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IMPACT OF RAW MATERIALS ON THE INTERPRETATION OF MIDDLE PALAEOLITHIC ASSEMBLAGES

ABSTRACT: Middle Palaeolithic assemblages mostly comprise a manifold mix of various rocks and minerals Neanderthals acquired from resources in various distances. We can assume that the importance of the individual raw materials influenced and changed the human behaviour; this is reflected in the objects themselves and secondarily also in our classification and interpretation options. We demonstrate the complexity of this issue on the multilayer site of Bojnice III (layers VIII, IX, and X). The overall character of the industry (small dimension and using of coarse raw materials) has prompted some researches to classify it as micro-Mousterian or Taubachian. Technological analysis indicates that the character of the industry is secondary phenomena (the taphonomy) of the collection. The operation sequences are incomplete, and it is evident we work only with a part of the original assemblage. We can deduce that Neanderthals carried high-quality tools (fine-grained materials) between the settlement locations; hence they applied a certain degree of planning. The cultural classification of the assemblage should be based on the the bifacial component that appears to be dominant; it allows us to link the Bojnice inventories with Micoquian sensu lato. *It also becomes evident that the ways of processing of various raw materials were not significantly different, but the quality of the raw material has still played an important role in other aspects of human behaviour (i.e. economy, mobility, or planning). Generally, the influence of raw materials on the lithic industry assemblage should be taken into account separately for each site. Therefore, we cannot mechanically transfer analogies among different regions because local conditions (density and quality raw material sources, their accessibility, morphology of landscape, climate, etc.) had a bearing on the behaviour of humans, who should adapt to them and therefore their material culture can be modified too.*

KEY WORDS: Slovakia – Middle Palaeolithic – Micoquian – Raw material impact – Lithics – Neanderthal – Planning depth

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INTRODUCTION

One of intensely studied topic of the Palaeolithic research in Europe is the behaviour of Neanderthals in the Middle Palaeolithic period. An important source of our knowledge is chipped stone industry, the main information material preserved in more or less unchanged form. The characteristic feature of Middle Palaeolithic stone industry, especially in the area of Central Europe, is the variety of materials Neanderthals used for the manufacture of their tools. The raw material composition comprises materials of different quality (e.g. silicites, quartz, quartzite, cherts, rock crystals, etc.), but also of diverse provenance (from local to very distant sources). If we want to take advantage of the information potential of the lithic raw material, we have to determine the utilised rocks and minerals in the first place, and proceed to the localisation of their sources. In Central Europe petroarchaeological analysis has a long tradition that is manifested not only in the building of large lithoteques, but also in a great number of works dealing with the individual raw materials in selected regions (e.g. Biró 2009, Markó 2009, Přichystal 2002, Přichystal *et al.* 2003, Siman 1991, Trnka 2010). Nowadays we also have complex syntheses available, the advantage of which is that they apply the same methodological rules (summarization cf. Přichystal 2009). Due to this, we are currently aware of most of the utilised lithic materials, and able to locate and characterise their resources quite satisfactorily.

For a more thorough understanding of human behaviour within the lithic it is necessary to assess the proportions of raw material types in relation to the technology and typology of the lithic assemblage. It is inevitable to deal with a question, in what forms are the raw materials found on the site, what is the composition of metric groups, the amount of original cortex on the blanks, and/or what is the use of the individual kinds of raw materials for tools.

The key advantage is that the manufacturing procedures of lithic industry used by Neanderthals have already been explored and described quite well (e.g. Bourguignon 1998, Hiscock *et al.* 2009, Jaubert 2011, Neruda, Nerudová 2005, Turq 2000a, b). Due to detailed technological studies, refitting, traceological and experimental analyses the processes of manufacture and consumption of stone implements have been successfully reconstructed. On the one hand, this enables us to uncover some trends or strategies of the Neanderthals and in the instances when we are capable of linking these phenomena with the superposition of layers, we can reconstruct the development of human behaviour over time.

On the other hand, the complexity of chipped stone industry holds some negative aspects as well. Mutual relations of various types of information may be interpreted differently (researcher influence), or may vary among sites (influence of local conditions). This obviously opens the opportunities for various interpretation approaches, so that the phenomenon itself does not become clarified but a number of other questions and issues remained to be resolved.

A classic example of such problems is the interpretation of Middle Palaeolithic variability, which has shown itself most markedly in the discussion between F. Bordes and L. R. Binford (cf. Dibble, Rolland 1992, Sackett 1982). In fact, both of the seemingly diametrically different concepts regarded lithic industry as a static source, i.e. final product left on a site by humans in the form, in which it was manufactured.

An entirely new light on the variability of the Middle Palaeolithic tooling component of the lithic industry was shed by the dynamic (reduction) system. This has shown that the Middle Palaeolithic tools cannot be regarded as final products with one stylistic pattern applied throughout, but more likely as results (palimpsests) of various reutilisation (reduction) events that might have significantly changed the original morphology of the tool (Dibble 1984, 1987b, Dibble, Rolland 1992, Rolland 1977, 1981, Rolland, Dibble 1990). This view can result to changing the overall typological classification (Goodyear 1974: Fig. 11). Such a view ensues from the outcomes of several case studies, which exemplify this phenomenon in a particular archaeological inventory. In this respect, e.g. the works by J. Gallagher (1977) or G. Frison (1968) can be considered classic.

An important consequence of the dynamic model is the finding that the taphonomy of the discovered collections has a significant influence on their general character. This applies not only to the state of preservation dependent on the effect of natural processes (weathering, redeposition, etc.), but also to the impact of human behaviour on the formation of the assemblage. It evidently depends on humans themselves, what they decide to leave at the place where they stayed for some time, and what they take with them to another location. Humans could also have had influence on the distribution of the finds within the site area, or even on the possibilities of their preservation (e.g. hoards).

It is interesting to note, although the taphonomy is a very important part of the osteology research of hard animal tissues, within the lithic industry this aspect is not usually taken into the consideration. The importance of the taphonomy and extend analyis of both raw materials and technology can be demonstrated on materials from the Middle Palaeolithic site Bojnice III in Slovakia. Through the assessment of the bottom layers VIII, IX, and X that contained an adequate quantity of industry, we can uncover some of the methodological problems, revise the cultural classification and postulate new findings about the Neanderthal population behaviour in the period of Eemian/Weichselian transition. Using these as an example, we can try to tackle two groups of questions:

(1) To what extent has the manufacturing technology of Middle Palaeolithic stone industry been influenced by the quality and availability of the raw material, and/or in what way has it influenced human behaviour?

(2) To what extent has the behaviour of the Neanderthals influenced our interpretations of the analysed materials?

BOJNICE III (SLOVAKIA)

The travertine formation with the superposition of Palaeolithic layers in the castle moat (hence the designation Bojnice III – "hradná priekopa" (castle moat)) is situated in NW Slovakia, on the right bank of the Nitra River upper course, approx. three km WWN from the town Prievidza (*Figure 1A, B*). The valley opens to SW, and its altitude at the place of the locality is 300 meters. Specific climatic conditions are influenced by the surrounding mountainous terrain the height of which exceeds 1000 m above sea level. The site was discovered by V. Ložek in 1964, and consequently excavated by J. Bárta between 1965 and 1969 (Bárta 1965, 1966, 1967, 1972).

In sectors A and B the base of the travertine formation was captured at the depth of 8 m, where brown clayey sediments of the last interglacial started to occur (*Figure 1C*). In the entire thickness of the profile 11 archaeological layers were differentiated (*Figure 2*), and locally it was possible to differentiate also sub-layers IXa and IXb. The chronostratigraphic positions of the finds can be determined mainly on the grounds of analysis of malacofauna (analysed by V. Ložek in Neruda, Kaminská in press), which divides the sequence into the basal part falling within the late Eem Interglacial period (archaeological layers XI and X), and the upper part formed during the Early Weichselian (layers IX to I), while the fauna representing the first glacial maximum (MIS 4) was not captured.

