of climate and caused retreating of the Allerød forest. It stopped the ice sheet from diminishing and contributed to the extending of mountain glaciers (Mojski 1993). At the same time the process of dune formation commenced (Nowaczyk 1986). The period in question was also connected with the return of typical Pleistocene fauna, including its major representative – reindeer, which played an essential role in hunting economy (Bratlund 1996, Street, Baales 1999). Hunting escapades involved long-distance seasonal migration. Typical lithic inventory of TCP is marked by presence of diverse tanged points – Lynby points in the early phase and Ahrensburgian, Sviderian and Grensk point in the late phase – but also end-scrapers and burins. These were accompanied by bone harpoons and Lyngby axes (Kozłowski 1999). Settlement of the younger phase of TPC in its entire range is significantly denser in relation to former periods, which allow detailed regional studies.

Swiderian Culture occupied eastern part of Oder drainage basin but also Vistula, Neman, and Pripyat drainage basins. In the territories of Poland more than 1000 sites of Swiderian culture are known. They concentrate within the area of lowlands on dune sands, most frequently in the zone of the periglacial plains. Nevertheless, settlement centers were noted in the uplands as well, and few were discovered at the foothills and in the mountains even (Bárta 1980, Valde-Nowak, Łanczont 2008). In its development subsequent phases can be distinguished, all of which were recorded at stratified site on sand dunes in Całowanie (Schild *et al.* 1999a, b). The main typological element defining the Swiderian units is a willow leaf-shaped point (Swiderian tanged point). Apart from it, a typical assemblage comprises burins, endscrapers and retouched blades.

The major technological change at beginning of the Younger Dryas was almost completely rejecting of flake technique commonly used by azyloidal industries dated to the Allerød period. Flint processing technology of the Swiderian culture was typical to other industries of younger phase of TCP. It based mostly on exploitation of opposite platform blade cores with common flaking surface (Fiedorczuk 2006, Ginter 1974). More advanced flint processing technology required employing raw material of higher quality. It is clearly seen in the system of raw material acquisition which was basing on local or semi-local resources of good quality but presence of distant imports is noticed. A long range circulation of raw material was improved by ecological pattern of open landscape involving hunting escapades and long-distance seasonal migrations. This area of interest was discussed in several publications but it was conducted mostly from a perspective of other regional centers of Swiderian (Libera 1995, Sulgostowska 1989, Szymczak 1992) or from perspective of particular types of raw materials, first of all – chocolate flint (Schild 1975, 1976). Comprehensive view was proposed by Sulgostowska (2005, 2006). Chocolate flint was main raw material accompanying the Swiderian assemblages. It was extracted on a large scale in the foreground of the Holy Cross Mountains, in the centre of "Swiderian world" and it was reaching distant periphery of that world. Among other siliceous rocks exploited by the Swiderian communities were other encountered resources, which outcrops were situated both within the extent of the Swiderian culture and imported ones – located on the boundary or outside its territorial extent. The first group constituted of flints with a regional significance, only occasionally reported from distant areas. They are local or semilocal resources: cretaceous flint – collected from

outcrops located in the north-eastern Poland, Belarus, and Ukraine, so-called Baltic flint – an erratic one, commonly found in the moraines of the ice sheet extension during previous glacial periods, Świeciechów, Gościeradów and Jurassic flint. Other resources played only marginal role.

Surroundings of Kraków abound in Jurassic flint. It is encountered in both forms, directly within its bedrock, which in the neighborhood of Cracow is limestone of Jurassic age, as well as erratic flint. Its classification into variants was formulated by Kaczanowska, Kozłowski (1976). Beside few exceptions, an attempt to link certain variants with corresponding outcrops has failed, which hinders conducting research on a regional scale. In the area in question assemblages of the Swiderian culture are dominated by Jurassic flint which can be regarded as local resource as its outcrops were available elsewhere in the vicinity. Against this background, extralocal raw materials, understood as distant imports (more than 100 km), are well readable, though their number, except for few cases, does not exceed several percent of the inventory.

The aim of this paper is to present a detailed study of raw material economy as seen from perspective of the Jurassic flint province. Attention was paid to its general amount but also their technological properties and possible symbolic aspects. Amongst extralocal resources one can mention chocolate, erratic, and Świeciechów flints, radiolarite and obsidian, but research objectives of this paper are restricted exclusively to chocolate flint and radiolarite that meet conditions required for the present study case: possibility to indicate their outcrops (*Figure 1*) and relative quantity. Erratic flint was not included in the analysis since it is a heterogenic raw material of difficult to establish extraction spots and considerably high diversification of macroscopic features. Other materials were represented by few specimens only (Świeciechów flint, obsidian).

CHOCOLATE FLINT AND RADIOLARITE

Chocolate flint was recognized and primarily described by Krukowski (1920) as "wax-chocolate" flint. Ever since, it has become a subject of numerous archaeological and geological research initiated by the studies of Samsonowicz (1923). Its outcrops are located in the area of the north-eastern boundary of the Holy Cross Mountains, within a radial distance of 150 km from sites in Little Poland. It was quarried from limestone bedrock of Upper Jurassic age. Intense exploitation of this flint was carried out, among others, in Orońsk and Wierzbica (Krukowski 1939–1948, Sulgostowska 2005). It is characterized by excellent quality parameters and was extremely popular among the Late Palaeolithic communities having inhabited basin of the upper and middle Vistula River. Division of chocolate flints, proposed by Schild (1971), supplemented with precise location of their outcrops are still used for macroscopic identification of this material. The highest participation of this material in the Late Palaeolithic inventories is recorded at sites located up to 100 km from outcrops, where was a resource of choice but it is numerously represented in the distant Swiderian assemblages. Its distribution reached as far as to the territories of present Latvia, Lithuania, Belarus, and Ukraine (Sulgostowska 2005). Worth noticing is occurrence of chocolate flint in an erratic form, encountered in moraine sediments as well as fluvioglacial sands and gravels in the western part of the Sandomierz Basin (Wilczyński 2009).

Radiolarite was recognized in assemblages from the territories of Poland considerably late (Kowalski, Kozłowski 1959). Its outcrops are situated in the area of the Pieniny Klippen Belt (80–200 km) and the Transdanubian Mountains (350 km). Radiolarite is characterized by high diversification of color, which can be observed within a single concretion event.

FIGURE 1. Localization of Jurassic flint, chocolate flint, and radiolarite outcrops.

Distribution of the raw material in question in the Late Palaeolithic reached the Lowland, however, it did not get as far as to its northern areas. It is most numerously represented in inventories from surroundings of Kraków. Northernmost site of the Swiderian culture, the assemblage of which contained artefacts of radiolarite, is located in Ośnica near Płock (Sulgostowska 2005).

SWIDERIAN CULTURE IN THE WESTERN PART OF LITTLE POLAND

First materials of the Swiderian culture from the western part of Little Poland were collected by amateur archaeologists as early as in the second half of the 19th century. It was the time when a settlement complex of the culture in question in dune sands areas of Czernichów, Tyniec, Kobierzyn and, Borek Fałęcki was discovered (Dagnan-Ginter, Drobniewicz 1974). Investigated repeatedly, by means of field survey exclusively, it provided abundant yet selective collections of stone artefacts. Regular, thorough excavations conducted in the 60-ties of the 20th century did not reveal any new materials, except for the site in Zakrzów (Kowalski, Kozłowski 1959). Subsequent, methodically gathered assemblages appeared in the 90-ties, when numerous inventories of Zagacie (Pawłowska 2003) and Przeginia Narodowa were obtained. A great breakthrough in studies upon the culture in question was brought by rescue excavations carried out on the route of A4 motorway by The Cracow Team for Archaeological Supervision of Motorway Construction. Due to those an enormous settlement complex of this culture was discovered in the Wilga drainage basin – Kraków-Kurdwanów (Roczkalski, Włodarczak 2002a, b, c); in the Serafa drainage basin Kraków-Kosocice (Włodarczak 2002), Kraków-Rżąka (Kosik 2002, Przybyła, Stefański 2003) and on the southern, sandy slopes of the Sandomierz Basin – agglomeration of sites in Kraków-Bieżanów (Byrska *et al.* 2006), Kokotów and Zakrzów (*Figure 2*). Extralocal materials were widely recorded in older assemblages. However, due to the character of the materials, mostly collections, it is difficult to undertake more detailed analysis. This paper presents selected sites: Kraków-Bieżanów 8 and 14 (Stefański 2012a), Kraków-Bieżanów 11 (Wilczyński 2012a), Kraków-Bieżanów 15 (Stefański 2012b), Kraków-Bieżanów 20 (Klimek *et al.* 2012), Kraków-Bieżanów 30 (Wilczyński 2012b) for which a comprehensive raw material specification was conducted. Though facies differentiation of the Swiderian culture in Little Poland is still under discussion, beside most common "Mazovian" facies characterized by common occurrence of the Swiderian tanged points, the other ones, of different typological structure, were also recognized (Roczkalski, Włodarczak 2002c). The presented materials mostly represent the "Mazovian" facies, however, the other units could be pointed as well (Kraków-Bieżanów 15 – kshemenitsa 2 and 3).

MATERIAL AND METHOD

Total number of considered lithics with raw material attribution (burned ones were excluded) is 11,714. Only

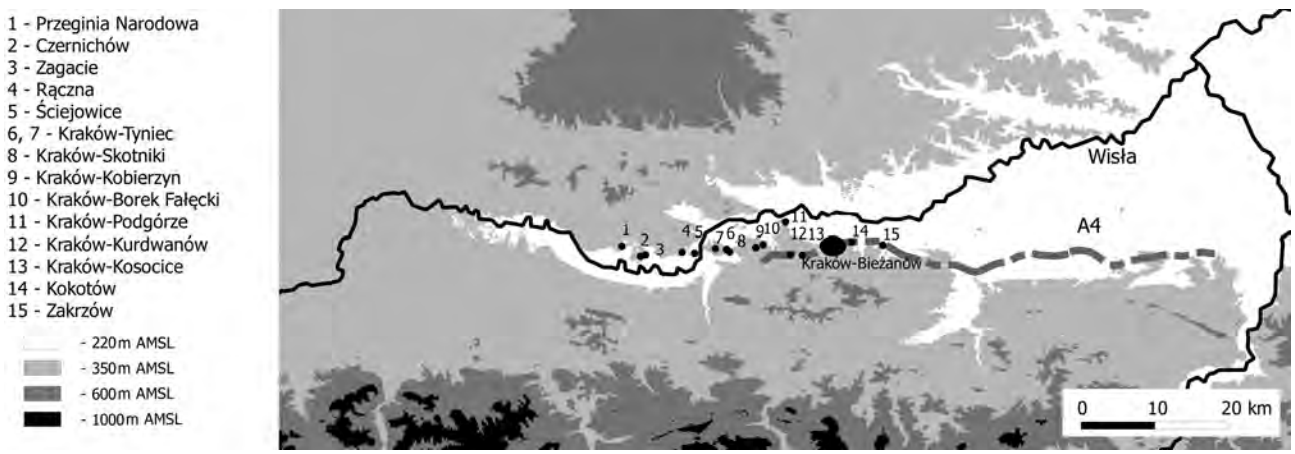

FIGURE 2. Localization of the main Swiderian sites in the western part of Little Poland.

TABLE 1. Contribution of particular categories of artefacts made of local Jurassic flint.

		Material					
		Local Jurassic flint		Chocolate flint		Radiolarite	
Spatial distribution units	Total[a]	*N*	%	*N*	%	*N*	%
Activity zones	515	412	80	67	13	28	5.4
Concentrations	248	180	72.6	12	4.8	53	21.4
Kshemenitsas	10,874	10,683	98.2	71	0.7	17	0.2
Total	11,637	11,275	96.9	150	1.3	98	0.8

[a] Total number of lithics with raw material attribution (burned ones were excluded).

150 were made on chocolate flint and 98 on radiolarite, 11,275 was on local Jurassic flint and the rest was made on other raw materials (*Table 1*). The first stage of performed analysis was a description and classification of stone artefacts into one of seven groups distinguished accordingly to the guidelines of "dynamic classification" proposed by Schild (1980). These groups comprise: cores, crested elements and tablets, blades, flakes and splinters, chips and chunks, tools and the last, tool production wastes (burin spalls and microburins). Application of "dynamic classification" enables functional characterization of assemblages and placing particular artefacts within the scheme of core flaking and tool manufacturing processes.

The second stage of the analysis was set on spatial observations concerning distinguished categories of stone artefacts over the certain sites. Widespread rescue excavations, randomly cut through the investigated area, provided brand new spatial distribution data. It confirms functional differentiation of the area exploited by the Swiderian community. Based on analysis conducted for a vast area of the settlement background, embracing several thousand square meters, following areas were distinguished:

– Kshemenitsas – spots of high density of stone artefacts, spread on tens of sq. metres, evidencing zones of camping where the flint processing activity took place (Kraków-Bieżanów 15 – kshemenitsas 1, 2, 3, Kraków-Bieżanów 20, Kraków-Bieżanów 30 – kshemenitsa III).
– Concentrations of stone artefacts – accumulations of flint materials counting up to several dozens of specimens, spread on tens of sq. metres (Kraków-Bieżanów 11, Kraków-Bieżanów 15 – concentrations 1, 2, Kraków-Bieżanów 30 – concentrations I, II).
– "Activity zone" of the Swiderian community – a vast area (thousands od sq. meters) of low density of stone artefacts (Kraków-Bieżanów 8 and 14, 11, 15, 20, 30).