LITHIC INDUSTRY

The material under the study has been obtained from eleven layers that contain 2410 pieces of lithic artefacts (*Table 1*). The quantities of finds rather vary in the individual archaeological horizons, and in many cases the numbers of items do not enable an adequately representative analysis (detailed techno-typological analyses of all layers in Neruda, Kaminská in press). Our attention will be focused only on layers VIII–X that

TABLE 1. Bojnice III. Composition of finds.

	Unmodified rocks	Cores	Blanks	Tools	Waste	Hammers	Total
Layer I	3	1		1	1		6
Layer II	6	4	3	6	27	2	48
Layer III	9		4	3	4		20
Layer IV	22		1	1	1		25
Layer V	8		1	1	3		13
Layer VI	3			2	19		24
Layer VII	5	1	2	1	12		21
Layer VIII	44	7	32	20	821	6	930
Layer IX	2	11	24	18	441	3	499
Layer X	44	14	54	39	663	2	816
Layer XI			1	1	5	1	8
Total							2410

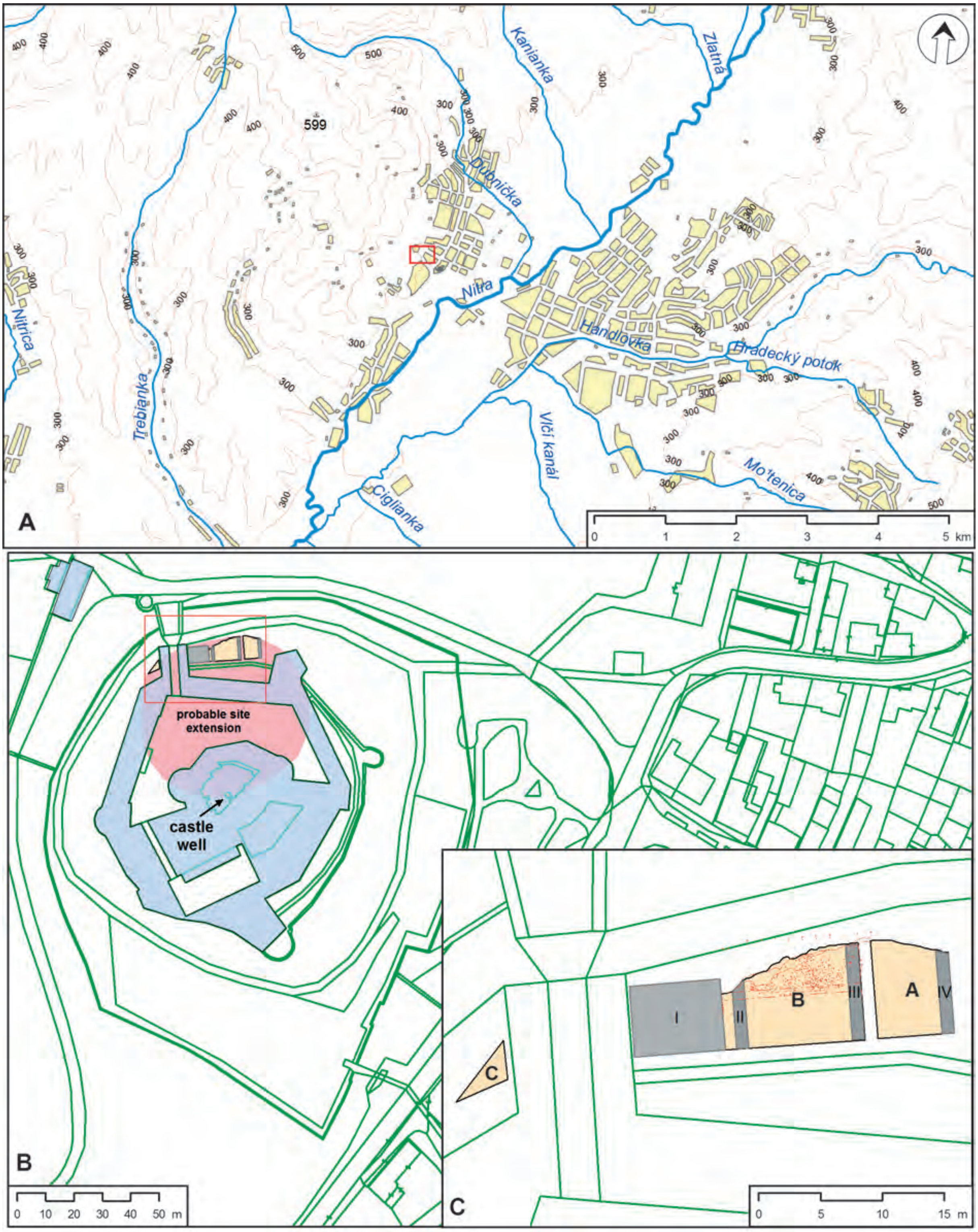

FIGURE 1. Bojnice III. A, position of site in the Prievidza Region; B, situation of site under the castle and estimated extend of the cultural layer; C, organization of sectors in J. Bárta's excavation.