Both activity zone and material concentrations were characterized by a significant occurrence of finished products in a form of tools and blades, as well as less numerous flakes and other elements, being residues of the flaking process. This structure does not seem accidental, having emerged due to destruction of the site or as a result of material selection.

RESULTS

Results of the analysis are presented in tables. Artefacts of chocolate flint (*Table 2*) and radiolarite (*Table 3*) were displayed against a background of specimens made of local Jurassic flint (*Table 4*). The outcome of above-mentioned ones is placed in table (*Table 5*), which should be considered as a simplified interpretation of obtained data. Another table presents raw material structure for groups of typological tools (*Table 6*).

Extralocal raw materials in analyzed assemblages contribute 2.1% of total number of stone artefacts (1.2% for chocolate flint and 0.8% for radiolarite; *Table 1*). Considerably frequent occurrence of extralocal raw materials in both, activity zone of the Swiderian culture (participation of chocolate flint reached an average rate of ca. 13%, the rate of radiolarite was 5.4%); as well as concentration (an average rate of 4.8% for chocolate flint and up to 21.4% of radiolarite) is quite common. However, taking into account kshemenitsas the situation looks differently. They were usually large accumulations of stone materials, having emerged due to intense flaking processes. Therefore, they contained a great number of tiny waste products. Participation of both above-mentioned raw materials is minimal – an average rate of 0.7% for chocolate flint and 0.2% for radiolarite. It is worth underlining that these raw materials occurred significantly less frequently, even if we compare an absolute number of finished products made of them.

TABLE 2. Contribution of particular categories of artefacts made of extralocal chocolate flint.

		Category of artifact made of chocolate flint															
		Total		Cores		Crested blades, tablets		Blades		Flakes, splinters		Chipas, chunks		Tools		Burin spalls, microburins	
Spatial distribution units	Total[a]	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
		Percentage of particular categories of artefacts in relation to total amount of lithics in units															
Kraków-Bieżanów 8, 14																	
Activity zone	46	11	23.9	1	2.2	4	8.7	2	4.3	1	2.2			3	6.5		
Kraków-Bieżanów 11																	
Activity zone	77	11	14.3			1	1.3	6	7.8					4	5.2		
Concentration I	44	1	2.3					1	2.3								
Concentration II	79																
Kshemenitsa III	1116																
Kraków-Bieżanów 15																	
Activity zone – western sector	122	23	18.9			2	1.6	9	7.4	4	3.3			8	6.6		
Activity zone – central sector	24	4	16.7					2	8.3					2	8.3		
Activity zone – eastern sector	163	11	6.7	3	1.8	2	1.2	2	1.2	2	1.2			2	1.2		
Concentration 1	37	7	18.9			1	2.7	3	8.1	1	2.7			2	5.4		
Concentration 2	44	3	6.8			1	2.3			1	2.3	1	2.3				
Kshemenitsa 1	648	9	1.4			2	0.3	5	0.8	2	0.3						
Kshemenitsa 2	632	47	7.4			2	0.3	22	3.5	17	2.7	5	0.8	1	0.2		
Kshemenitsa 3	1888	13	0.7			3	0.2	5	0.3	1	0.1	3	0.2	1	0.1		
Kraków-Bieżanów 20																	
Activity zone	50	7	14.0					3	6.0					4	8.0		
Kshemenitsa	6590	2	0.0									1	0.0	1	0.0		
Kraków-Bieżanów 30																	
Activity zone	33																
Concentration	44	1	2.3	1	2.3												
Total	11,637																
		Percentage of particular categories of lithics in relation to total amount of artefacts made of chocolate flint															
		150	100.0	5	3.3	18	12.0	60	40.0	29	19.3	10	6.7	28	18.7	0	0.0

[a] Total number of lithics with raw material attribution (burned ones were excluded).

TABLE 3. Contribution of particular categories of artefacts made of extralocal radiolarite.

		Category of artifact made of radiolarite															
		Total		Cores		Crested blades, tablets		Blades		Flakes, splinters		Chipas, chunks		Tools		Burin spalls, microburins	
Spatial distribution units	Total[a]	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
		Percentage of particular categories of artefacts in relation to total amount of lithics in units															
Kraków-Bieżanów 8, 14																	
Activity zone	46	6	13.0					2	4.4					4	8.7		
Kraków-Bieżanów 11																	
Activity zone	77	6	7.8	1	1.3			5	6.5								
Concentration I	44	23	52.3			2	4.5	13	29.6	7	15.9	1	2.3				
Concentration II	79																
Kshemenitsa III	1116	1	0.1					1	0.1								
Kraków-Bieżanów 15																	
Activity zone – western sector	122	7	5.7					5	4.1					2	1.6		
Activity zone – central sector	24	3	12.5					2	8.3					1	4.2		
Activity zone – eastern sector	163	1	0.6											1	0.6		
Concentration 1	37	1	2.7					1	2.7								
Concentration 2	44	29	65.9			4	9.1	15	34.1	1	2.3			6	13.6	3	6.8
Kshemenitsa 1	648	10	1.5			1	0.2	3	0.5	3	0.5	2	0.3	1	0.2		
Kshemenitsa 2	632	1	0.2			1	0.2										
Kshemenitsa 3	1888	3	0.2			1	0.1	1	0.1					1	0.1		
Kraków-Bieżanów 20																	
Activity zone	50	2	4.0					1	2.0					1	2.0		
Kshemenitsa	6590	2	0.0			2	0.0										
Kraków-Bieżanów 30																	
Activity zone	33	3	9.1					1	3.0					2	6.1		
Concentration	44																
Total	11,637																
		Percentage of particular categories of lithics in relation to total amount of artefacts made of radiolarite															
		98	100	1	1	11	11.2	50	51.0	11	11.2	3	3.1	19	19.4	3	3.1

[a] Total number of lithics with raw material attribution (burned ones were excluded).

TABLE 4. Contribution of particular categories of tools in respect of the raw material.

		Category of artifact made of local Jurassic flint															
		Total		Cores		Crested blades, tablets		Blades		Flakes, splinters		Chipas, chunks		Tools		Burin spalls, microburins	
Spatial distribution units	Total[a]	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
		Percentage of particular categories of artefacts in relation to total amount of lithics in units															
Kraków-Bieżanów 8, 14																	
Activity zone	46	28	60.9			4	8.7	10	21.7	3	6.5			11	23.9		
Kraków-Bieżanów 11																	
Activity zone	77	60	77.9	8	10.4	12	15.6	21	27.3	2	2.6	1	1.3	15	19.5	1	1.3
Concentration I	44	20	45.5					14	31.8	2	4.6			4	9.1		
Concentration II	79	79	100.0	1	1.3	12	15.2	20	25.3	20	25.3	26	32.9				
Kshemenitsa III	1116	1115	99.9	8	0.7	36	3.2	336	30.1	121	10.9	608	54.5	6	0.5		
Kraków-Bieżanów 15																	
Activity zone – western sector	122	90	73.8	3	2.5	9	7.4	29	23.8	14	11.5	1	0.8	34	27.9		
Activity zone – central sector	24	16	66.7	2	8.3	2	8.3	7	29.2					5	20.8		
Activity zone – eastern sector	163	149	91.4	10	6.1	14	8.6	37	22.7	50	30.7	22	13.5	15	9.2	1	0.6
Concentration 1	37	28	75.7			2	5.4	15	40.5	2	5.4			9	24.3		
Concentration 2	44	10	22.7	1	2.3			2	4.5	4	9.1			3	6.8		
Kshemenitsa 1	648	624	96.3	7	1.1	62	9.6	155	23.9	98	15.1	230	35.5	54	8.3	18	2.8
Kshemenitsa 2	632	535	84.7	10	1.6	56	8.9	111	17.6	162	25.6	186	29.4	9	1.4	1	0.2
Kshemenitsa 3	1888	1847	97.8	26	1.4	184	9.7	410	21.7	510	27.0	684	36.2	24	1.3	9	0.5
Kraków-Bieżanów 20																	
Activity zone	50	39	78.0	2	4.0	11	22.0	16	32.0	1	2.0			9	18.0		
Kshemenitsa	6590	6562	99.6	41	0.6	344	5.2	1373	20.8	803	12.2	3936	59.7	29	0.4	36	0.5
Kraków-Bieżanów 30																	
Activity zone	33	30	90.9	2	6.1	1	3.0	10	30.3					17	51.5		
Concentration	44	43	94.7	3	6.8	3	6.8	20	45.5	15	34.1			2	4.5		
Total	11,637																
		Percentage of particular categories of lithics in relation to total amount of artefacts made of local Jurassic flint															
		11,275	100	124	1.1	752	6.7	2586	22.9	1807	16.0	5694	50.5	246	2.2	66	0.6

[a] Total number of lithics with raw material attribution (burned ones were excluded).

TABLE 5. Particular models of raw material economy.

Spatial distribution units	Local Jurassic flint			Chocolate flint			Radiolarite		
	Finished products	Exploitation of prepared cores	Complete flint processing	Finished products	Exploitation of prepared cores	Complete flint processing	Finished products	Exploitation of prepared cores	Complete flint processing
Kraków-Bieżanów 8, 14									
Activity zone	×			×	×		×		
Kraków-Bieżanów 11									
Activity zone	×	×		×			×	×	
Concentration I	×			×			×	×	
Concentration II	×	×	×						
Kshemenitsa III	×	×					×		
Kraków-Bieżanów 15									
Activity zone – western sector	×	×		×			×		
Activity zone – central sector	×	×		×			×		
Activity zone – eastern sector	×	×	×	×	×	×	×		
Concentration 1									
Concentration 2	×	×		×	×		×		
Kshemenitsa 1									
Kshemenitsa 2	×	×	×	×	×		×		
Kshemenitsa 3	×	×	×	×	×		×		
Kraków-Bieżanów 20									
Activity zone	×	×		×			×		
Kshemenitsa	×	×	×	×			×		
Kraków-Bieżanów 30									
Activity zone	×	×			×				
Concentration	×	×						×	

Stone assemblages presented herein, in respect of the structure of particular classification groups (*Tables 2–4*), were ascribed to three generalized models of lithic artefacts manufacture process and distribution. The first one assumes bringing finished products, manufactured elsewhere, to the site. They were brought in a form of blanks or tools. The second model presumes exploitation of cores, an initial preparation of which was carried out outside the site – it is evidenced by an occurrence of cores, characteristic exploitation products, and significant predominance of blades over flakes and scarce amount of waste material. The last one assumes performance of complete flint processing, including both, initial preparation as well as exploitation of cores. This model involves occurrence of cores, characteristic core processing products, predominance of flakes over blades and a large amount of waste material. In most cases co-occurrence of certain models within a single assemblage was assumed. The obtained outcome is presented in *Table 5*.

Both chocolate flint as well as radiolarite was important for manufacture of typological tools (*Table 6*). On average, ca. 15% of all specimens in question were made of them. Considering tanged points exclusively, the rate reaches up to ca. 25% (ca. 15% for chocolate flint ca. and 10% for radiolarite). In the case of other tool types participation of extralocal raw materials readably decreases. Among end-scrapers, merely ca. 12% of all specimens were made of the raw materials in question (ca. 9% of chocolate flint and ca. 3% of radiolarite). It is similar in the case of burins, where only 10% of all specimens were made of chocolate flint or radiolarite (rate of both raw materials is ca. 5%). Taking into account participation of particular tool types among specimens made exclusively of chocolate flint (28 pcs), tanged points significantly prevail (14 pcs; *Figure 3*), contributing 50% of the entire tool inventory. Even greater rate of tanged points in the tool inventory is observed within the group of artefacts made of radiolarite, where they contribute 70% of the entire set (*Figure 4:2–5*).