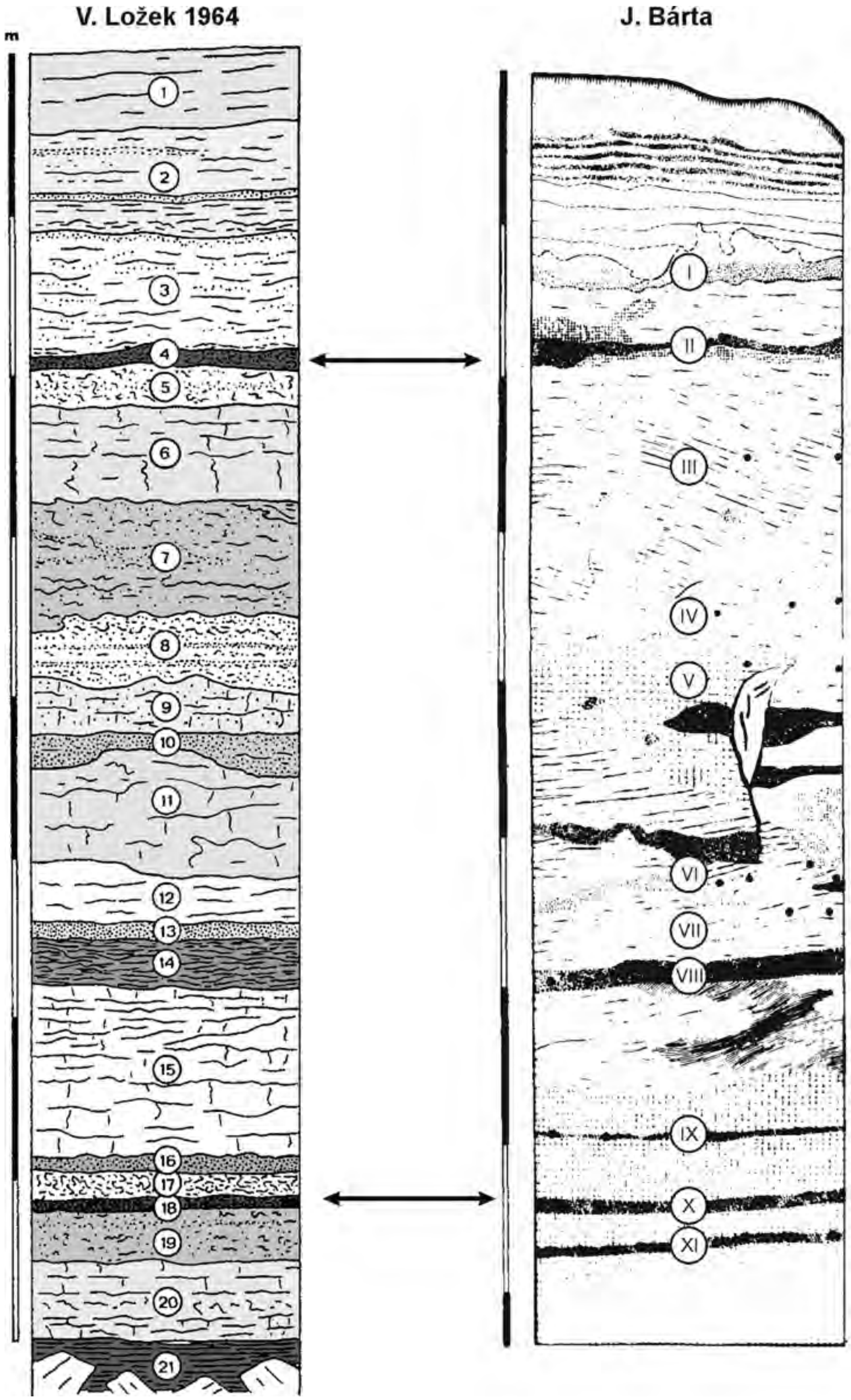

FIGURE 2. Bojnice III stratigraphy. Left, geological layers 1–21 after V. Ložek; right, archaeological layers I–XI after J. Bárta (cf. Neruda-Kaminská in press: Chapter 4.3, 7.2).

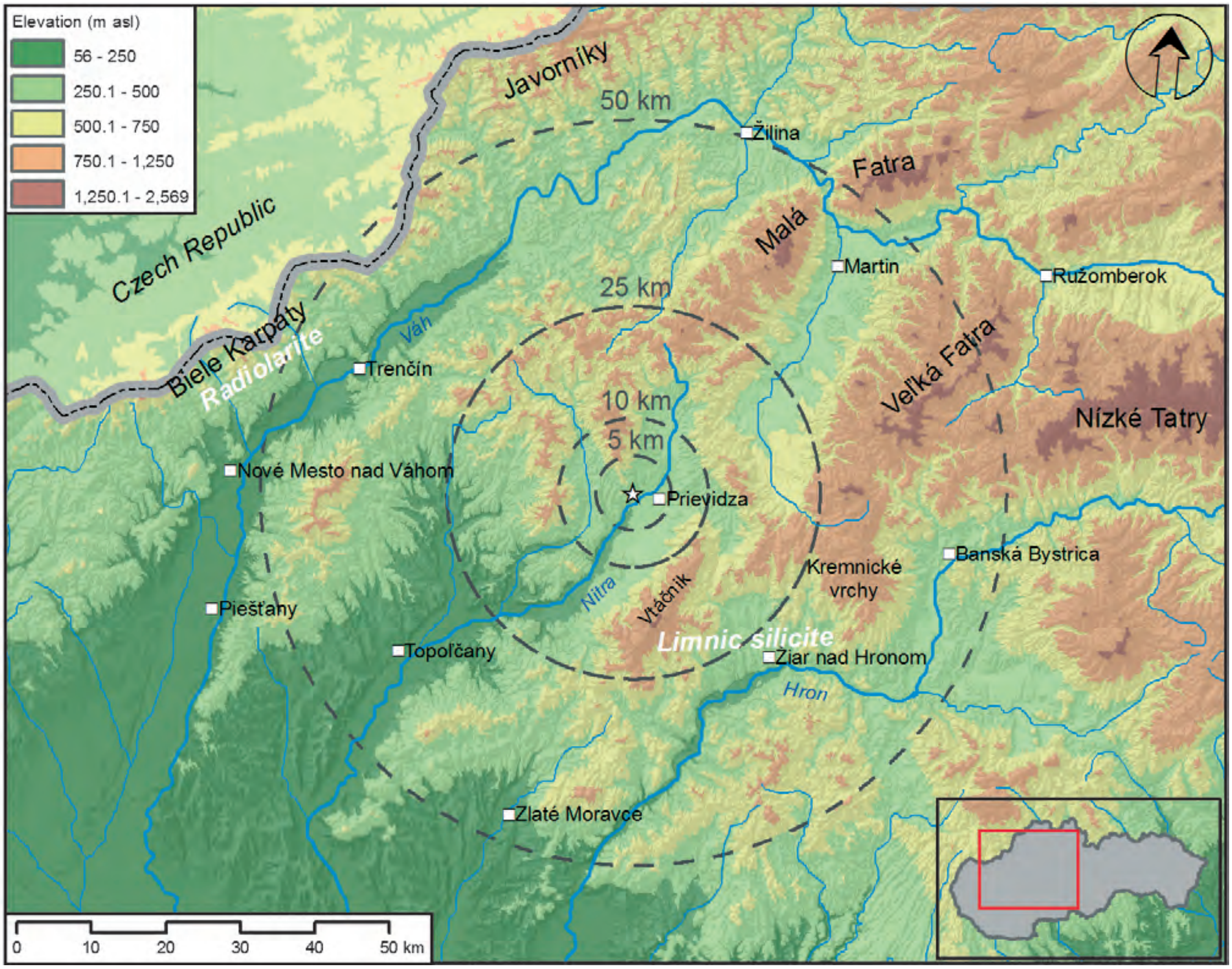

FIGURE 3. Relation of Bojnice III site to the fine-grained material sources (radiolarite, limnosilicite) of Slovakia.

contain a sufficient number of finds as well as fine-grained raw materials (radiolarite, erratic flint, and limnosilicite). The basic characteristics of the observed layers are very similar in terms of technology, typology, as well as raw materials (Neruda, Kaminská in press).

Raw material composition

The raw material composition of layer VIII–X (inclusive of waste) reveals a dominant representation of quartz (Neruda, Kaminská in press: 100, 107, 117); judging by the character of cortex it comes from the local fluvial sediments of the Nitra River. Andesite was also obtained from these resources but contrary to the nearby site Bojnice I it was only used exceptionally. Out of coarser raw materials quartzite was used as well. Fine raw materials originating from greater distances than the interval from 25 to more than 50 km are evidenced in all the three studied layers (*Figure 3*). These are limnosilicites from the Žiarska kotlina Basin, radiolarites from the region of the Váh River, and chert cf. erratic silicites ("flints") of unknown resource.

Metric

The overall small-shaped character of the industry is the typical attribute of all layers in Bojnice III. The distribution of raw materials according to main technologic groups (*Table 2*) shows that maximum frequency of both coarse- and fine-grained raw materials is in the group of fragments and chips from retouching. Therefore, the prevailing part of the collection, inclusive of the layers under our observation, falls within the metric interval of 0.1–4.0 cm (*Table 2*). The majority of

TABLE 2. Bojnice III. Comparison of groups of both coarse-grained and fine-grained materials on the base of metric (cm) and technological groups.