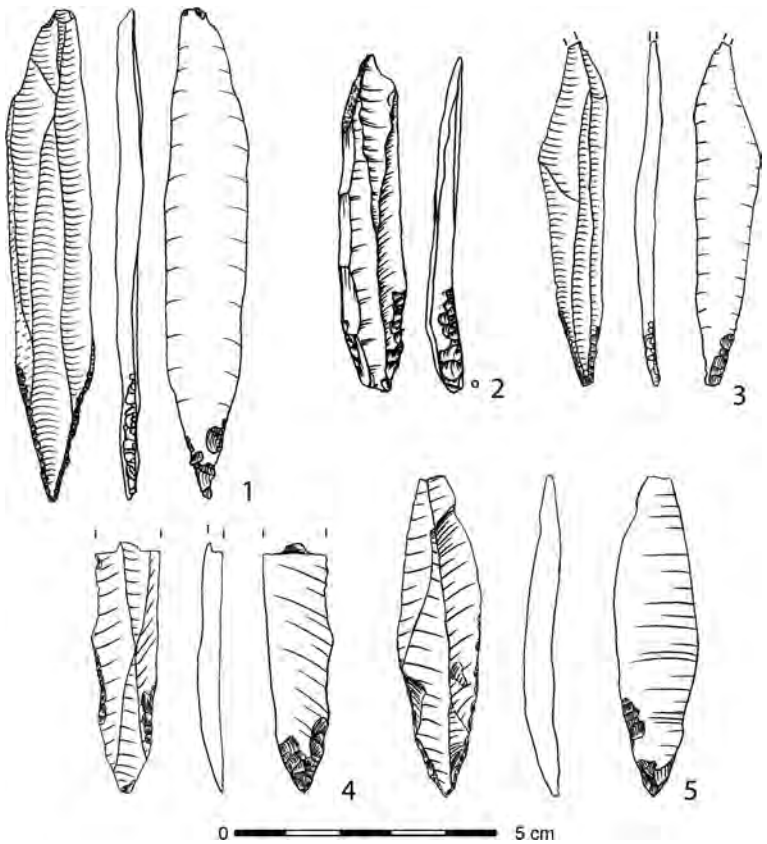

FIGURE 3. Artefacts made of chocolate flints – tanged points (1, 3–5, Kraków-Bieżanów 15; 2, Kraków-Bieżanów 8 and 14).

DISCUSSION

In most of investigated assemblages artefacts made of chocolate flint were brought to the site in a form of finished products or obtained in a process of exploitation of cores, initially prepared elsewhere. Although no thorough studies over differentiation of chocolate flint were carried out, it can be stated that in the inventory in question variants of light brown color extracted in the region of Tomaszów and of dark brown color quarried in the surroundings of Polany-Zele were dominating (Schild 1971). This raw material was most surely distributed along the Vistula valley, via an important communication route having linked the Swiderian settlements altogether. This model seems hardly applicable to kshemenitsa 2 encountered at site 15 in Kraków-Bieżanów. In spite of lack of cores, both a total number as well as the structure of chocolate flint artefacts indicate an intense exploitation of the raw material in question. Traces of complete chocolate flint processing were also recorded in the activity zone, surrounding the kshemenitsa, in the eastern sector of the site. A precore discovered there, having readable features of an erratic flint, may evidence local acquisition of chocolate flint from secondary deposits. Due to this fact, it should be assumed that a part of artefacts could have been made of raw material collected in relatively close neighborhood (ca. 20 km). Scale of the phenomenon in question is difficult to establish. It seems that in the scale of the entire inventory flint coming directly from outcrops located in the foreground of the Holy Cross Mountains dominates, which is confirmed by both, preferences in selection variants of this raw material, as well as relatively large parameters of blanks and tools made of it. It cannot be excluded whether the management of chocolate flint in the territory in question was different for particular facies of the Swiderian culture. Classical "Mazovian" assemblages employed mostly chocolate flint extracted directly from its outcrops. Whereas, facies represented by an inventory of

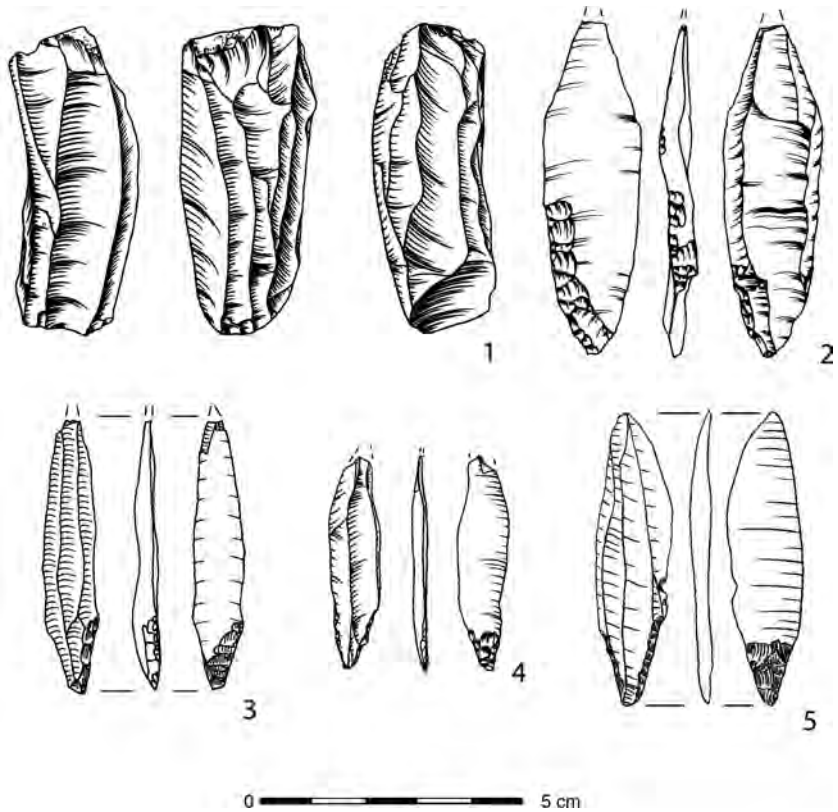

FIGURE 4. Artefacts made of radiolarite – core (1), tanged points (2–5) (1, Kraków-Bieżanów 11; 2, Kraków-Bieżanów 8 and 14; 3, 5, Kraków-Bieżanów 15; 4, Kraków-Bieżanów 30).

TABLE. 6. Contribution of particular categories of tools in respect of the raw material.

	Tanged points			Endscrapers			Burins			Retouched blades			Other tools		
	Jurassic flint	Chocolate flint	Radiolarite	Jurassic flint	Chocolate flint	Radiolarite	Jurassic flint	Chocolate flint	Radiolarite	Jurassic flint	Chocolate flint	Radiolarite	Jurassic flint	Chocolate flint	Radiolarite
Kraków-Bieżanów 8, 14															
Activity zone	5	1	2				3	1		3		2		1	
Kraków-Bieżanów 11															
Activity zone	9	2		1	1		7			1			1	1	
Concentration I							2						2		
Concentration II															
Kshemenitsa III				3			1						2		
Kraków-Bieżanów 15															
Activity zone – western sector	9	3		16	2		4	1	2	4	1		1	1	
Activity zone – central sector	4	2	1				1								
Activity zone – eastern sector	5	2	1	4			2			3			1		
Concentration 1	1			3	2		2			2			1		
Concentration 2			4			1	2		1	1					
Kshemenitsa 1	13			12		1	10			15			4		
Kshemenitsa 2				1			1			1	1		5		
Kshemenitsa 3		1	1	10			6			3			5		
Kraków-Bieżanów 20															
Activity zone	5	2	1	2	1			1		2					
Kshemenitsa	6	1		2			14			4			3		
Kraków-Bieżanów 30															
Activity zone	15			2			4						3		
Concentration			2												
Total	72	14	10	56	6	2	57	3	3	39	2	2	26	3	0
		96			64			63			43			29	
%	75.0	14.6	10.4	87.5	9.4	3.1	90.5	4.8	4.8	90.7	4.7	4.7	89.7	10.3	0.0
		100.0			100.0			100.0			100.0			100.0	

kshemenitsa 2 would have utilized, partly at least, secondary deposits of this raw material. Similar situation is reported at site 10 in Kraków-Kurdwanów where the "non-Mazovian" unit exploited the local sources (Roczkalski, Włodarczak 2002c).

Radiolarite occurred almost exclusively in a form of finished products, merely in few, exceptional cases traces of exploitation of radiolarite cores, prepared elsewhere, were recorded. The most frequently represented is radiolarite of red or liver-like color. Green radiolarite was recorded exceptionally whereas grey variants are not encountered. Radiolarite was most likely imported from the area of the Pieniny Klippen Belt, which is confirmed by macroscopic observations. Nevertheless, exact spots of its extraction cannot be established. Assumed radial distance from its deposits may vary from ca. 80 km, to the closest outcrops in the Pieniny Mountains, to 200 km, to its outcrops in western Slovakia. Yet, it should be underlined that routes of escapades launched for acquiring this raw material lead through the mountain region. At this point, two exceptional assemblages, nearly half of the inventory of which was made of radiolarite, should be quoted – concentration 2 at site 15 and concentration I at site 11, both in Kraków-Bieżanów. In the first case the assemblage was brought to the site in a form of finished tools, intensely utilized, which is evidenced by an occurrence of a few radiolarite burin spalls. In the other case traces of exploitation of radiolarite cores, initially prepared elsewhere, were encountered. Both inventories should be indisputably considered as a record of a human group swiftly moving between the Carpathian region and the Vistula valley. From the entire territory discussed herein merely one core made of this raw material is known (*Figure 4:1*). An interest in radiolarite is documented by identification of this raw material in inventories obtained from other sites of the Swiderian culture in Little Poland. The most abundant assemblage containing radiolarite artefacts is known from the site in Zakrzów, com. Niepołomice, where this raw material constitutes 1.7% in the inventories gathered during research carried out by Kowalski (Drobniewicz 1970, Kowalski, Kozłowski 1959, Sulgostowska 2005). Due to the latest research conducted at the site in question by The Cracow Team for Archaeological Supervision of Motorway Construction new data has emerged, according to which merely 0.7% of the inventory was made of radiolarite (excluding chips), yet, as many as 12% of typological tools ascribed to the Swiderian culture was made of this raw material (Klimek, Peschel 2009).

Both rocks discussed document raw material circulation routes among the Swiderian communities. Obtained data has brought some light onto the ways of provisioning with these important raw materials. One of the most intriguing issues in this matter is a significant discrepancy in terms of intensity of their utilization, recorded in smaller accumulations (activity zones, concentrations) and kshemenitsas. Various possibilities may be taken into consideration:

– Region of Kraków-Bieżanów was an attractive hunting territory, where seasonal aggregation of the Swiderian communities took place – apart from local populations newcomers with extralocal raw materials at their disposal appeared (chocolate flint from the north, radiolarite from the south); residues of their visit have been preserved in a form of activity zones and concentrations. Kshemenitsas are relics of local units camping episodes, raw material economy of which was based on local material, whereas, extralocal rocks were obtained as a result of an exchange.
– Circulation of the very same human groups between the Vistula valley and the Carpathian region. Those migrations, most likely of seasonal character, forced with e.g., prey availability, determined dynamics of the raw material management. Dispersion of stone artefacts would indicate direction of the migration (chocolate flint from the north, radiolarite from the south). Activity zones and concentrations, characterized by an occurrence of finished products, would have emerged due to exhaustion of raw material supplies. Whereas, kshemenitsas could have been relics of seasonal camps where raw material supplies would have been supplemented with specimens made of local Jurassic flint.

As it was mentioned above, both, chocolate flint as well as radiolarite, were particularly important for manufacturing blades and tools. It seems that their importance was due to both aspects, technological, i.e., incredibly high chipping properties of chocolate flint, as well as symbolic – characteristic color of radiolarite. Technological properties of chocolate flint are readable in parameters of specimens made of it, significantly larger in comparison to artefacts of both, Jurassic flint and radiolarite. In case of tanged points from site 15 in Kraków-Bieżanów, a half of ten largest specimens was made of chocolate flint, the biggest one was 94 mm long (*Figure 3:1*). Moreover, an average preserved length of blades made of chocolate flint at this site is by ca. 20% greater than corresponding average length counted for Jurassic flint and radiolarite. Popularity of radiolarite among the Swiderian communities was due to attractiveness of distinct color of this raw material

(Sulgostowska 2005), rather than technological properties. Radiolarite of red color, most likely of certain symbolical value, was a subject of exceptional interest; it was frequently employed for tanged points manufacturing.

CONCLUSIONS

The analyses presented in the paper clearly demonstrate that extralocal raw materials, notwithstanding exceptional cases, were not a substantial supply for local societies. This is reasonable if we consider an abundance of local material. Spatial analysis shows complex arrangements of extralocal raw materials (kshemenitsas vs. concentrations and "activity zones") subject to some rules, which surely reflects commonplace behavior. The interpretation of that cannot be explicit so equivalent models were proposed. Chocolate flint was recognized as important from technological point of view what is proved by significant differences in dimensions of blanks and tools made of it. Radiolarite was a resource of choice, mainly for tanged points production. It attracted attention with his red color, unusual amongst the other Swiderian resources which could have reflected some symbolic behavior. Both chocolate flints and radiolarite indicate vectors of Swiderian migrations. It followed Vistula River up to Kraków then turned into short Transcarpathian route. Exceptional concentrations of radiolarite artefacts shows clearly fast Transcarpathian movement of Swiderian groups into centers around Kraków and it leads to a hypothesis that area in question could have served as a centre for further distribution of radiolarite.

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REFERENCES

BÁRTA J., 1980: Velky Slavkov – die Swiderien-Siedlung in der Slowakei. *Acta Archaeologica Carpathica* 20: 5–15.

BRATLUND B., 1996: Hunting strategies in the Late Glacial of northern Europe: a survey of the faunal evidence. *Journal of World Prehistory* 10, 1: 1–48.

BURDUKIEWICZ J. M., 2011: Late Glacial hunter-gatherer reactions to the Younger Dryas cooling event in the southern and eastern Baltic regions of Europe. *Quaternary International* 242, 2: 302–312.