	Coarse-grained materials						Fine-grained materials					
	0.1-2.0	2.1-4.0	4.1-6.0	6.1-8.0	8.1-10.0	Total	0.1-2.0	2.1-4.0	4.1-6.0	6.1-8.0	8.1-10.0	Total
Layer VIII												
Unmodified rocks	19	30	4			53						
Cores		6	1			7						
Blanks	1	34	7	1		43		1				1
Blank fragments	17	52	1	1		71		1				1
Small chips	250					250	36					36
Fragments	379	88	1			468						
Total	666	210	14	2	0	892	36	2	0	0	0	38
Layer IX												
Unmodified rocks		3	2			5						
Cores		10	1			11						
Blanks		32			1	33			1			1
Blank fragments		32	2			34						
Small chips	169					169	48					48
Fragments	134	60	2	1		197	1					1
Total	303	137	7	1	1	449	49	0	1	0	0	50
Layer X												
Unmodified rocks	25	22	3			50						
Cores		11	2			13		1				1
Blanks		44	6	1		51		16				16
Blank fragments	2	59	1			62	3	13				16
Small chips	213					213	138					138
Fragments	38	197	4			239	15	1		1		17
Total	278	333	16	1		628	156	31	0	1	0	188

flakes and cores (their remains and fragments included) is preserved in the interval 2.1–4.0 cm.

Technology

From the technologic viewpoint the assemblages from the richest layers VIII, IX, and X belong to the volumetric concept of the core reduction (*Figure 4:1, 4:4*) that represents the first technological concept of the tool production (concept of *debitage*). Cores are preserved in a few modifications of shape, while items with hierarchised surfaces (sub-discoid cores), which differentiate striking and exploitation area, prevail. They were mainly preserved in the form of exhausted pieces and their fragments (*Figure 5*) and therefore we are unable to describe the entire process of reduction with an adequate precision, especially the form, in which the raw material was brought to the site.

The recorded forms of blanks are also in correspondence with the main method of core exploitation. Nevertheless, a great percentage of blanks consists of fragmented flakes, and many of them are taphonomically damaged to such extent that their further technologic characteristics cannot be determined. Blanks from fine-grained raw materials (radiolarite, limnosilicite) were virtually exclusively preserved in the forms without cortex, or with only minimum quantities of cortex.

The second technological concept of the tool production is represented by the bifacial forms (handaxes and bifacial backed knives). Regretfully same as with cores this procedure is corroborated by small, significantly reduced items, which makes more precise characterisation of the procedures difficult (*Figure 4:3, 4:5*). The presence of this method is important for further evaluation.

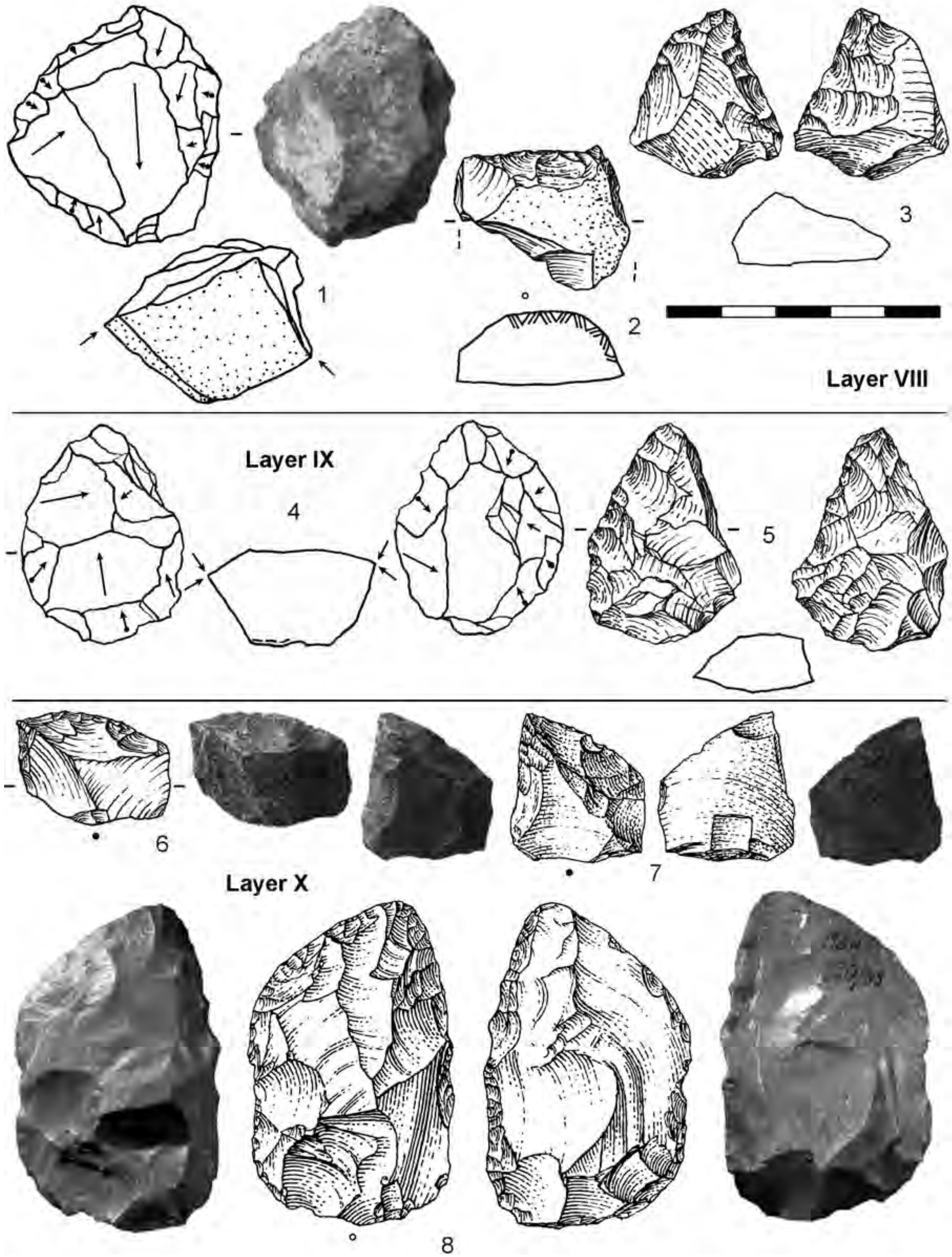

FIGURE 4. Bojnice III. Typical implements of layers VIII, IX, and X. 1, 4, subdiscoid cores; 2, 6–8, side scrapes; 3, 5, bifacial back knives.

Typology

Simple side scrapers on quartz (*Figure 4:2*) and denticulates are most numerous in the layer VIII (cf. *Table 3*). Other types of side scrapers (transversal, ventral, and bifacial) and bifacial implements (reduced forms of bifacial backed knives; *Figure 4:3*) are only represented by one item each.

In layer IX the proportion of notches and denticulates decreases (*Table 3*), although simple side scrapers on quartz still prevail. Ventral and bifacial side scrapers and bifacial backed knives (*Figure 4:5*) occur sporadically. Fragments of tools and items with local use-wears are most represented. There was no tool manufactured from fine-grained raw material in layer IX.

From the typological point of view layer X is the richest (*Table 3*). In the group of coarse-grained materials simple side scrapers complemented by a range of complex side scrapers (*Figure 4:6–7*) indistinctively prevail. Notches and denticulates have a minimum representation. Mainly complex side scrapers (side

TABLE 3. Bojnice III. Composition of tools in individual layers within the raw materials.

	Raw material				
	Quartz	Quartzite	Limno-silicite	Radiolarite	Total
Layer VIII					
Single side scraper	5				5
Double side scraper	1				1
Transversal side scraper	1				1
Ventral side scraper	1			1	2
Bifacial side scraper	1				1
Truncated flake	1				1
Bifacial backed knife	1				1
Notch and denticulate	6				6
Fragments and use-wear	1			1	2
Layer IX					
Single side scraper	4				4
Ventral side scraper	1				1
Bifacial side scraper	1				1
Notch and denticulate	1				1
Bifacial backed knife	1				1
Fragments and use-wear	7	3			10
Layer X					
Single side scraper	3	1	2		6
Double side scraper	1				1
Pointed side scraper		1			1
Déjeté side scraper	1	1		1	3
Transversal side scraper		1	1		2
Ventral side scraper	1				1
Side scraper with thinned back	1		1		2
Bifacial side scraper	2				2
Notch and denticulate	1	1	1		3
Bifacial backed knife				1	1
Fragments and use-wear	6	4	7		17

scrapers with thinned back, *déjeté* and transversal side scrapers) appear among the tools made of fine-grained raw materials (*Figure 4:8*), and a bifacial backed knife is corroborated by one item made of radiolarite.