BYRSKA M., FRAŚ J., MATOGA A., PIERÓG I., PRZYBYŁA M. M., STEFAŃSKI D., 2006: Wstępne wyniki ratowniczych badań archeologicznych na wielokulturowych stanowiskach 8, 11, 12, 14, 15 oraz 20 w Krakowie-Bieżanowie, woj. małopolskie. In: Z. Bukowski, M. Gierlach (Eds.): *Raport 2003–2004. Wstępne wyniki konserwatorskich badań archeologicznych w strefie budowy autostrad w Polsce za lata 2003–2004*. Pp. 523–527. Zeszyty Ośrodka Ochrony Dziedzictwa Archeologicznego (d. Zeszyty ORBA). Seria B: Materiały Archeologiczne, Warszawa.

DAGNAN-GINTER A., DROBNIEWICZ B., 1974: Przyczynki do znajomości osadnictwa schyłkowopaleolitycznego i mezolitycznego w okolicach Krakowa. *Materiały Archeologiczne* 15: 5–39.

DROBNIEWICZ B., 1970. *Materiały schyłkowopaleolityczne i mezolityczne z Zakrzowa pow. Kraków.* MA thesis. Institute of Archaeology Jagiellonian University, Kraków.

FIEDORCZUK J., 2006: *Final Paleolithic camp organization as seen from the perspective of lithic artifacts refitting*. Instytut Archeologii i Etnologii Polskiej Akademii Nauk, Warszawa.

GINTER B., 1974: Wydobywanie, przetwórstwo i dystrybucja surowców krzemiennych w schyłkowym paleolicie północnej części Europy środkowej. *Przegląd Archeologiczny* 22: 5–122.

KACZANOWSKA M., KOZŁOWSKI J. K., 1976: Studia nad surowcami krzemiennyni południowej części Wyżyny Krakowsko-Częstochowskiej. *Acta Archaeologica Carpathica* 16: 201–215.

KLIMEK A., PESCHEL K., 2009: Materiały krzemienne ze stanowiska Zakrzów 1, pow. wielicki. Opracowanie. In: M. M. Przybyła (Ed.): *Zakrzów pow. wielicki, st. 1 (nr autostradowy 114).* Report in the archive of The National Heritage Board of Poland.

KLIMEK A., STEFAŃSKI D., ZAJĄC M., 2012: Materiały krzemienne i kamienne ze stanowiska 20 w Krakowie-Bieżanowie (tom V). In: A. Matoga (Ed.): *Kraków-Bieżanów, stan. 20. Opracowanie wyników wyników badań.* Report in the archive of The National Heritage Board of Poland.

KOSIK A., 2002: Materiały krzemienne ze stanowiska 27 w Krakowie-Bieżanowie oraz ze stanowiska 1 w Krakowie-Rżące. In: P. Włodarczak (Ed.): *Południowe obejście Krakowa. Materiały z epoki kamienia i z wczesnego okresu epoki brązu*. Pp. 215–248. Krakowski Zespół do Badań Autostrad, Kraków.

KOWALSKI S., KOZŁOWSKI J. K., 1959: O użytkowaniu jaspisu w epipaleolicie Polski południowej. *Materiały Archeologiczne* 1: 7–12.

KOZŁOWSKI S. K., 1999: Tanged Points Complex. In: S. K. Kozłowski, J. Gurba, L. Zaliznyak (Eds.): *Tanged Points Cultures in Europe*. Pp. 28–35. Wydawnictwo UMCS, Lublin.

KRUKOWSKI S., 1920: Pierwociny krzemieniarskie górnictwa, transportu i handlu w holocenie Polski. Wnioski z właściwości surowców. *Wiadomości Archeologiczne* 5: 185–206.

KRUKOWSKI S., 1939–1948: Paleolit. In: S. Krukowski, J. Kostrzewski, R. Jakimowicz (Eds.): *Prehistoria Ziem Polskich*. Polska Akademia Umiejętności, Kraków.

LIBERA J., 1995: *Późny paleolit i mezolit środkowowschodniej Polski. Część pierwsza. Analiza*. Wydawnictwo UMCS, Lublin.

MOJSKI J. E., 1993: *Europa w plejstocenie. Ewolucja środowiska przyrodniczego*. Polska Agencja Ekologiczna, Warszawa.

NOWACZYK B., 1986: *Wiek wydm, ich cechy granulometryczne i strukturalne a schemat cyrkulacji atmosferycznej w Polsce w póznym Vistulianie i Holocenie*. Uniwersytet im. Adama Mickiewicza, Poznań.

PAWŁOWSKA M., 2003: Schyłkowopaleolityczna pracownia wiórów na stanowisku 2 w Zagaciu, gm. Czernichów. *Materiały Archeologiczne* 34.

PRZYBYŁA M. M., STEFAŃSKI D., 2003: Zabytki krzemienne ze stanowiska 27 w Krakowie-Bieżanowie i stanowiska 1 w Krakowie-Rżące In: S. Kadrow (Ed.): *Kraków-Bieżanów, stanowisko 27 i Kraków-Rżąka, stanowisko 1. Osada kultury łużyckiej*. Pp. 31–52. Kraków.

ROCZKALSKI B., WŁODARCZAK P., 2002a: Materiały z epoki kamienia odkryte na stanowisku 9 w Krakowie-Kurdwanowie In: P. Włodarczak (Ed.): *Południowe obejście Krakowa. Materiały z epoki kamienia i z wczesnego okresu epoki brązu*. Pp. 165–198. Krakowski Zespół do Badań Autostrad, Kraków.

ROCZKALSKI B., WŁODARCZAK P., 2002b: Materiały z epoki kamienia oraz z wczesnego okresu epoki brązu, odkryte na stanowisku 11 w Krakowie-Kurdwanowie. In: P. Włodarczak (Ed.): *Południowe obejście Krakowa. Materiały z epoki kamienia i z wczesnego okresu epoki brązu*. Pp. 127–164. Krakowski Zespół do Badań Autostrad, Kraków.

ROCZKALSKI B., WŁODARCZAK P., 2002c: Obozowisko późnopaleolityczne w Krakowie-Kurdwanowie (stanowisko 10) In: P. Włodarczak (Ed.): *Południowe obejście Krakowa. Materiały z epoki kamienia i z wczesnego okresu epoki brązu*. Pp. 11–104. Krakowski Zespół do Badań Autostrad, Kraków.

SAMSONOWICZ J., 1923: O złożach krzemieni w utworach jurajskich północno-wschodniego zbocza Gór Świętokrzyskich. *Wiadomości Archeologiczne* 8: 17–24.

SCHILD R., 1971: Lokalizacja prahistorycznych punktów eksploatacji krzemienia czekoladowego na północno-wschodnim obrzeżeniu Gór Świętokrzyskich. *Folia Quaternaria* 39: 1–61.

SCHILD R., 1975: Późny paleolit. In: W. Chmielewski, W. Hensel (Eds.): *Prahistoria ziem polskich. Paleolit i mezolit*. Pp. 159–338. Ossolineum.

SCHILD R., 1976: Flint mining and trade in Polish prehistory as seen from the perspective of the chocolate flint of Central Europe. A second approach. *Acta Archaeologica Carpathica* 16: 147–177.

SCHILD R., 1980: Introduction to dynamic technological analysis of chipped stone assemblages. In: R. Schild (Ed.): *Unconventional archaeology. New approaches and goals in Polish archaeology*. Pp. 57–85. Ossolineum, Wrocław-Warszawa-Kraków-Gdańsk.

SCHILD R., PAZDUR M. F., VOGEL J. C., 1999a: Radiochronology of the tanged point technokomplex in Poland. In: S. K. Kozłowski, J. Gurba, L. Zaliznyak (Eds.): *Tanged points cultures in Europe.* Pp. 13–15. Wydawnictwo UMCS, Lublin.

SCHILD R., TOBOLSKI K., KUBIAK-MARTENS L., PAZDUR M. F., PAZDUR A., VOGEL J. C., STAFFORD J., T.W., 1999b: Stratigraphy, palaeocology and radiochronology of the site of Całowanie. In: M. Kobusiewicz, J. K. Kozłowski (Eds.): *Post-Pleniglacial re-colonisation of the Great European Lowland. Folia Quaternaria.* Pp. 239–268. Polska Akademia Umiejętności, Kraków.

STEFAŃSKI D., 2012a: IV. Materiały krzemienne ze stanowiska 8 w Krakowie-Bieżanowie (wraz z włączonym stanowiskiem 14 w Krakowie-Bieżanowie (tom II). In: I. Wójcik (Ed.): *Wielokulturowa osada w Krakowie-Bieżanowie stanowisko 8 (wraz z właczonym stanowiskiem 14 w Krakowie-Bieżanowie), powiat krakowski (nr na autostradzie 97 i 98) Kraków-Bieżanów, stanowisko 15 (nr autostradowy 99, 101 i 209)*. Report in the archive of The National Heritage Board of Poland.

STEFAŃSKI D., 2012b: Materiały krzemienne ze stanowiska 15 w Krakowie-Bieżanowie (tom VII). In: M. M. Przybyła (Ed.): *Kraków-Bieżanów, stanowisko 15 (nr autostradowy 99, 101 i 209).* Report in the archive of The National Heritage Board of Poland.

STREET M., BAALES M., 1999: Pleistocene/Holocene changes in the Rhineland fauna in a northwest European context. In: N. Benecke (Ed.): *The Holocene history of the European vertebrate fauna. Workshop, 6th to 9th April 1998, Berlin*. Pp. 9–38. Verlag Marie Leidorf, Rahden.

SULGOSTOWSKA Z., 1989: *Prahistoria międzyrzecza Wisły, Niemna i Dniestru u schyłku pjejstocenu*. Państwowe Wydawnictwo Naukowe, Warszawa.

SULGOSTOWSKA Z., 2005: *Kontakty spolecznosci póznopaleolitycznych i mezolitycznych miedzy Odra, Dzwina i Górnym Dniestrem. Studium dystrybucji wytworów ze skal krzemionkowych*. Instytut Archeologii i Etnologii Polskiej Akademii Nauk, Warszawa.

SULGOSTOWSKA Z., 2006: Final Palaeolithic societies' mobility in Poland as seen from the distribution of flints. *Archaeologia Baltica* 7: 36–42.

SZYMCZAK K., 1992: *Północno-wschodnia prowincja surowcowa kultury świderskiej*. Wydawnictwo Uniwersytetu Łódzkiego, Łódź.

TAUTE W., 1968: *Die Stielspitzen-Gruppen im nördlichen Mitteleuropa. Ein Beitragzur Kenntnis der späten Altsteinzeit*. Böhlau, Köln.

VALDE-NOWAK P., ŁANCZONT M., 2008: Late Palaeolithic dwellings from Skawa Gorge in the Beskidy Mts. (Polish Carpathians). In: Z. Sulgostowska, A. J. Tomaszewski (Eds.): *Man-Millennia-Environment. Studies in honour of Romuald Schild*. Pp. 215–223. Instytut Archeologii i Etnologii Polskiej Akademii Nauk, Warsaw.

WEBER M.-J., GRIMM S. B., BAALES M., 2011: Between warm and cold: Impact of the Younger Dryas on human behavior in Central Europe. *Quaternary International* 242, 2: 277–301.

WILCZYŃSKI J., 2009: Targowisko – a new Late Glacial site in southern Poland. *Eurasian Prehistory* 6: 95–118.

WILCZYŃSKI J., 2012a: Materiały krzemienne (tom I). In: M. Mazur (Ed.): *Wyniki ratowniczych badań wykopaliskowych na stanowisku 11 i 12 w Krakowie-Bieżanowie (nr autostradowy 104, 105), Opracowanie materiałów.* Report in the archive of The National Heritage Board of Poland.

WILCZYŃSKI J., 2012b: Materiały krzemienne oraz kamienne z wielokulturowego stanowiska Kraków-Bieżanów 30, pow. Krakowski (tom II). In: B. Grabowska, B. Konieczny (Eds.): *Opracowanie materiałów archeologicznych z ratowniczych badań wykopaliskowych na stanowisku Kraków-Bieżanów 30, gm. Kraków, woj. małopolskie, Kraków.* Report in the archive of The National Heritage Board of Poland.

WŁODARCZAK P., 2002: Materiały z epoki kamienia oraz wczesnego okresu epoki brązu, odkryte podczas badań ratowniczych na trasie autostrady A4, prowadzonych na południowych rubieżach Krakowa. In: P. Włodarczak (Ed.): *Południowe obejście Krakowa. Materiały z epoki kamienia i z wczesnego okresu epoki brązu*. Pp. 1–10. Krakowski Zespół do Badań Autostrad, Kraków.

ZALIZNYAK L. L., 1999: Terminal Palaeolithic of Ukraine, Belarus and Lithuania (survey of cultural dierentiation). In: M. Kobusiewicz, K. J. Kozłowski (Eds.): *Post-Pleniglacial re-colonisation of the Great European Lowland*. *Folia Quaternaria.* Pp. 333–361. Polska Akademia Umiejętności, Kraków.

Damian Stefański
Paleolithic and Mesolithic Department
Archeological Museum in Kraków
ul. Senacka 3
31-002 Kraków
Poland
E-mail: damian.stefanski@ma.krakow.pl

Jarosław Wilczyński
Institute of Systematics and Evolution of Animals
Polish Academy of Science
ul. Sławkowska 17
31-016 Kraków
Poland
E-mail: wilczynski@isez.pan.krakow.pl