DISCUSSION

There are important conclusions ensuing from the analysis of the industry. The technological analysis of cores has revealed the missing production sequences (*Figure 5*). The cores, which were probably prepared beyond the site (cf. representation of cortex on the blanks and the dimensions of cores and blanks), were preserved practically only in the form of small remnants and fragments. Thus the question, where are the cores that made the exploitation of the target blanks still possible, was brought to the fore. We have to tackle the problem of these missing artefacts also in the group of tools, in which implements made of fine-grained raw materials were virtually not preserved, although from the technological and raw material analysis of chips we know the reutilisation of these tools occurred directly on the studied site. With some exceptions, the possible proofs of such tools feature very small dimensions, and this indicates greatly advanced stage of reduction.

The basic characteristic of the studied Bojnice III collections is the incompleteness of the assemblages. If we compare the representation of cores, the character and proportions of blanks and waste (Neruda, Kaminská in press: Chapter 4), it is evident that the small dimensions of the industry constitute a secondary phenomenon that is linked with the taphonomy of the assemblage and cannot be employed as one of cultural determinants. Incompleteness of the operation sequence can be interpreted in two principal ways:

- geological processes that caused post-deposition changes on the site (N-Transforms, cf. Uthmeier 2004a, 2004b);
- anthropic impacts (C-Transforms, cf. Uthmeier 2004a, 2004b); however these may include two possible alternatives – transfer of the finds within the site, or export of the finds beyond the locality.

The method of excavations and especially the preserved field documentation do not make the use of modern analytical means possible. Nevertheless, it is evident from the preserved materials that the thickness of the individual horizons was not great, and in the instance of layer VIII it apparently did not exceed 10 cm (Neruda, Kaminská in press: Fig. 79C). It follows that the vertical distribution of finds was rather minimal. The question of the horizontal motion of artefacts, which might occur in relation to the dynamics of forming of the travertine mound, is more complex. It is obvious that in the place of discovery of the lithic industry periods of sedimentation had to take turns with relatively quiet periods. Sedimentation of travertine had to proceed at the time when mineral water was running over the place of discovery. The water could theoretically be one of the causes of displacement of the artefacts. The current observations at the outflows of mineral waters show, however, that the items, which fall on the area of precipitated carbonate, are repositioned minimally as their become cemented relatively quickly. If in the instance of the studied area we have to do with a secondary deposition of the finds transferred from elsewhere, it would probably mean that items from various places of the site of discovery were captured, and this would eliminate functional differences among the partial locations on the site; however this is not corroborated by the lithic industry analysis. The second argument, which would more likely evince an *in situ* location of the studied industry, is the presence of bone retouchers that correlate with the representation of chips. Moreover, the proportion of chips would probably be higher, if water screening of cultural horizons was applied during the excavations. If we admit chips and small flakes from forming and rejuvenation of tools are static objects that remain in the place, where these processes were carried out (Weißmüller 1995), we may conclude that the issue of "missing artefacts" is more likely hidden at the second possibility – anthropic impact (C-Transforms).

Within this concept of the anthropic impact it is necessary to analyse two options that might occur:

- The tools manufactured from these materials occur at another place and were not captured by the excavations;
- The tools were carried away from the site (export of tools).

The first option is possible, as the area of excavations was not large, and it can be rightfully assumed that the size of the locality is larger and it is extended below the present fortified castle. However in such case the absence of tools and the presence of chips would suggest hiving of zones with various functions, so that, e.g. tools would be manufactured/reutilised in places differing from those of their consumption. Such behaviour was evidenced, e.g. in the Micoquian layer 7a in the Kůlna Cave (Neruda 2011, Neruda *et al.* 2011); regretfully a similarly oriented spatial analysis cannot be performed within the Bojnice station. In the instance of the Bojnice site the blanks from radiolarite or other fine-grained raw materials would have to be detached at another place within the site, and then carried to the place, that was excavated by J. Bárta, to be formed or resharpened (preserved chips and retouchers made of hard animal tissues), and subsequently again brought to another place within the same locality. Processing of coarse-grained raw materials was analogous because of incompleteness of the operating chains. The quartz and quartzite chips prove retouching of tools at the place of excavations; their representation is by no means significant (the tools are rather fragmentary). Thus in the case of coarse-grained raw materials too we have to do with a kind of a negative selection as the target products were not preserved in Bojnice III (big flakes or tools made on them).

The second variant falling within the C-Transforms category explains the phenomenon in view by import and export of tools among the individual sites (base camps). From our perspective this explanation appears to be the most probable, especially from the angle of the technological composition of the assemblage. Obviously fine-grained raw materials were brought to the site already in a transformed shape, most often in the form of tools (in various stages of reduction), were resharpened on the site, and consequently exported when the location of the settlement was changed (*Figure 6*). This way of behaviour was captured, e.g. at the Crimean Buran-Kaya III site, level B1 (Uthmeier 2004a), Plaidt-Hummerich in the Neuwied Basin in Western Germany

Layer	Stage of preparation	Stage of exploitation	Exhausted pieces
II	missing	sub-discoid core with hierarchical surfaces	sub-discoid core with hierarchical surfaces sub-prismatic ?
VIII	sub-discoid core (*sparse*)	missing	sub-discoid core with hierarchical surfaces
IX	missing	missing	discoid core sub-discoid core with hierarchical surfaces irregular core
X	pre-core (*sparse*)	missing	sub-discoid core with hierarchical surfaces *nucleus s'enclume*

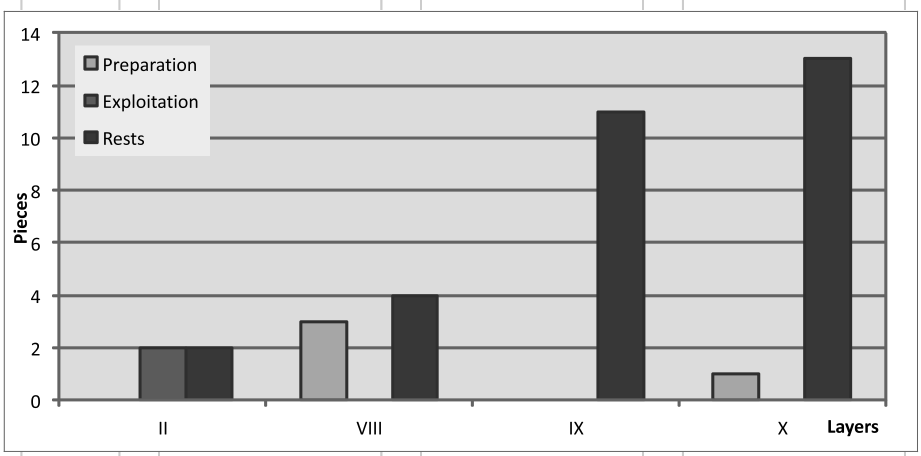

FIGURE 5. Bojnice III. Presence of technological groups in individual layers VIII, IX, and X.

(Bosinski *et al.* 1986), or Maastricht-Belvédère "J" site (Roebroeks *et al.* 1987). This phenomenon is well correlated with the observation that the degree of transformation is often related with the distance from the resource (Geneste 1985, Roebroeks *et al.* 1988).

The interpretation that takes into account the import of already final tools may also rely on the form, in which we have – in exceptional instances (layer X) – captured the distant types of raw materials (radiolarite, limnosilicite, and cherts cf. erratic flint). Complex types of side scrapers are mainly represented; reduced forms of bifacial backed knives are rare. All these tools show a high degree of reduction of the original blank, either a flake or a bifacial form, which may not only be in relation with the reduction/rejuvenation of the original tool, but also with the fact that especially bifacial forms may also be used as cores. For this reason bifacial forms of tools and side scrapers are usually considered the most suitable for the transfer of raw material to a greater distance, e.g. during relocations of settlements (Geneste 1985, Hayden 1976, Keeley 1980). Within European assemblages this phenomenon was significantly recorded, e.g. on the above mentioned Maastricht-Belvédère J site (Roebroeks *et al.* 1987) or the Plaidt-Hummerich site (Bosinski *et al.* 1986), or, e.g. in layers 9 and 10 in Marillac, Charente (Meignen 1988). In the Moravian material this effect may be distinctively seen in the Taubachian collection from layer 11 in the Kůlna Cave, where porcelanites from the farthest distance are corroborated also by bifacial items (Neruda 2001: Fig. 32). The shapes of these are reminiscent of small, more robust leaf points but the items do not bear signs of working edge modification, and thus are closer to cores.

If this is the case, it has to be taken into account that some tools belong to the category of long live tools. This assumption is also in a relatively good correlation with the already performed analyses. The Micoquian bifacial tools from the Kůlna Cave, which showed a more marked reduction of the cutting edge (a more open angle), had a palimpsest of use-wears on their surfaces; this is a proof of a longer-term utilisation (Neruda *et al.* 2011, 2010).

If we explain the issue of artefacts "missing" from the Bojnice III site as an anthropic impact (C-Transforms) due to inter-site transfer (export) of artefacts, this implies important aspects of Neanderthal behaviour. Neanderthals apparently distinguished both the quality of raw material and the morphology of the tools and utilised the suitable items for a longer period of time (cf. Dibble 1987a). If we take into consideration that radiolarites and limnosilicites are found in a more than 50 km distance

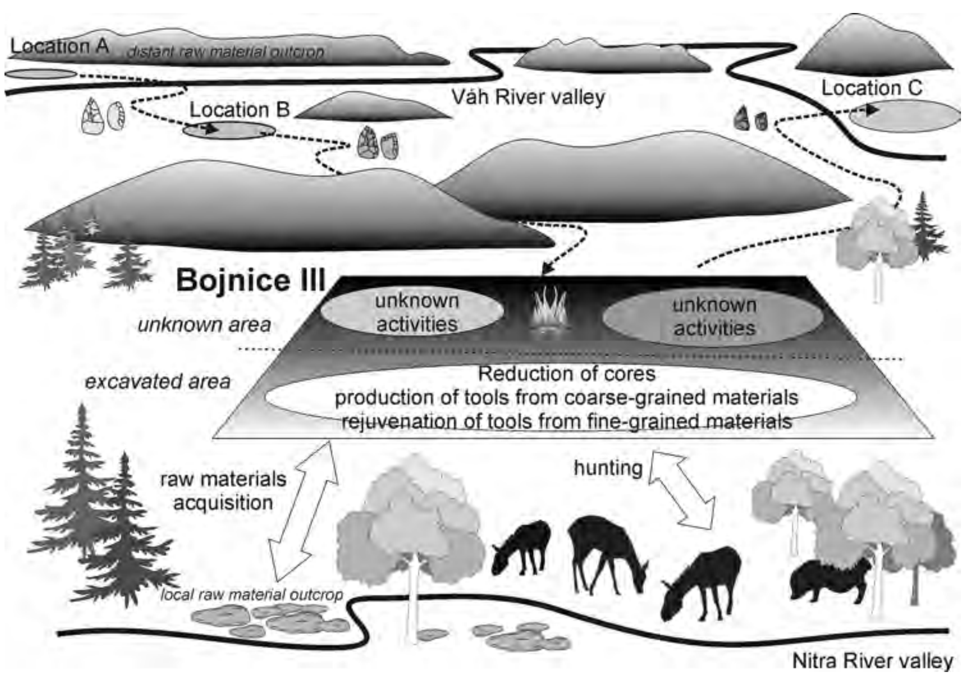

FIGURE 6. Model of Neanderthal behaviour within fine-grained materials and Bojnice III site.

from the Bojnice site (*Figure 3*), it can be assumed that when moving at greater distances Neanderthals used high-quality raw material in a planned manner. The distance and the significance of imports would then suggest mobility within a relatively large territory. If this interpretation is correct, at least the layers X, IX, and VIII in view in Bojnice III would correspond with the concept that allows for some aspects of behaviour to be planned as early as in Middle Palaeolithic; hence the classic conception upheld especially by L. Binford (Binford 1979, 1982) and accepted for a long time, that curation economy is an expression of anatomically modern humans, has to be rejected. Obviously this does not mean that the above proofs of curation in Middle Palaeolithic collections automatically imply an "always fully determined optimal and detailed planning and anticipation" (Roebroeks *et al.* 1988); but they definitely demonstrate that Neanderthal behaviour was much more complex than it seemed to be up to now.

An additional aspect of the above interpretations of the Bojnice assemblages is also a better understanding of the significance of the individual techno-typological components for cultural classification. The original accentuation of small dimensions of the industry and the dominant representation of simple side scrapers lead to seeking for analogies on other travertine sites (Micro-Mousterian; Bárta 1967, 1972), many of which are usually connected with Taubachian (Valoch 1984, 1996).

It is our assumption the overall habitus of industries discovered in layers X, IX, and VIII does not reflect a specific type of tool kit but it is an outcome of the process of reduction of the industry and the planning depth of Neanderthals. In other words, in the instance of the Bojnice III station we have to do with a kind of a negative selection (anthropic impact on the taphonomy), represented primarily by greatly reduced forms of cores and waste from manufacture of tools. Small dimensions of the industry, which implied a resemblance with Central European Taubachian, are in fact a secondary feature, and we have to rely on other indicia that suggest an alternative classification (Neruda, Kaminská in press: Chapter 6). The technology of blank production is characterised by an absence of Levallois method, the application of volumetric discoid method, the presence of complex side scrapers of the type with modification of both sides of the semiproduct (natural plate, blank, etc.) and the occurrence of bifacial backed knives, albeit captured in a substantially reduced form, are more important for cultural classification. We find the closest analogies in the Central European Micoquian, the existence of which at the end of Eemian is not supported by an adequately broad base. In this respect it is necessary to try to answer the question, how the forms of bifacial tools from Bojnice really correlate with the known standard sites in Poland or Germany, where it is possible to divide Micoquian into several facies. That is to say, we are incapable of an unequivocal assigning of the Bojnice assemblage as belonging to any of these. If we apply the dynamic-taphonomical model, which proved to be of importance for the Bojnice collections, it becomes evident that the studied assemblages are influenced by local conditions, consequently the local conditions have had an impact on Neanderthal behaviour, and this has reflected in the archaeological record.

It is again the lithic raw material the evaluation of which may bring satisfactory explanation of the differences between collections rich in certain specific forms of bifacial backed knives (in Germany or Poland) and assemblages that do not have these recurrent forms (e.g. Moravia – the Kůlna and the Šipka Caves; Slovakia – Bojnice I and III). We have to take into consideration the character and exploitability of the available raw material resources. Rich collections of the Bockstein, Klausenische, Wylotne, Ciemna, etc. types came into existence in the regions with ample sources of raw materials of incomparably better quality, than is found, e.g. in the assemblages from Moravia and Slovakia, where utilisation of coarse-grained local materials substituted for the scarce high-quality raw material, as we demonstrated on the example from Bojnice III. In the territories with poor quality, availability, exploitability, etc. of raw material it is inevitable to adapt the manufacturing technology and the consumption process in such a way that this negative aspect becomes eliminated as much as possible. One of the ways is an intense utilisation of tools, especially those made of higher quality raw materials (spongolite, radiolarites). However, intense reduction of a tool forced by a requirement for a new sharp working edge affects the morphology of a tool. The preferred stylistic pattern can be maintained only for a certain period of time (depending on the quality of the raw material, size of the tool, or experience of the knapper). If we want to use the tool further, from a certain moment it is necessary to change (many times very markedly) the original pattern; consequently the typological classification can be changed as well. This fully corresponds to the findings of ethnological (Frison 1968, Gallagher 1977) and experimental research (Migal, Urbanowski 2006, Urbanowski 2003).

On the contrary, in the regions with ample raw material we can resolve the requirement for a new sharp working edge by a manufacture of a new tool; this is often more advantageous from the economic viewpoint. Therefore, it is logical that in this case the preferred stylistic patterns and technological procedures can be applied repeatedly within several reutilisations, since the items are big enough. If a certain specific modification of a bifacial artefact is really a result of a preferred stylistic pattern, it is applied to many items, and this will be reflected in the overall character of the assemblage. Due to this we are able to define specific shapes and make use of them as a base for cultural classification.

It still remains a question, whether we can bring together the sites of both models (the regions both rich and poor in raw materials) under one culture or facies. In solving of this question, we cannot avoid the fundamental issue, whether we are going to prefer the differences in archaeological inventories, or to accentuate the mutual resemblances. We believe that, in view of the information potential of Middle Palaeolithic assemblages, the second option is more correct from the methodological point of view.

A too strict (static-typological) approach in the regions poorer in raw materials will result in each individual collection or locality appearing pretty much unique. With regard to the presumed demographic situation of Middle Palaeolithic, this may appear more probable: there were more or less independently moving, separate small groups of Neanderthals, who produced stone inventories of their own. However, this will bring us to the point, where the individual information will hardly allow us to construct a historic synthesis to describe the changes in human behaviour over time. We will also hardly explain, why similar or the same technological approaches appeared independently in many places almost concurrently (this applies exactly to, e.g. Micoquian in Central Europe).

If we accentuate the similarities between the industries instead, and at the same time endeavour at the explanation of differences, we will be able to make regional syntheses of our information, and to try to determine the main features – the behavioural strategies of the primeval population in the individual territories at the given time. The proposed model can never be complete and precise, since the resolution abilities of our dating methods are inadequate, and we also have to take into account further factors (taphonomy of the sites, non-preserved localities or non-retrieved items, etc.); still from the historical perspective it facilitates our better understanding of changes, or the mechanisms of changes that were occurring. Simultaneously, we have to realise that an approach with this orientation is only possible on the premise that, on a broader geographical and chronological scale, the utilisation of division into local facies will not be possible. It will be a kind of a *sensu lato* classification, and the acquired models will not have the same validity as in the case of, e.g. primeval cultures of the post-Palaeolithic period.

CONCLUSIONS

The described examples from the Bojnice sites clearly demonstrate the complexity of the issues we have to wrestle with in the study of the relations of lithic raw materials, technology, and human behaviour. Through a detailed analysis we are capable of capturing many more aspects of human activities, and in some cases we can even reconstruct dynamic processes over a certain period of time. Thus we succeeded for instance in finding out that Neanderthals used their tools, especially those made of high quality raw materials, for a longer time, and were capable of planning for a longer time ahead. Due to superposition of layers we know this was not an exceptional case, but that this behaviour has been recurrent.

The findings that are more of methodological character are equally important. Nowadays a preserved archaeological layer under study is generally assumed to be a result of many processes that have a bearing on its taphonomy. Mostly we are only looking for the influences beyond the sphere of human behaviour, and consequently we regard archaeological material as a representative assemblage with preserved characteristic patterns, which facilitate the classification and confrontation of these collections. However, on the example from Bojnice we have demonstrated that a specific human activities may have a very negative influence on the character of the discovered industry. At the moment, when our ancestors realised the important role the quality of their tools played, they had to adapt their behaviour to the specific conditions of the respective region. It seems necessary to judge the influence of raw material on human behaviour, and consequently on the character of lithic chipped industry on a case-to-case basis; we should avoid mechanical transfer of parallels among regions with totally different conditions (especially as regards raw materials).

When considering that availability and quality of a raw material may impact upon the overall character of an archaeological assemblage (a complete cross-section of the production of stone tools has not come down to us), in the future we will have to pay much more attention to this aspect, and to focus on the identification of these issues. This is the only way for us to become capable of a more realistic classification of the individual collections in terms of both function and culture. It is the assemblages from Bojnice that count among standard situations. In an inadequate technological assessment the taphonomical aspects of the collections have been omitted or overlooked, and the first characteristic, which was most marked, the size of the industry, has been preferred. The size together with a limited tooling component has led to an erroneous classification. Through the application of a detailed techno-typological analysis focused on stone raw materials we succeeded in identifying other elements (the bifacial component and complex side scrapers in relation to fine-grained raw materials), which enabled us to incorporate the Bojnice inventories into the scope of Micoquian *sensu lato*.

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REFERENCES

BÁRTA J., 1965: Bojnice vo svetle paleolitického osídlenia. *Vlastivedný zborník Horná Nitra* 2: 9–18.

BÁRTA J., 1966: *Einige beachtenswerte paläolithische Fundstelle in der Westslovakei*. Vydavatel'stvo Slovenskej Akadémie Vied pre Archeologický Ústav SAV a Okresné Múzeum v Nitre, Nitra.

BÁRTA J., 1967: Stratigraphische Übersicht der paläolithischen Funde in der Westslowakei. *Quartär* 18: 57–80.

BÁRTA J., 1972: *Pravek Bojníc. Od staršej doby kamennej po dobu slovanskú*. Obzor n. p., Bratislava.

BINFORD L. R., 1979: Organization and formation processes: looking at curated technologies. *Journal of Anthropological Research* 35: 255–273.

BINFORD L. R., 1982: Reply to R. White's "Rethinking the Middle/Upper Paleolithic transition". *Current Anthropology* 23: 177–181.

BIRÓ K. T., 2009: Sourcing raw materials for chipped stone artifacts: The state-of-the-art in Hungary and the Carpathian basin. In: B. Adams, B. S. Blades (Eds.): *Lithic materials and Paleolithic societies*. Pp. 47–53. Wiley-Blackwell.

BOSINSKI G., KRÖGER K., SCHÄFER J., TURNER E., 1986: Altsteinzeitliche Siedlungsplätze auf den Osteifel-Vulkanen. *Jahrbuch des Römisch-Germanischen Zentralmuseums* 33: 97–130.

BOURGUIGNON L., 1998: Le débitage Quina de la couche 5 de Sclayn : éléments d'interprétation. In: M. Otte, M. Patou-Mathis, D. Bonjean (Eds.): *Recherches aux grottes de Sclayn, vol. 2, L'Archéologie*. Pp. 249–276. Liège.

DIBBLE H. L., 1984: Interpreting typological variation of Middle Paleolithic scrapers. Function, style, or sequence of reduction. *Journal of Field Archaeology* 11, 4: 431–436.

DIBBLE H. L., 1987a: Comparaisons des séquences de réduction des outils moustériens de la France et du Proche-Orient. *L'Anthropologie* 91, 1: 189–196.

DIBBLE H. L., 1987b: The interpretation of Middle Paleolithic scraper morphology. *American Antiquity* 52, 1: 109–117.

DIBBLE H. L., ROLLAND N., 1992: On assemblage variability in the Middle Paleolithic of Western Europe. In: H. L. Dibble, P. Mellars (Eds.): *The Middle Paleolithic: Adaptation, Behaviour and Variability*. Pp. 1–28. The University Museum University of Pennsylvania, Philadelphia.

FRISON G., 1968: A functional analysis of certain chipped stone tools. *American Antiquity* 33: 149–155.

GALLAGHER J., 1977: Contemporary stone tools in Ethiopia: Implications for archaeology. *Journal of Field Archaeology* 4: 407–414.

GENESTE J.-M., 1985: *Analyse lithique d'industries moustériennes du Périgord: une approche technologique du comportement des groupes humains au Paléolithique moyen*. Université de Bordeaux I, Bordeaux.

GOODYEAR A., 1974: *The Brand site: a techno-functional study of a Dalton site in Northeast Arkansas*. Fayetteville.

HAYDEN B., 1976: Curation, old and new. In: J. S. Raymond, B. Loveseth, C. Arnold, G. Reardon (Eds.): *Primitive art and technology*. Pp. 47–59. University of Calgary Press, Calgary.

HISCOCK P., TURQ A., FAIVRE J.-P., BOURGUIGNON L., 2009: *Quina procurement and tool production*. Wiley-Blackwell.

JAUBERT J., 2011: La technologie des Néandertaliens en Europe occidentale. *Dossiers d'Archéologie* 345, Mai/Juin: 68–73.

KEELEY L. H., 1980: *Experimental determination of stone tool uses. A microwear analysis*. University of Chicago Press, Chicago.

MARKÓ A., 2009: Raw material circulation during the Middle Palaeolithic period in northern Hungary. In: *Surowce naturalne w Karpatach oraz ich wykorzystanie w pradziejach i wczesnym sredniowieczu*. Pp. 107–119. Krosno.

MEIGNEN L., 1988: Un exemple de comportement technologique differential selon les matières premières: Marillac, couches 9 et 10. In: M. Otte (Ed.): *L'Homme de Néandertal, Vol. 4: La technique*. Pp. 71–79. Liège.

MIGAL W., URBANOWSKI M., 2006: Pradnik knives reuse – Experimental approach. In: T. Wiśniewski, A. Płonka, J. M. Burdukiewicz (Eds.): *The Stone. Technique and technology*. Pp. 73–89. Wrocław.

NERUDA P., 2001: La distribution des matières premières au Taubachien à la grotte Kůlna. In: *Préhistoire et approche expérimentale*. Pp. 349–362. Montagnac.

NERUDA P., 2011: Neandertálské prostorové struktury v jeskyni Kůlně. In: K. Valoch (Ed.): *Jeskyně Kůlna – historie a význam jeskyně*. Pp. 132–138. Správa jeskyní České republiky, Průhonice.

NERUDA P., KAMINSKÁ Ľ., in press: *Neanderthals from Bojnice in the Context of the Central Europe*. Moravské zemské muzeum, Brno.

NERUDA P., LÁZNIČKOVÁ-GALETOVÁ M., DRESLEROVÁ G., 2011: *Retušéry a kosti s rýhami z jeskyně Kůlny v Moravském krasu. Interdisciplinární analýza tvrdých živočišných materiálů ze středopaleolitických horizontů*. Moravské zemské muzeum, Brno.
NERUDA P., NERUDOVÁ Z., 2005: The development of the production of lithic industry in the Early Upper Palaeolithic of Moravia. *Archeologické rozhledy* 57: 263–292.
NERUDA P., NERUDOVÁ Z., ŠAJNEROVÁ-DUŠKOVÁ A., 2010: Trasologická analýza micoquienských bifaciálních nástrojů z jeskyně Kůlny. *Acta Musei Moraviae, Scientiae sociales* 95, 1: 3–15.
PŘICHYSTAL A., 2002: Zdroje kamenných surovin. In: J. Svoboda (Ed.): *Paleolit Moravy a Slezska. 2. aktualizované*. Pp. 67–76. Archeologický ústav AV ČR, Brno.
PŘICHYSTAL A., 2009: *Kamenné suroviny v pravěku východní části střední Evropy*. Masarykova univerzita, Brno.
PŘICHYSTAL A., SVOBODA J. A., ŠKRDLA P., 2003: Lithic raw materials used by humans at Stránská skála. In: J. A. Svoboda, O. Bar-Yosef (Eds.): *Stránská skála. Origins of the Upper Paleolithic in the Brno Basin, Moravia, Czech Republic*. Pp. 59–64. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, Massachutsetts.
ROEBROEKS W., KOLEN J., DE LOECKER D., 1987: An early Weichselian site at Maastricht-Belvédère (Site J). *Analecta Praehistorica Leidensia* 20: 1–9.
ROEBROEKS W., KOLEN J., RENSINK E., 1988: Planning depth, anticipation and organization of Middle Paleolithic technology: the "archaic natives" meet Eve's descendants. *Helinium* 28, 1: 17–34.
ROLLAND N., 1977: New aspects of Middle Palaeolithic variability in Western Europe. *Nature (London)* 266, 5599: 251–252.
ROLLAND N., 1981: The interpretation of Middle Palaeolithic variability. *Man* 16: 15–42.
ROLLAND N., DIBBLE H., 1990: A new synthesis of Middle Paleolithic variability. *American Antiquity* 55, 3: 480–480.
SACKETT J., 1982: From de Mortillet to Bordes. A century of French Paleolithic research. In: G. Daniel (Ed.): *Towards a history of archaeology*. Pp. 85–89. Thames & Hudson, London.
SIMAN K., 1991: Procurement and distribution of raw materials in the Palaeolithic of north-east Hungary. *ERAUL* 43: 27–44.
TRNKA G., 2010: Early flint mining and siliceous raw materials in Central Europe. In: S. Domínguez-Bella, J. R. Muñoz, J. M. Gutiérrez López, M. P. Rodríguez (Eds.): *Minerales y Rocas en las sociedades de la Prehistoria*. Cádiz.
TURQ A., 2000a: Les méthodes de taille. *Paléo*: 368–381.
TURQ A., 2000b: Technologie lithique. *Paléo*: 26–32.
URBANOWSKI M., 2003: *Pradnik knives as an element of Micoquian techno-stylistic specifics.* PhD thesis. Warsaw University Institute of Archaeology, Warsaw University, Warsaw.
UTHMEIER T., 2004a: Planning depth and saiga hunting: on-site and off-site activities of Late Neadertals in Level B1 of Buran-Kaya III. In: V. P. Chabai, K. Monigal, A. E. Marks (Eds.): *The Middle Paleolithic and Early Upper Paleolithic of Eastern Crimea*. Pp. 193–231. Université de Liège, Liège.
UTHMEIER T., 2004b: Transformation analysis and the reconstruction of on-site and off-site activities: methodological remarks. In: V. P. Chabai, K. Monigal, A. E. Marks (Eds.): *The Middle Paleolithic and Early Upper Paleolithic of Eastern Crimea*. Pp. 175–191. Université de Liège, Liège.
VALOCH K., 1984: Le Taubachien, sa géochronologie, paléoécologie et paléoethnologie. *L'Anthropologie* 88, 2: 192–208.
VALOCH K., 1996: *Le Paléolithique en Tchéquie et en Slovaquie*. Jérôme Millon, Grenoble.
WEIßMÜLLER W., 1995: *Sesselfelsgrotte II. Die Silexartefakte der Unteren Schichten der Sesselfelsgrotte. Ein Beitrag zum Problem des Moustérien*. Saarbrücker Druckerei und Verlag, Saarbrücken.

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